PAN-CONTINENTAL PALEOINDIAN EXPANSIONS AND INTERACTIONS AS VIEWED FROM THE EARLIEST LITHIC INDUSTRIES OF LOWER CENTRAL AMERICA

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Abstract

PAN-CONTINENTAL PALEOINDIAN EXPANSIONS AND INTERACTIONS AS VIEWED FROM THE EARLIEST LITHIC INDUSTRIES OF LOWER CENTRAL AMERICA

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The historical, biological, technological, and even chronological relationships between North and South American early lithic industries and the humans who manufactured them are still a matter of conjecture. To this day, the Paleoindian records of both continents have remained isolated from each other. Efforts to close this gap have not only been impeded by geographic distance but by an information void as well. One problem has centered on the origin and dispersion of the fluting technique in South America, which is usually associated with the North American Clovis culture (c. 11,500-10,900 ^{14}C yr B.P.). The presence of a variety of fluted points in South America has been explained by either a Clovis migration or a diffusion of ideas between Clovis groups and other distinct (culturally and/or biologically) but contemporary Paleoindians. In light of this problem, lower Central America is a most promising area in which to test migration models and hypotheses that address technological similarities among widely dispersed Paleoindian groups such as the fluting technique in South America.

This dissertation presents results of a research project, which incorporated collection analyses as well as fieldwork in Panama. Surveys and excavations which I conducted on the Isthmus located several quarries and workshops exploited by Paleoindians. Most important, however, was the discovery of a fluted point assemblage at the Cueva de Los Vampiros near the Pacific Coast. This occupation marks the third occurrence, between the Rio Grande and Colombia, where diagnostic early Paleoindian artifacts have been found in a buried, datable context.

Comparative technological and morphological analyses revealed that lanceolate fluted points found in Central America and northern South America are best explained by a Clovis expansion as opposed to a passing of ideas through pre-established southern populations. Moreover, technological and stylistic similarities between several Central American fluted points and examples from the Gulf region states indicate that a circum-Gulf and Caribbean network may have existed along the now submerged coastal shelves. It is suggested that the presence of fluted points below the equator can also be explained by a Clovis-related human migration. However, this second radiation followed important technological evolutionary modifications in northern South America where fishtail points may have first appeared.

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Although many persons contributed to the elaboration this dissertation, any errors, omissions, and/or flights of fancy are solely mine.

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Chapter I

INTRODUCTION

The Monte Verde and Kennewick finds have scrambled the conservative world of First American archaeology [Thomas 2000:167].

Introduction

One of the great debates of American archaeology continues to center around the initial peopling of the New World. For over 70 years, archaeologists, physical anthropologists, molecular biologists, and linguists have struggled to find who were the first humans to live on the American continent and when they arrived. To this day, ideas regarding how these early humans traveled to the New World or the routes they may have taken are still contentious issues. Although many different points of entry into the New World have been suggested (Robledo 1954; Rivet 1957; Greenman 1963; Dixon 1993, 1999; Stanford and Bradley 2002), most scenarios begin with an Arctic passage across the Bering Land Bridge followed by a general north-to-south and west-to-east migration via an unglaciated corridor between the North American ice sheets (Sauer 1944; Lothrop 1961; Haynes 1966; Tankersley 1991; Steele et al. 1998; Anderson and Gillam 2000). According to one school of thought, this radiating "wave" of early colonists expanded through Middle America and continued south until it reached the icy shores of the Strait of Magellan (Martin 1973; Greenberg et al. 1986; Kelly and Todd 1988; Webb and Rindos 1997; Fiedel 1999).

The most archaeologically-visible and widespread traces left behind during this purported journey belong to the Clovis culture and its distinctive fluted point technology. Clovis hunter-gatherers arrived in North America sometime before 11,500 ^{14}C yr B.P. after which time they expanded to all other habitable regions of the continental Americas. The presence of the specialized fluting technique in South America (Bird 1938; Bell 1960, 1965; Mayer-Oakes 1986a; Ardila and Politis 1989; Ardila 1991; Gnecco 1994; Jackson 1995; Jaimes 1999) has been a key element supporting the idea of a single, pan-continental colonization event or process by pioneering Clovis groups. Consequently, the majority of peopling models thus far proposed have sketched an uninterrupted Clovis expansion along interior routes, starting from Alaska and ending in Tierra del Fuego.

Despite the prominence of North American fluted points, some archaeologists have maintained that South America was already occupied when Clovis groups arrived on the scene (Bryan 1973a, 1983; Dillehay 2000). Mounting evidence over the past few years has challenged the "Clovis First" migration model to the point where it may no longer be tenable. In North America, excavations at the Meadowcroft (Adovasio et al. 1978, 1999; Goldberg and Arpin 1999), Cactus Hill (McAvoy and

McAvoy 1997; Johnson 1998), Topper (Goodyear 1999, 2000), Schaefer, and Hebior sites (Overstreet et al. 1995; Overstreet and Stafford 1997) have provided evidence of human occupations possibly antedating Clovis. Similar claims have also been made for South American sites such as Monte Verde (Dillehay 1989, 1997), Taima-taima (Ochsenius 1979), Tibitó (Correal Urrego 1981, 1986), Pubenza (Correal Urrego 1993), El Abra 2 (Correal Urrego and van der Hammen 1977; Hurt et al. 1977), and Lapa Vermelha (Laming-Emperaire et al. 1975; Prous 1986b) to name a few. As a result, the existence of pre-Clovis groups is now more widely accepted and alternative migration models have been formulated to demonstrate how South America could have been colonized before the initial Clovis expansion (Fladmark 1979, 1983; Mandryk 2001). One popular hypothesis proposes a late Pleistocene coastal migration along the Pacific Rim which brought people to South America while bypassing the interior regions (Gruhn 1988, 1994; Dillehay 1999; Dixon 1999; Fix 2002). Early maritime economies are well documented on the Pacific side of the Americas and may represent descendants of ancient communities that occupied these shores before the Holocene marine transgression (Orr 1962; Llagostera 1979; Stothert 1985, 1988; Sandweiss et al. 1989, 1998; Chauchat 1992; Dixon et al. 1997; Fedje and Christensen 1999; Keefer et al. 1998; deFrance et al. 2001; Rick et al. 2001). Nevertheless, archaeologists have not been unanimous and debates continue over interpretation of data from purported pre-Clovis sites (Fiedel 1999; Dillehay et al. 1999; Lynch 2001).

One argument, to which I pay particular importance in this dissertation, centers around three competing hypotheses put forth to explain the presence of the fluting technique in South America. The first suggests that the fluting technique was brought to South America by humans who were bioculturally related to North American Clovis groups (Lynch 1983; Snarskis 1979; Ranere and Cooke 1991; Morrow and Morrow 1999). The second contends that the fluting technique was diffused south through pre-existing populations from an unidentified contact/boundary zone (Bryan 1973a, 1983). Lastly, it has been suggested that fluting was independently invented in South America and may or may not have diffused north (Mayer-Oakes 1986b).

At present, the historical, biological, technological, and even chronological relationships between North and South American early lithic industries and the humans who manufactured them are still a matter of conjecture. Lack of agreement and poor information has caused the Paleoindian records of both continents to remain isolated from each other. Data from North American sites support one story while the oldest occupations from South America relate another. Efforts to close this gap have not only been impeded by geographic distance but by an information void as well. Although, hundreds of late Pleistocene human occupations have been documented in North and South America, only a handful of early sites in Middle America have provided diagnostic artifacts in datable context. This situation has prevented archaeologists from understanding how early North and South American populations relate to each other and has made it almost impossible to formulate hemispherewide colonization models based on archaeological evidence. This is unfortunate since it is in Central America that Paleoindians first encountered tropical environments. The adaptive repercussions that may have ensued following their entry into the Neotropics are still unknown yet they are crucial for understanding the origins of late Pleistocene cultures in South America. In the absence of a firm grasp of what happened in this intermediate region, the early archaeological records of North and South America have remained disconnected from each other.

Therefore, an important goal for Paleoindian archaeologists today is to formulate a Pan-American colonization models that integrate both North and South American archaeology into a single narrative. Current explanations can no longer treat each continent as disjointed entities and independent archaeological records must be brought together. In other words, time has come for a "unified theory" of the peopling of the New Word.

Lower Central America: A Strategic Testing Ground For North-South Paleoindian Contacts

Lower Central America, and especially Panama, are promising areas in which to gather data and test hemispherical Paleoindian colonization models (Dillehay and Meltzer 1991; Meltzer 1995:36). The Isthmus stands constricted like the waist of an hourglass between the two principal continents of the Americas. Its geographical characteristics, combined with the fact that it contains both Clovis-like and fishtail projectile points (hereafter FPPs), offer a unique opportunity for archaeologists looking for clues linking Paleoindians of North, Central, and South America. No matter the route(s) used by early migrants during the colonization process, the Isthmian passageway would have been an unavoidable stopping place for anyone moving to or from South America. Since human movements between Central and South America were routed through Panama or along its coasts, it is a logical area of research to confront many of the problems described above. Moreover, bifacial reduction of cryptocrystalline stone has not been observed in any Panamanian lithic assemblage post-dating 7000 ^{14}C yr B.P. (Ranere and Cooke 1995, 1996, 2002). This peculiarity of the Isthmian archaeological record has, in fact, helped researchers identify early sites by the simple presence of bifacial thinning flakes of fine-grained lithic material. Panama also offers another extremely important advantage. Certain elevated areas of shoreline along its Pacific Coast provide many areas where possible ancient coastal occupations are now preserved. Given that Panama was either the last stop before entering South America or the first one upon leaving, it might contain missing evidence capable of joining the archaeological records of both continents.

Working Hypotheses, Expectations, Questions, and Research Objectives

Several avenues of research, such as detailed technological analyses and comparisons of lithic assemblages, can offer significant clues to the origins of the fluting technique in South America.

However, similarities and differences between North and South American Paleoindian lithic tools are meaningless without factoring in contextual data. That is to say, without a clear picture of the cultural and adaptive milieu, resemblances among artifacts will not necessarily support a migration scenario nor will discrepancies imply a diffusion of ideas. Lithic assemblages must be compared in relation to the economic systems and ever-changing environments in which they were used. All too often, a "classic" Clovis technological yardstick is used to determine the degree of cultural and, more boldly, biological affinity between early populations of Central and South American and northern Paleoindians. This method has both strengths and weaknesses, depending on whether archaeologists recognize and factor in important environmental variables that might explain why incongruities appear between some assemblages. For example, since reduction processes are influenced, among other things, by the types of sources exploited and the quality of the stones themselves (Andrefsky 1994), comparisons based on hallmarks of North American Clovis technology, often characterized by high quality lithic materials (Goodyear 1989), may not be applicable in areas where such materials were absent. Moreover, analyses must examine entire tool kits and not concentrate solely on projectile points. Storck (1991), who has examined similar arguments opposing diffusion and migration to explain the origins of fluted point in Ontario, states:

> it is necessary to go beyond an examination of similarities and differences in the technology of fluted-point manufacture and in the contents of associated tool assemblages, and to explore the complex interplay of cultural and ecological forces that gave them significance and meaning [Storck 1991:159].

Other clues, such as those related to group ideologies, although difficult to interpret, would also be useful since these abstract elements are less likely to have been borrowed (Storck 1991). Even then, however, analytical results might still be subjective and open to multiple interpretations.

Paramount to solving many of these problems is the need to assess the validity of our assumptions and expectations when comparing late Pleistocene-early Holocene assemblages from North, Central, and South America for the purpose of establishing Pan-American Paleoindian cultural relationships. In other words, how do we, as anthropologists, measure the biological and cultural affinity of humans, using lithic assemblages? Can we really know, beforehand, what kinds of transformations a Clovis tool kit from the North American Plains (consisting of lithic, bone, and wood technologies) would experience as it made its way to the southern cone? Since we now know that Paleoindians occupied tropical forests as well as more open vegetation, such as páramo, grasslands, and savannas (Cooke and Ranere 1992c; Piperno et al. 1991; Roosevelt et al. 1996; Ranere 2000; Ranere and Cooke 2002), we cannot hold the environment as a constant. Inter-assemblage variability may ultimately say more about an environment and how people were adapting to it than who their makers were or were not. Thus, when trying to understand the reason(s) for the similarities and differences between a North American Clovis point and a South American FPP, how can archaeologists distinguish between causal factors such as; 1) changing adaptive strategies, when faced with new environmental selective pressures; 2) cultural distortion and selective borrowing, when an idea is passed from one group to another, 3) trivial idiosyncrasies between flintknappers, or 4) simple stochastic and historical events that may have affected styles (O'Brien and Lyman 2000) (e.g., group isolation and the flow of information)? To avoid such ambiguities researchers need to incorporate large-scale, multivariate patterns to support their explanations.

Several avenues of investigation can help provide answers to some of the problems cited thus far. They include studies that focus on the chronology, biology, techno-ideology, and languages associated with the first Americans. Although the field of linguistics has offered some interesting results (Greenberg et al. 1986; Gruhn 1988; Nichols 1990, 2002) only the first three sources of data were considered in my research.

1. Chronological

Above all, a firm culture-historical foundation or temporal framework must be established before the simplest hypotheses can be tested. Paleoindian sites from various parts of Middle America must be dated before we can begin to discuss problems of directionality related to people and/or ideas. Results from any kind of comparative analyses need to be affixed to a time line in order to understand their proper meaning.

2. Biological

When faced with questions of biocultural affinity, there is no escaping the fact that, although humans can modify and/or borrow technologies, they cannot change their genes. Consequently, the most robust results and perhaps final arbiter of the debates may come from future ancient DNA analyses. While craniofacial studies have shown interesting patterns among the earliest New World populations (Neves and Pucciarelli 1989, 1991; Steele and Powell 1992, 1994, 1999; Soto-Heim 1994; Munford et al. 1995; Chatters et al. 1999; Neves et al. 1999; Owsley and Jantz 1999; Powell and Neves 1999; Powell and Rose 1999; Blum et al. 2001; Brace et al. 2001; González-José et al. 2001; Jantz and Owsley 2001; Neves and Blum 2001), results remain controversial (Thomas 2000). For the moment, adequate samples of late Pleistocene skeletons from North, Central, and South America are wanting and archaeologists must rely on other sources of data to make sense of the variability found in material culture.

3. Techno-Ideological

This third area of study has a richer data set and is the most accessible at present. However, analytical results stemming from this information are also the most subjective. Research based on tool form and manufacturing techniques can only tell us to what degree various assemblages are similar or different. They do not *automatically* explain cause(s) and are not definitive answers to our problems. Similarities and differences in ideology are harder to identify and understand but may be inter-culturally more stable and could represent stronger group-specific markers (Storck 1991).

Individually, these three principal sources of information can only provide a part of the solution and need to be interlinked to produce a more comprehensive picture. My research attempted to integrate this tripartite approach while focusing on information from lower Central America (i.e., Costa Rica and Panama). My project was prompted and guided by several ideas put forth in recent peopling models as well as unanswered questions which continue to preoccupy archaeologists:

a) Are Paleoindian occupations in North America older than, younger than, and/or contemporaneous with those found in South America?

b) Did early Paleoindians occupy the Pacific shores of Panama? If so, how do these groups relate, if at all, to other early Paleoindians from North and South America?

c) Was lower Central America populated by late Glacial (14,000- 10,000 ^{14}C yr B.P.) groups using a simple unifacial tool industry similar to the Abriense and Tequendamiense assemblages of Colombia (Hurt 1977; Gruhn and Bryan 1998; Nieuwenhuis 1998)?

d) How do Clovis-like and FPPs from lower Central America relate and compare technologically and typologically to their respective counterparts found on the opposite ends of the continent?

e) How can we explain Pan-Paleoindian assemblage similarities and/or differences in light of the present debates over technological diffusion and human migration.

f) Are the observable technological variations between North American Clovis material and the early assemblages of Central and South America representations of 1) changing environmental adaptations during the Clovis expansion or; 2) different cultural groups?

g) How do other aspects of lower Central American Paleoindian culture, such as settlement patterns, economy, lithic material procurement strategies, etc., vary from those found in other parts of the American continent?

h) Is it possible to trace geographic clines associated with the presence and absence of diagnostic Paleoindian technological traits, such as fluting, that would allow us to follow the direction of ideas and/or humans groups?
i) In essence, were lower Central America and Northern South America cultural "melting pots", zones of contact, filters, or regions of accelerated adaptation and evolutionary change?

It was with the purpose of addressing the problems and dichotomies I have just outlined, that I designed a research project in Costa Rica and Panama. My immediate objectives were to:

a) Examine previously collected fluted point assemblages from lower Central America.
b) Locate additional Paleoindian sites in Panama in order to:
    1. Record data from new stone tool assemblages and increase my sample size.
    2. Obtain radiocarbon dates from buried contexts.
c) Conduct typological and technological analyses on these Central American assemblages, identify patterns, and compare results to Paleoindian industries from North and South America.

My investigation proceeded under certain assumptions about the New World Paleoindian record:

a) The fluting technique was invented on the American continent.
b) The fluting technique was invented only once and should have a single geographic point of origin.
c) Fluted points were distributed across the Americas by:
    1. Migrating groups that were bioculturally related to those who innovated the technique.
    2. A diffusion of ideas between two or more bioculturally diverse populations (be it through direct or indirect contact with the innovators).
    3. Any permutations thereof.

Work began in 1997 at the Museo Nacional in Costa Rica where I spent a month analyzing lithic collections from the Guardiria (Turrialba) quarry/workshop site. This was followed by two archaeological surveys in Panama. The first was carried out at Lake La Yeguada in Veraguas Province (January to April 1999) while the second focused the interior region of the Azuero Peninsula

(November 2000 to October 2001). This initial fieldwork lead to the discovery of a Paleoindian quarry/workshop and two megafaunal localities which provided the first radiocarbon dates associated with extinct fauna in Central America. Additional data were collected during a re-excavation of Vampiros Cave located along Parita Bay (January to May 2002). Exceptionally, our small archaeological intervention at Cueva de Los Vampiros discovered the first buried fluted point occupation in Panama. Further analyses of Paleoindian lithic collections were conducted at the Smithsonian Tropical Research Institute (STRI) and the Sam Noble Oklahoma Museum of Natural History.

I begin in the next chapter with a brief overview of the early lithic industries of South America to set the stage for the Middle American data. (Note: For the purpose of this dissertation, the Middle American region is defined based on the Collins English dictionary as the expanse of land between the Rio Grande and Colombia including the Greater Antilles. Central America excludes Mexico while lower Central America encompasses Honduras, El Salvador, Nicaragua, Costa Rica, and Panama.) In Chapter 3, I describe and examine current hypotheses put forth to explain the presence of the fluting technique in South America. Chapter 4 consists of a series of reviews on the paleoecological, biogeographical, and archaeological data of late Pleistocene Middle America. Results from geological, palynological, paleolimnological, and foraminiferal studies are compiled and synthesized in order to reconstruct the vegetation cover and climate that prevailed when humans first entered Middle America. The fossil record is also examined to identify what animals were available to early colonizers and to see if it can provide information on the problem of late Pleistocene extinctions. In Chapter 5, the archaeological evidence is presented against this paleoenvironmental and biogeographical backdrop. Data provided by early human remains as well as current molecular studies are also examined. Following this wide-range review, Chapter 6 brings us up to date with a series of discussions and interpretations based on the available information. In this section, I evaluate topics such as late Pleistocene settlement patterns, economies, and lithic material procurement strategies. I also describe early lithic industries from Middle America, both typologically and technologically, to see what they can tell us thus far on the origin(s) of fluted projectile points both in Central and South America. I then close Chapter 6 with a review of recent craniofacial and genetic studies in South America which are providing clues on the origins of the first humans to inhabit that continent. Results from my collections analyses, archaeological surveys, and excavations are then presented in Chapter 7. The discussion in Chapter 8 assesses these new findings in light of current problems, our present state of knowledge, and my initial research objectives. Finally, in Chapter 9, I conclude by a cursory review of these new findings and their implications, assess what problems still need to be resolved, and offer a few recommendations towards future study.

Chapter II

EARLY SOUTH AMERICAN LITHIC INDUSTRIES

Although many examples of fluted points have been discovered in Middle and South America, lanceolate Clovis-like forms occur at very few sites south of the Isthmus of Panama (Carluci 1963; Seguel and Campaña 1975; Ardila and Politis 1989; Jackson 1995; Jaimes 1999; Dillehay 2000:159). Beyond this juncture, other fluted and non-fluted point types dominate the early record. Before we can discuss the significance of this or attempt to explain possible technological influences as well as biological and/or cultural relationships between North and South America, an overview of early South American lithic industries is necessary. Presented below are some of the better-known and well-defined late Pleistocene-early Holocene technological "cultures" of South America. Because it is still impossible to determine if some represent "complexes" or "traditions", I have decided to identify them simply as "assemblages" that share common technological features.

Fishtail Projectile Point Assemblages

Fishtail projectile points were first discovered in 1937 at Fell's and Pali Aike Caves in Chile (Bird 1938, 1969; Emperaire et al. 1963). At the time, Bird was able to establish the antiquity of FPPs based on their association with extinct horse and giant ground sloth (Bird 1988). Since then, many more FPPs have been found throughout South America (Bell 1965; Schobinger 1971, 1973; Ossa 1976; Chauchat and Quiñones 1979; Flegenheimer 1980; Nami 1985, 1987a, b; Mayer-Oakes 1986a; Flegenheimer and Zarate 1989; Politis 1991; Miotti 1995; Mazzanti 1997; Suárez 2000; Martínez 2001), as well as at localities in Middle America (Bullen and Plowden 1963; Bird and Cooke 1977, 1978; Snarskis 1979; MacNeish et al. 1980b; Santamaria 1981; Ranere and Cooke 1991, 1995, 1996, 2002; Pearson and Bostrom 1998). While detailed descriptions and contexts of finds are not available for all South American FPPs (Politis 1991), many reported examples are unmistakably fluted. Technologically, many Central and South American FPPs differ from Clovis-like points in that they were manufactured by thinning large, flat flakes (Bird and Cooke 1978; Ranere and Cooke 1991) as opposed to being end products of multi-stage bifacial reduction (Callahan 2000; Bradley 1982, 1991, 1993). Blades on Middle American FPPs were bifacially thinned by removing a series of large expanding flakes from opposing margins. These flakes overlapped at the points' mid-lines and effectively flattened their central surfaces. Final shaping was accomplished using bimarginal percussion and pressure (Ranere and Cooke 1991, 2002; Pearson and Bostrom 1998; Ranere 2000). Many South American FPPs were fashioned on flake blanks that required only minimal shaping, leaving large intact pseudo-fluted surfaces of their ventral sides (Bird 1969; Mayer-Oakes 1986a:52;

Nami 2000). Radiocarbon dates from South American FPP sites range between c. 12,400 and 7900 ^{14}C yr B.P. (Table 1, note: all radiocarbon dates in tables and text are uncalibrated unless otherwise indicated).

El Jobo Point Assemblages

First defined in the late 1950s (Cruxent 1956, 1957; Jackson 1999), El Jobo assemblages of Venezuela are characterized by willow leaf-shaped points with bi-convex cross-sections, often manufactured on quartzite (Nami 1993). While initial discoveries of El Jobo points were frequently associated with the remains of extinct mammals (Cruxent 1970), mixing and other contextual problems at the El Jobo, Muaco, Taima-taima, and Cucuruchu sites cast doubt on the alleged antiquity of the points (Haynes 1974; Lynch 1974, 1990). Subsequent excavations at the Taima-taima site in 1976 (Ochsenius and Gruhn 1979) exposed the midsection of an El Jobo point within the remains of a juvenile *Haplomastodon* (Gruhn and Bryan 1984). Based on a series of radiocarbon assays on wood twigs believed to be part of one of the animal's stomach contents, the investigators assigned an age of c.13,000 ^{14}C yr B.P. for the this kill site (Bryan and Gruhn 1979:57).

El Jobo assemblages are believed to represent a unique South American pre-Clovis bifacial industry with no cultural affiliation with Clovis Paleoindians (Bryan 1973a, 1983). This interpretation has been challenged by critics who maintain that these artifacts may not be of pre-Clovis age and could have migrated downward through the soft sediments. In addition, upwelling springs may have contaminated the remains with older carbon (Haynes 1974; Lynch 1974, 1994). More recently, an AMS date of 10,710 ± 60 ^{14}C yr B.P. (B-95602) on bone collagen was obtained from a giant ground sloth kill site at El Vano, in the Venezuelan Andes (Jaimes 1998). Despite a technological analysis of El Jobo points by Nami (1993) demonstrating marked differences in reduction strategies compared to Clovis, the discovery of possibly fluted examples from the Los Planes site (Jaimes 1999) might indicate a previously unsuspected relationship between these two industries. Two fragments of possible El Jobo points have also been reported from Panama but remain undated (Pearson 2000a, b; Ranere and Cooke 2002). Interestingly, El Jobo points show some resemblance with projectiles discovered at Monte Verde, where gomphothere remains were also unearthed (Dillehay 1992).

Middle Magdalena/Monte Alegre Assemblages

The unfluted stemmed projectile points found in Middle Magdalena and Monte Alegre assemblages share many similarities (Roosevelt 1998) and are grouped here as a single category. Both point types are characterized by straight, bifacially-flaked blades shaped by the removal of small parallel pressure flakes, giving them isosceles or equilateral triangular outlines, depending on their degree of resharpening (Simões 1976; López Castaño 1989; Roosevelt et al. 1996; Cooke 1998). Shoulders are inversely tapered and stem shapes range from sharply contracted to pointed. Middle Magdalena assemblages are dated between 10,400 ± 90 (Beta-40855) and 10,230 ± 80 (Beta-40854) ^{14}C yr B.P. based on radiocarbon assays from the La Palestina site (López Castaño 1989, 1995, 1999). Projectile points with similar attributes were also discovered at the undated or later sites of Peñones de Bogotá, Puerto Berrio (López Castaño 1990, 1994, 1995; Ardila 1991), Yondó (Cooke 1998), Mahates, Bentanci (Reichel-Dolmatoff 1965), and Santander (Robledo 1954).

Monte Alegre assemblages of Brazil contain similar triangular stemmed points manufactured on hyaline quartz, such as those discovered at the Tapajós River (Simões 1976) and Caverna da Pedra Pintada (Roosevelt et al. 1996; Roosevelt et al. 2002). Radiocarbon dates associated with this Amazonian industry range from 11,145 ± 135 (GX17413) to 10,110 ± 60 (GX19532 CAMS) ^{14}C yr B.P. (Roosevelt 1998) and average approximately 10,500 ^{14}C yr B.P. (Gibbons 1995). Optically stimulated luminescence and thermoluminescence analyses on sediments and burned lithic artifacts from Pedra Pintada provided additional dates ranging between 12,000-11,500 and 17,500-11,900 yr B.P. respectively (Michab et al. 1998). Faunal and macrobotanical remains recovered from Pedra Pintada indicate that these early hunter-gatherers were well adapted to tropical rain forests and subsisted on fruits, nuts, and fish (Roosevelt 1998). Similar to El Jobo, Monte Alegre assemblages are believed to have derived from a pre-existing culture unrelated to North American Clovis industries. Finally, it is worth mentioning that an undated projectile point showing similar characteristics as the Middle Magdalena/Monte Alegre specimens was also discovered off the Venezuelan coast on the present island of Trinidad (Harris 1991).

Restrepo and Sipaliwini Assemblages

Restrepo points from Colombia form a loose ensemble of fluted and unfluted stemmed points that share a basic outline. Restrepo points are distinct from FPPs in overall shape and were manufactured from bifacial preforms (Reichel-Dolmatoff 1965; Ardila 1991; Correal Urrego 1993; Cooke 1998). Their blades vary between straight and excurvate with at least one example displaying a serrated edge (Correal Urrego 1993, fig. 9). Shoulders are variable and bases are usually straight to slightly concave (Reichel-Dolmatoff 1965; Ardila 1991), with flute scars extending past the stem and into the blade. Only a single example has been recovered from controlled excavations (Correal Urrego 1983) and radiocarbon dates are still lacking for these assemblages. Other stemmed examples which are possibly related to Restrepo points are found in Guyana (Roth 1924; Evans and Meggers 1960; Williams 1998), and in Sipaliwini assemblages of Surinam (Boomert 1977, 1980; Versteeg 1998).

Abriense and Tequendamiense Assemblages

Abriense and Tequendamiense assemblages of Colombia were first identified at the El Abra and Tequendama type site rockshelters (Correal Urrego and van der Hammen 1977; Hurt et al. 1977). Abriense assemblages are characterized by small retouched flakes grouped under the "Edge-trimmed tool tradition" (Hurt 1977; Gruhn and Bryan 1998; Nieuwenhuis 1998). Tequendamiense assemblages show a higher degree of workmanship and include formal tool types and bifaces (Cooke 1998; Gruhn and Bryan 1998). Both industries are believed to have been used by groups of transhumant hunter-gatherers moving between the highlands of the Sabana de Bogotá and the Magdalena Valley. The earliest Abriense flake tools at El Abra 2 are associated with a date of 12,400 ± 160 ^{14}C yr B.P. (GrN-5556), while assemblages at the Tequendama 1 rockshelter range in age between 10,920 ± 260 (GrN-6539) and 10,460 ± 130 ^{14}C yr B.P. (GrN-6731, Correal Urrego and van der Hammen 1977; Cooke 1998). Abriense and Tequendamiense tools were also found in association with proboscidean remains dated to 11,740 ± 110 ^{14}C yr B.P. (GrN-9375) at the Tibitó site (Correal Urrego 1981). Other unifacial industries were discovered at the Nemocón 4 and Sueva 1 rockshelters (Correal Urrego 1979). A charcoal date of 10,090 ± 90 ^{14}C yr B.P. (GrN-8111) was obtained above Abriense-like tools at Sueva 1, providing a minimum age for the occupation (Correal Urrego 1986; Dillehay 2000:123). Considerable problems of interpretation surround the Abriense Edge-trimmed tool tradition, which remains poorly-defined and equivocally-dated (Lynch 1990, 1994; Cooke 1998). Moreover, the seeming absence of bifacial flaking in the Abriense industry might reflect a sampling problem and its separation from Tequendamiense assemblages might be unjustified (Dillehay 2000:118).

El Inga and Rio Cauca Stemmed Point Assemblages

The El Inga site was discovered in 1956 in the Andean Highlands of Ecuador near Quito (Bell 1960, 1965, 2000; Mayer-Oakes and Bell 1960a, b; Mayer-Oakes 1966). El Inga is but one of many localities near the capital where both fluted and unfluted bifacial projectile points have been discovered (Santiana and Carluci 1962; Carluci 1963; Mayer-Oakes 1982). These include Clovis-like, fishtail, Ayampitin-like (tear-drop and laurel leaf-shaped), Paiján-like, and various stemmed and pentagonal specimens. Among this last category were points described as "Broad Stemmed" (Bell 1965; Mayer-Oakes 1986a, b) and "Shouldered Lanceolate" (Mayer-Oakes 1986a, b) or "Arenal" (Lynch and Pollock 1980). El Inga Broad Stemmed points have triangular outlines and straight to slightly contracted stems. Shoulders are horizontal or slightly tapered above straight or concave bases. Many examples were manufactured on thin flakes that retained unretouched portions of their original blanks, giving some pseudo-fluted appearances. El Inga Shouldered Lanceolate points are pentagonal or rhomboidal in shape. Their technological and typological attributes suggest that they may, in fact, be sub-types (perhaps even knives) or preforms for Broad Stemmed projectiles (Mayer-Oakes 1986a:151).

Five radiocarbon dates, ranging from 9000 to 3900 ^{14}C yr B.P., were obtained from soil samples at El Inga (Bell 1965). Subsequent comparisons between radiocarbon results and obsidian hydration rinds, measured on artifacts from known stratigraphic proveniences, suggested that the earliest dates of 9030 ± 144 (R-1070/2) and 7928 ± 132 (R-1073/3) ^{14}C yr B.P. were the most reliable (Bell 1977). Radiocarbon dates derived from soil samples from the nearby site of San José ranged between 3470 and 1480 ^{14}C yr B.P., while obsidian hydration dates from the same locality clustered between 11,300 and 9300 years B.P. (Mayer-Oakes 1982, 1986a; Mayer-Oakes and Portnoy 1986, 1993). Another pentagonal point was recovered at Chobshi Cave in the Ecuadorian province of Azuay, and was bracketed between 10,010 ± 430 (Tx-1133) and 8480 ± 200 (Tx-1132) ^{14}C yr B.P. (Lynch and Pollock 1980).

Additional Broad Stemmed and Shouldered Lanceolate points were discovered at the La Elvira and Alto Cauca sites located in the Popayan Valley of Colombia (Mayer-Oakes 1986a:205; Illera and Gnecco 1986; Gnecco and Illera 1989; Note: Dillehay [2000:123-125] incorporates the Popayan and Middle Magdalena points with Restrepo). One example, found on the surface at La Elvira, is fluted on one side (Gnecco 1994, fig. 2d), and is estimated to date between 10,000 and 9000 ^{14}C yr B.P. (Gnecco 1994:39). Pentagonal bifaces associated with radiocarbon dates of 10,050 ± 100 (B-65878), 10,030 ± 60 (B-93275), and 9530 ± 100 (B-65877) ^{14}C yr B.P. were unearthed at the San Isidro site, located approximately 30 km downstream from Popayan on the Cauca River (Gnecco and Bravo 1994; Gnecco and Mora 1997). This last series of dates is more reliable than the ones from El Inga, obtained from soil samples and obsidian hydration, and give a more accurate age for this type of industry. Lastly, excavations in the Orinoco Valley of Venezuela recovered another pentagonal point estimated to date between 9000 and 6000 ^{14}C yr B.P. (Barse 1990).

Paiján Assemblages

Paiján assemblages are found on the northern coast of Peru. Paiján sites include La Cumbre, the Quirihuac Shelter (Ossa and Moseley 1971; Ossa 1978), and several open air workshops, campsites, and burials in the Cupisnique desert (Chauchat 1975, 1978, 1992). Paiján sites in the Pampa de los Fosiles date between 10,640 ± 260 (GIF-9403) and 8730 ± 160 (GIF-5159) ^{14}C yr B.P. (Hall 1995). The majority of Paiján stemmed points were manufactured from bifacial preforms reduced by direct percussion and shaped by pressure flaking (Pelegrin and Chauchat 1993). Blades are slender and vary morphologically from straight, excurvate, to parallel-sided and are often characterized by acuminated distal tips. Shoulders are horizontal to slightly inversely tapered and their narrow, unfluted stems are straight to incurvate. Paiján points have been found associated with fish bone middens, suggesting to investigators that these delicate implements served primarily, although not exclusively, as tips for fishing spears (Chauchat and Briceño 1998). Most importantly, both Paiján and FPPs were found at La Cumbre (Ossa 1976) and Quebrada Santa Maria (Chauchat and Pelegrin 1994; Briceño 1997, 1999), indicating that both types may have been used concurrently by the same groups. Based on this evidence, Chauchat and Briceño (1998) believe that Paiján points were ultimately derived from FPPs, which represent an ancestral bifacial industry. According to this scenario, Paiján points were a technological adaptation by Andean hunters, following an economic diversification or shift from interior to coastal resources. However, Dillehay (2000:150) believes that Paiján and FPPs represent coexisting yet culturally different populations. It should also be noted that Paiján points from the Peruvian coast share some similarities with Middle Magdalena specimens (López Castaño 1999:112), suggesting a possible link between these two regions.

The various industries described above demonstrate that the Paleoindian record of South America is as complex as the one from North America (Gnecco 1990; Dillehay 2000). Archaeologists need to consider more intricate, multilineal inter-relationships between South American fluted points and other late Pleistocene-early Holocene bifacial industries found on that continent. To this already complicated picture we must now add the evidence from Monte Verde (Adovasio and Pedler 1997; Dillehay 1997b; Meltzer et al. 1997; Fiedel 1999b, 2000b; Dillehay et al. 1999) which has pushed back the initial peopling of the New World by approximately 1000 to 500 ^{14}C years. A perplexing outcome of this paradigmatic reshuffling continues to be an absence of similar Monte Verde-like sites in North and Middle America, and the cultural distinctiveness between these early Chileans and Clovis populations (Haynes 1997).

Chapter III

THE FLUTING TECHNIQUE IN MIDDLE AMERICA

One thing is certain, the presence of such a specialized reduction strategy as the fluting technique in both hemispheres of the Americas can only be explained by a pan-continental expansion of related populations or contact between flute-using groups and other Paleoindians. The idea that fluted points appeared during the same general time period in both North and South America as a result of independent technological convergence (Mayer-Oakes 1986b; Politis 1991) seems an improbable stretch of coincidence (Lynch 1983; O'Brien et al. 2001:1117). Although most archaeologists would agree with this, it is the nature and direction of this undeniable interaction that still fuels debates (Bonnichsen 1991). As was stated earlier, current disputes over the origins of South American fluted points (including FPPs), oppose two main view points—technological diffusion versus human migrations with or without replacement.

The Origins of South American Fishtail Points

At least three different models (Figure 1) have been put forth to explain the origins of South American FPPs and their relationship to Clovis (Bryan 1973a; Rouse 1976; Snarskis 1979; Lynch 1983; Ranere 1980, 2000; Schobinger 1988; Politis 1991; Faught and Dunbar 1997; Morrow and Morrow 1999). Each of the hypotheses presented below carries its own set of assumptions and predictions, but all share the idea that the fluting technique was a northern innovation that first appeared and dispersed with Clovis populations.

Model 1 (Anagenesis):

> *FPPs were the end product of a single evolutionary lineage, starting with parallel-sided Clovis points, changing to waisted forms, and ending with fishtail and other fluted stemmed types (Lynch 1983; Snarskis 1979; Ranere 1980, 1997; Morrow and Morrow 1999).*

This first model predicts that FPPs can never be as old as the oldest North American Clovis points. Under this scenario, point assemblages will display a mixture or continuum of morpho-technological traits spread over time (O'Brien et al. 2001). Clear-cut distinctions between individual specimens using common typological classifications may not be obvious. As the projectile points underwent modifications, observable variation is expected to overlap geographically, perhaps over large areas, with the most significant differences found at geographical and/or temporal extremities. Morpho-technological changes could be attributed to stochastic drift and/or selective pressures. The expected pattern for this model predicts that FPPs will diverge technologically, typologically, or both, over chronological and geographical clines. In other words, similarities between Clovis and FPPs will decrease through time and the further south they are found (assuming a return-migration did not occur [Anthony 1990]).

Model 2 (Cladogenesis):

> *FPPs were the result of a single or multiple cultural divergence(s) that split Clovis into a new fishtail and/or stemmed industry and one or more contemporaneous Clovis-like industry(ies).*

The chronological prediction of this second model is the same as the first—that is, FPPs can never be as old as the basal Clovis culture. We might expect less geographic overlap between these projectile points, assuming morpho-technological differences are reflections of distinct environmental pressures, economic niches, or local raw material quality and/or availability. Greater divergence is also expected with time and distance, but, unlike the first model, transitional projectile forms may be short-lived and limited due to more rapid selection and/or extinction.

Model 3 (Independent Origin):

> *South American bifacial stemmed points (including FPPs) were the product of one or more independent invention(s) associated with a single or multiple non-Clovis migration(s). These first South Americans later came into contact with Clovis-related groups from which they borrowed the fluting technique (Gruhn and Bryan 1977; García-Bárcena 1979; Bryan 1983).*

Although the nature of this encounter and its biological ramifications are speculative, it is considered responsible for the exchange of ideas that led to the application of the fluting technique to FPPs. This is the only model that allows, but does not necessarily require, FPPs to be as old or older than the oldest Clovis points. Geographical predictions are difficult to assess but some degree of overlap is expected since contact is an obligatory part of this model. Technological similarities between Clovis and FPPs would also decrease further south or, more precisely, closest to the FPP center of origin. Unlike the other models, however, a separate origin for FPPs predicts that it is the youngest examples that will share more technological similarities with Clovis (e.g., fluted versus unfluted bases).

Since the predictions and the expected archaeological signatures for these three models are not mutually exclusive, and because our data are still deficient, none can be completely rejected at present. Currently, there is no consensus on whether South American fishtail and stemmed points were a result of technological modifications by Clovis groups expanding south (Lynch 1983; Snarskis 1979; Ranere 1980, 1997; Schobinger 1988; Ranere and Cooke 1991; Faught and Dunbar 1997; Morrow and Morrow 1999) or independent inventions carried north by a separate South American population (Bryan 1973a; Rouse 1976; Politis 1991). Present arguments about the relationships between Clovis and other early industries of South America must be evaluated before archaeologists can hope to advance to higher levels of model building and hypothesis testing (Bonnichsen and Schneider 1999). The current problem is summarized by Dillehay et al. (1992:186) who state: "Until a secure north-to-south migratory linkage is established between the two continents, it is just as likely that South Americans with flutes and stemmed points migrated north." This situation is compounded by the particular geographical characteristics of lower Central America which undoubtedly fractured "waves" of human migration spreading south. The narrow Isthmus of Panama not only funneled populations into South America but the Colombian coast beyond, which formed a major crossroads, must have separated groups and accelerated cultural differentiation (Dillehay 1999). Consequently, Martin's (1973; Mossiman and Martin 1975) radiating "bow waves" model breaks down at the doorstep of South America and must be re-evaluated in light of these geographic variables. For all intents and purposes, the peopling of South America must be envisioned as if this part of the continent was an island and the dynamic of its colonization approached accordingly (Bowdler 1977; Beaton 1991; Rindos and Webb 1992; Webb and Rindos 1997). Indeed, regardless of an interior, an Atlantic, or a Pacific Coast route, the constriction of the Isthmus would have focused the point of entry into South America within a narrow area, mimicking a maritime landing. Figure 2 presents four different migration scenarios that illustrate some of the possible permutations created by the geographical characteristics of the Isthmian region and northern South America. It is important to note that these are ideal models that assume a constant rate of dispersal and are used here simply to expose the problem. They do not factor in topography or hydrography, which would add to this complexity (Faught and Anderson 1996; Steele and al. 1998; Anderson and Gillam 2000). Hence, geographical and chronological data, associated with the expansion of the first South Americans, may not be obviously patterned across the continent. For example, it impossible to determine on what side of the "popularity curve" (O'Brien and Lyman 2000) some FPP assemblages are situated. Put another way, without good chronological control, low percentage of fluted points in a region could represent either a decline or an increase in the use of the technique. Fortunately, detailed technological analyses can help unravel the nature of the relationship between Clovis and FPPs. Since both point types clearly overlap in lower Central America, this region represents a key area in which to conduct such research.

Chapter IV

PLEISTOCENE ENVIRONMENTS OF MIDDLE AMERICA

Continental Subdivisions and Physiography

Middle America can be divided into two major geographic zones. The first encompasses most of northern Mexico and Baja California between the Rio Grande and the Tropic of Cancer. This region is characterized by the arid Chihuahuan and Sonoran deserts and the more temperate climate of the Sierra Madre Occidental and Oriental. The second zone, which is part of the Neotropics, includes all conterminous Middle American countries south of the Tropic of Cancer. This part of the continent is composed of a patchwork of geological provinces defined by topographic and ecological features (Maldonado-Koerdell 1964). Among these we find the Coastal Plains (e.g., Gulf of Mexico, Pacific, and Caribbean), the Yucatan Peninsula, and the isthmuses of Tehuantepec and Panama.

Volcanism, produced by the subjugation of the Cocos Plate under the Pacific rim, is perhaps the single most important geological process that has shaped the Central American Neotropics (Mann 1995). Fifty volcanoes (25 of which are still active, [West 1964]) line the Central American Volcanic Arc (CAVA), extending 1500 km from Guatemala to Panama (Leeman and Carr 1995). In Mexico, the Sierra Madre Occidental, the Trans-Mexican Volcanic Belt (TMVB), and the Sierra Madre del Sur join with the CAVA to form a sinuous backbone spanning the entire middle continent (Figure 3). Middle America is also crisscrossed by intricate fault systems, making it one of the most tectonically active zones on the planet. Witnesses to these violent forces are visible as abrupt relief changes where terrain has been thrust upwards or downwards along fault lines. This process is especially active along the Pacific coastline of Costa Rica and Panama, where considerable Pleistocene and Holocene tectonic uplift has been recorded (Corrigan et al. 1990; Gardner et al. 1992; Collins et al. 1995).

Glacial Geomorphology

Like all other land masses on Earth, the outline of Middle America was markedly different during the Pleistocene due to an important marine regression. The continent widened as new terrain was exposed by falling sea levels (Figure 3). The Atlantic coastline of Middle America was especially affected by this process, since it is characterized by low lying shelves that dip gradually out to sea. The Pacific side was not as drastically modified due to the great depth of the oceanic trench that runs along the coast. One notable exception was the southern coast of Panama where lowered sea levels exposed large expanses of land on each side of the Azuero Peninsula. During this time, the Gulf of Panama would have been an expanded lowland with hills in its center, now forming the Pearl Islands (Terry 1941; Golik 1968; Clary et al. 1984).

Alpine glaciers on the peaks of the highest volcanic cones in Middle America advanced and retreated with each major climatic pulse. However, Quaternary geomorphologists have yet to agree on the chronology of these events or how they correlate with advances in North and South America (White 1962; Hollin and Schilling 1981; Heine 1984; Nixon 1989; Vázquez Selem 1997). Most glaciers were located on the TMVB where the highest mountains are found (Lorenzo 1959). Heine (1984 1994) has proposed a five-stade glacial sequence for Mexico that includes a late Pleistocene advance c. 12,000 ^{14}C yr B.P. (MII Stade) followed by an early Holocene cooling that began sometime between 10,000 and 8500 ^{14}C yr B.P. (Stade MIII). In general, most glacial geomorphologists believe that the last Pleistocene advance in Mexico occurred between 13,000 and 11,000 radiocarbon years ago (Metcalfe et al. 2000).

Fieldwork in the Caribbean has shown that cirques and moraines also formed on the Cordillera Central of the Dominican Republic (Schubert 1988:135). Further south on the mainland, glaciers expanded on the Altos de Cuchumatanes in Guatemala and on the Chirripó massif in the Talamanca range of Costa Rica (Horn 1990; Orvis and Horn 2000). By dating organic material recovered from alpine lakes on Cerro Chirripó, Orvis and Horn (2000:30) were able to determine that the last Costa Rican advance (Chirripó I) occurred shortly before 12,300 ^{14}C yr B.P.

Although Middle American glaciers did not seriously impede the movement of animals or humans, as did those in North America and the Southern Andes, they nonetheless had a significant impact on the surrounding environment. Perigalcial zones may have created added stress and economic challenges for early colonists or may have been coveted areas in which to live. At the same time, sporadic volcanic eruptions and ash fall may have prematurely forced groups to migrate to other regions, or worse, killed entire bands.

Pleistocene Vegetation of Middle America

The latitudinal and elevational changes in biota and temperature were all important factors that affected both Paleoindian rates of expansion through particular geographic regions as well as how humans were adapting to each of these zones (Kelly and Todd 1988; Webb and Rindos 1997). The relatively narrow stretch of land forming Middle America stands between two large oceans which exert considerable influence on the continental environment. Life during the late Pleistocene was at the mercy of frequent volcanic eruptions, cold snaps, warm phases, severe droughts, as well as fluctuating coastlines and water tables. These changes were of such magnitude and swiftness at the end of the Pleistocene that they culminated in mass extinctions.

Information from a large number of proxy records has helped us gain a clearer image of the world in which the first Middle Americans lived. Plant communities have been reconstructed from palynological, phytolith, and packrat midden studies. Geochemical, isotopic, diatomic, and sedimentological analyses of lake and marine cores have also shown us something of late Pleistocene climate regimes and hydrography. Terrestrial data presented below are subdivided according to five major geographic regions (Figure 4). The first includes the arid and semi-arid regions of northern Mexico. The second zone (Central Mexico) is delineated by the Tropic of Cancer and the Isthmus of Tehuantepec. The next subdivision begins at the Yucatan Peninsula, continues into the Peten, and ends at the Nicaraguan border (Upper Central America). The fourth is comprised of Cuba and Hispanola, the two main islands of the Greater Antilles. Finally, the fifth zone joins Nicaragua, Costa Rica, and Panama, to form the southernmost Central American sub-region.

1. Northern Mexico

Pollen Evidence

In northern Mexico we find that temperate semi-desert (shrub and grasses) covered the lowlands and semi-arid temperate woodland or scrub existed along the Sierra Madre Occidental around 18,000 ^{14}C years ago (Figure 5) (Adams and Faure 1999). A temperate coniferous forest, dominated by pine (*Pinus*), oak (*Quercus*), and spruce (*Picea*), was also shown to exist in the Alta Babicora basin during the late Pleistocene (Ortega-Ramirez et al. 1992; Metcalfe et al. 1997, 2000).

Plant macrofossils from packrat middens (*Neotoma* sp.) in the Chihuahuan and Sonoran deserts indicate that the Pleistocene climate in northern Mexico was more equable than it is today. For example, midden contents from the Puerto de Ventanillas and Sierra de la Misericordia sites in the Bolson de Mapimi basin (Chihuahuan desert) showed that woodland species such as juniper and pinyon persisted in the region until 12,000 to 9000 ^{14}C yr B.P. (Van Devender and Burgess 1985; Metcalfe et al. 2000). Higher precipitation and cooler summers during the late Pleistocene explain the co-occurrence of taxa now living in allopatric communities (Meyer 1973; Van Devender et al. 1994). Packrat middens from the Sonoran desert also contained the remains of juniper and pinyon until 10,000 ^{14}C yr B.P. (Van Devender et al. 1994; Metcalfe et al. 2000). Modern desert conditions did not appear in northern Mexico until the mid-Holocene.

Diatomic, Geochemical, and Isotopic Evidence

A diatom analysis from Alta Babicora in Chihuahua revealed that this basin contained a deep lake before 11,060 ^{14}C yr B.P., after which time it became markedly shallow (Metcalfe et al. 1997, 2000). This sudden drop in the lake's water level is believed to be associated with the Younger Dryas (see below).

2. Central Mexico

Pollen Evidence

Five major localities have been the subject of palynological studies in the Basin of Mexico. Among these, lakes Chalco and Texcoco, and the archaeological site of Tlapacoya, show similar overall trends in addition to site-specific signals. Between c. 18,000 and 14,000 ^{14}C yr B.P. the climate was colder and drier than it is today (Sears and Clisby 1955; Clisby and Sears 1955; Foreman 1955; Markgraf 1989). Vegetation consisted of a mix of pine-oak forest, with alder (*Alnus*), juniper, and important grass (Poaceae) and brush zones. At Chalco, the xerophytic shrub fluctuated with pulses of increased humidity (Lozano-García et al. 1993; Lozano-García and Ortega-Guerreo 1994, 1998) while arid conditions appear to have held steady around Lake Texcoco (Lozano-García and Ortega-Guerreo 1998). An increase in pine pollen between 14,000 and 8000 ^{14}C yr B.P. at Tlapacoya shows that a milder and wetter climate may have prevailed during this time (Lorenzo and Mirambell 1999; Metcalfe et al. 2000). After 14,000 ^{14}C yr B.P., grasslands gradually shrunk under the encroaching pine forests. At Chalco, *Quercus* frequencies decreased while those of *Alnus* increased, indicating that the climate during the late Glacial was still cooler yet slightly more humid than today. Lake Texcoco dried up completely between 14,000 and 6140 ^{14}C yr B.P. and suffered from considerable erosion (Lozano-García and Ortega-Guerreo 1998:86).

Additional palynological information comes from Lake Pátzcuaro located at a lower elevation west of the Valley of Mexico (Deevey 1944; Watts and Bradbury 1982). Here, pollen spectra between the Last Glacial Maximum (LGM) and the end of the Pleistocene also demonstrate a cold and dry environment dominated by forest taxa such as alder, juniper, oak, pine, and sagebrush (Watts and Bradbury 1982). The Pleistocene-Holocene transition at Lake Pátzcuaro is marked by an increase of pine and a drop in juniper.

Finally, a pollen analysis at the megafaunal locality of Tepeji de Rodriguez in the state of Puebla revealed that an open woodland composed of *Pinus*, *Alnus*, and grasses existed around the site prior to the Holocene (Torres Martinez and Agenbroad 1991).

Diatomic, Geochemical, and Isotopic Evidence

Because lakes in the Basin of Mexico have been known to coalesce during periods of increased precipitation, Pleistocene climatic events, affecting water levels along the TMVB, can be detected in the basins diatomic and sedimentary records. The low frequency of planktonic diatoms at Lake Texcoco during the LGM indicates that it was very shallow and that an arid climate prevailed during this time in the Basin of Mexico (Bradbury 1971:199). A slight increase in the lake's water level between 13,600 and 11,100 ^{14}C yr B.P. is possibly correlated with a glacial advance or a meltwater influx into the Gulf of Mexico (Street-Perrott and Perrott 1990:611). A return to brackish planktonic and benthonic diatoms was observed at the end of the Pleistocene, marking another episode of aridity around Lake Texcoco. This same cycle of low-high-low water levels was also observed in the sediments of Lake Chalco (Bradbury 1989) and was probably caused by periodic volcanic eruptions (Metcalfe et al. 2000:707). Water levels at Chalco were relatively low during most of the Pleistocene, reflecting a dry climate. Levels increased slightly between 14,000 and 10,000 ^{14}C yr B.P., but by 9000 yr B.P. the lake returned to a shallow, saline-alkaline marsh (Caballero and Guerrero 1998; Metcalfe et al. 2000). Diatoms from a peat layer also revealed that a shallow marsh was present at Tlapacoya between 23,000 and 10,000 ^{14}C yr B.P. (Watts and Bradbury 1982). Other, corroborative evidence has come from the sediments of Lake Chiconahuapan which show that a shallow, alkaline marsh was in place in the Upper Lerma Basin before the Holocene (Metcalfe et al. 1991).

3. Upper Central America

Pollen Evidence

An undated profile from Loltun Cave has shown that a savanna type environment existed on the Yucatan Peninsula when megafaunal bones began to accumulate (Xelhuantzi-López 1986). Research at lakes Quexil and Salpeten (Metcalfe et al. 2000), located in the Peten of northern Guatemala, has provided good proxy data for a major portion of the peninsula. Vegetation around these two lakes, between c. 18,000 and 14,000 ^{14}C yr B.P., consisted mostly of non-arboreal pollen with some conifers (juniper and pine) (Leyden 1984, 1987, 1995; Leyden et al. 1993, 1994). The existence of a sparse temperate thornscrub in what is now a tropical semi-evergreen forest demonstrates that the Peten was colder and drier following the LGM. A lowering of the tree line of approximately 400 m is estimated for this cold interval (Leyden 1984). A warmer and slightly more humid climate prevailed between 14,000 and 12,500 ^{14}C yr B.P. favoring the expansion of a temperate oak forest. By 11,000 ^{14}C yr B.P., the humidity in the Peten had increased sufficiently to allow mesic temperate hardwoods such as pine, oak, and Moraceae to replace juniper (Leyden et al. 1994:201). A climatic reversal attributed to the Younger Dryas (Leyden et al. 1994; Leyden 1995) occurred just before 10,750 ^{14}C yr B.P., increasing the presence of Malvaceae and temporarily pushing back the encroaching forest.

Diatomic, Geochemical, and Isotopic Evidence

Water level fluctuations on the Yucatan Peninsula were recorded at Laguna Chinchancanab using stable oxygen isotope (^{18}O) and carbonate levels in snail shells (Covich and Stuiver 1974). Both data sets showed a major phase of lake level fluctuations between 22,000 and 8000 ^{14}C years ago. A missing section of the record, dating to the terminal Pleistocene, suggests that the lake was seasonally dry and suffered from deflation. The most important fluctuations were caused by the rising and lowering of the Yucatan's phreatic aquifer which is regulated by the eustatic changes in the Gulf of Mexico.

Sedimentologic data from lakes Salpeten and Quexil confirm the overall Pleistocene aridity observed in their pollen records. Before 10,500 ^{14}C yr B.P., Lake Salpeten was a closed, swampy lake 30-40 m lower than today (Deevey et al. 1983). High levels of gypsum in Lake Quexil's Pleistocene sediments are also interpreted as evidence of increased aridity (Leyden et al. 1993, 1994; Brenner 1993), since gypsum precipitates under higher evaporation and precipitation ratios (E/P) than those presently recorded in the Peten. Enriched δ^{18}O values in carbonates found at the same levels are also clear indicators of global cooling. Interestingly, a calcite spike occurs between 12,500 and 10,000 ^{14}C yr B.P. marking an episode of evaporitic precipitation of carbonates possibly associated with the Younger Dryas.

4. Greater Antilles

Pollen Evidence

Palynologists working at Lake Miragoane in Haiti were able to determine that an open and dry vegetation characterized by xeric palm and montane shrub was in place around the lake just before the Holocene. This cold episode is believed to be a Younger Dryas signal (Hodell et al. 1991).

Diatomic, Geochemical, and Isotopic Evidence

High levels of carbonates in 10,500 ^{14}C yr-old ostracod shells from Lake Miragoane have corroborated the pollen data suggesting arid conditions associated with the Younger Dryas (Curtis and Hodell 1993). The lake is believed to have been shallow and saline until the Holocene.

5. Lower Central America

Pollen Evidence

Pollen core localities in Costa Rica include the Lachner Bog (Martin 1964), Deep Sea Drilling Project's site 565 (Horn 1985), and the La Chonta Bog (Hooghiemstra et al. 1992; Islebe et al. 1995). Zone II of the Lachner Bog pollen diagram, dated between 20,750 and 8100 ^{14}C yr B.P., was characterized by an abundance of non-arboreal taxa (Poaceae, Umbelliferae, and Compositae) suggesting that the alpine páramo vegetation of the Talamanca range was depressed by as much as 650 m during the LGM. The Holocene was marked by an upward migration of the montane forest which included oak, alder, and *Podocarpus* (Martin 1964).

Pollen from sediments recovered off shore on the Pacific side of Costa Rica contained high frequencies of pine and oak, suggesting a colder and drier climate during the late Pleistocene (Horn 1985). The presence of grass during this same interval indicates that the montane forest was open. Post glacial warmth and humidity is evident in the highest part of the core as tropical species gradually replace pine.

More recent palynological analyses were conducted at the La Chonta Bog, located in the Talamanca range. Although slightly lower in elevation than the Lachner Bog, the vegetation around La Chonta before 13,000 ^{14}C yr B.P. was also characterized by a cold and dry grassy páramo which included upper montane trees such as oak (Hooghiemstra et al. 1992). Between c. 13,000 and 11,000 ^{14}C yr B.P., the upper montane forest expanded and became the dominant vegetation. This was followed by a return of the páramo and a depression of the tree line by as much as 300-400 m which lasted until 10,400 ^{14}C yr B.P. This cold reversal, referred to as the "La Chonta stadial", is believed to be a Younger Dryas event (Islebe et al. 1995). The Holocene transition was marked by a re-expansion of oak, elm, and alder.

Paleoenvironmental studies in Panama have also demonstrated that the Isthmus was considerably cooler (5-7 degrees C) and drier during the Pleistocene (Piperno and Pearsall 1998). In central Panama, sediments began to accumulate at the bottom of Lake La Yeguada approximately 14,500 ^{14}C years ago. During this time, the climate was cool and dry and the lake was surrounded by an open oak-magnolia and holly (*Ilex*) montane forest (Bush et al. 1992). The tree line was depressed by as much as 900 m and the Pacific coastal plain was probably a parkland or thornscrub with sections of herbaceous savanna (Piperno et al. 1990, 1991, 1992). The sudden increase of particulate carbon in the lake deposits, c. 11,050 ^{14}C yr B.P., suggests that humans may have artificially maintained more open areas by burning the surrounding vegetation (Piperno et al. 1990). Local plant communities underwent a major reorganization between 11,000 and 10,500 ^{14}C yr B.P. as a result of increased precipitation and warmer temperatures. Oak pollen reached its maximum during this interval and lowland taxa became more common. This climatic amelioration continued into the Holocene culminating in a moist tropical forest.

Further east, the climate at El Valle following the LGM was warm and dry with low frequencies of trees (Bush and Colinvaux 1990). Between 14,000 and 10,000 ^{14}C yr B.P. temperatures dropped and montane species descended as much as 1000 m in elevation. This forest was composed mostly of oak but supported lowland species as well. Wetter and warmer conditions subsequently prevailed between 10,000 and 9000 ^{14}C yr B.P., forcing the montane vegetation upward to its modern elevation.

Pollen and phytoliths from a core extracted from the submerged Chagres Valley (now Gatún Lake) indicate that an open tropical forest with grasses and sedges covered this area between 13,000 and 9000 ^{14}C years ago (Bartlett and Barghoorn 1973; Piperno 1985). Significantly, pollen from this core, which was extracted at sea-level, contained a stilt palm species (*Iriartea corneto*) which is found today in forests of the Darien Province at an elevation of 1200-1500 m (Bartlett and Barghoorn 1973:235).

Finally, new pollen data from Monte Oscuro (Piperno and Pearsal 1998; Piperno and Jones in press), situated approximately 10 km from the Pacific, are adding support to the idea that the Panamanian coastal lowlands were grassier and more open during the Pleistocene.

Diatomic, Geochemical, and Isotopic Evidence

Lake La Yeguada provides the only sedimentologic and diatomic data for lower Central America. Finely laminated sediments of alternating green and pink-gray bands were deposited on the lake bottom between 14,000 and 10,800 ^{14}C yr B.P. The green layers contained pollen, diatoms, and chlorophyll deposited during dry seasons. The pink layers were composed of eroded clays washed into the lake during rainy seasons (Bush et al. 1992). These varve-like laminae also contained illite (which forms in arid conditions), and kaolinite (which requires more extensive chemical weathering and humidity). Diatoms show that the lake was shallow and saline up until the Holocene. Precipitation increased markedly after this time and illite was no longer deposited in the lake's sediments (Bush et al. 1992).

Marine Proxy Records

Pleistocene ocean sediments and planktonic foraminiferal faunal assemblages reflect both continental changes in the ice sheets and rates of terrestrial erosion. Fluctuations in the oceans produced by mainland agents affected the earth's climate, often resulting in closed system feedbacks. It is therefore important to understand how the oceans reacted during the Pleistocene, as they in turn influenced continental climates.

An analysis of the kaolinite/quartz ratios found in Pleistocene deposits in the Caribbean Sea demonstrates that Central America was indeed very arid at that time (Bonatti and Gartner 1973). Low production of kaolinite on the exposed continents surrounding the Caribbean Sea shows that the land masses were drier than today. Additional evidence of increased Pleistocene aridity is provided by carbonate eolianites (wind-laid limestone) found on the eastern side of the Yucatan Peninsula (Ward 1973). These cemented land features were produced by the precipitation of calcite in solution under semiarid to arid conditions. Eolianites formed when the Pleistocene climate was characterized by cycles of rainfall followed by intense evapotranspiration.

Deep sea cores from the Colombia Basin have shown a high influx of terrigenous clay, silts, and sands coming from South America and Panama during glacial stades (Prell 1978). This considerable discharge of terrestrial sediments demonstrates that an arid climate prevailed on the continents. Dryer conditions accelerated chemical weathering, and increased erosion and transport of sediments by reducing forest cover. Planktonic foraminiferal analyses from the same cores revealed elevated frequencies of *G. ruber* during glacial episodes (Prell and Hays 1976). This species is presently found in the saline, low-productivity waters of the Sargasso Sea, indicating that the Pleistocene climate in Panama and perhaps Costa Rica was characterized by high E/P ratios.

Late Pleistocene Aridity and Younger Dryas Signals in Middle America

The foregoing summary of proxy records for late Pleistocene and early Holocene environmental change prompt asking the question: Why was Middle America so dry during the terminal Pleistocene? Remarkably, Leyden (1985) has estimated that as much as 50% less rain fell in the tropical lowlands in northern South America and lower Central America during the Pleistocene. Several hypotheses have been put forth to explain why precipitation dropped during glacial times. One has focused on the Intertropical Convergence Zone (ITCZ) which is responsible for the characteristic dry and rainy seasons of the Neotropics today (Prell and Hays 1976). This annual cycle is produced when the ITCZ moves above and below the Equator, bringing with it monsoonal rains. However, during the Pleistocene the ITCZ was depressed further south by glacial air mass and cooler sea surface temperatures (SSTs) in the Gulf of Mexico, resulting in longer dry seasons in the Central American Neotropics (Leyden et al. 1993; Metcalfe et al. 2000). The second idea suggests that lowered SSTs were the principal cause of reduced rainfall. Indeed, inflow of glacial meltwater from the Laurentide ice sheet into the Gulf of Mexico via the Mississippi greatly affected the surrounding Mexican and Caribbean climates. Cooler SSTs in the Gulf of Mexico resulted in a dramatic reduction in water vapor transport across Middle America from the Atlantic to the Pacific (Manabe and Hahn 1977; Street-Perrott and Perrott 1990; Leyden et al. 1993, 1994). Lowered temperatures in the western Pacific also weakened the El Niño Southern Oscillation (ENSO) which had a periodicity of approximately 15 years between 15,000 and 7000 ^{14}C yr B.P. (Rodbell et al. 1999).

As the Pleistocene drew to a close, a sudden climatic reversal (Table 2) interrupted the melting of the ice sheets for approximately 1000 years between c.11,000-10,900 and 10,200-10,000 ^{14}C yr B.P. (Fairbanks 1989; Fiedel 1999a). This short stadial is better-known as the Younger Dryas. As far as we know, the Central American climate during the Younger Dryas was cool but moist (Leyden 1995). Signs of the Younger Dryas event have been recorded at many of the Middle American localities discussed so far. Additional evidence comes from sediment cores from the Gulf of Mexico which show a sudden return of cold water plankton and an increase in the δ^{18}O interspersed between meltwater pulses from the Mississippi (Fairbanks 1989; Flower and Kennett 1990; Peterson et al. 1991). At the same time, an expansion of cold adapted plants and a lowering of tree lines were also observed in the pollen diagrams from Lake Quexil, Lake Miragoane, and La Chonta (Leyden 1995). The Younger Dryas was also responsible for lower lake levels in many regions of Middle America (Curtis and Hodell 1993; Leyden et al. 1993, 1994; Metcalfe et al. 2000) as well as glacial advances ([Orvis and Horn 2000]; see Heine, [1994] for different interpretation). Increased water levels and monsoonal activity were recorded during this period at Lake La Yeguada. However, vegetation around the lake remained relatively stable since northern cold air fronts did not extend south of Costa Rica during this stadial, leaving the ITCZ free to move over Panama (Leyden 1995:837). A Younger Dryas signal was also detected at the El Abra Cave site in Colombia (El Abra Stadial) where it lasted from approximately 11,000 to 10,000 ^{14}C yr B.P. (Van der Hammen and Hooghiemstra 1995). Finally, it is interesting to note that Haynes (1984, 1991) has identified a lithostratigraphic marker (Black Mat), in the Southern Plains of the United States, associated with the Younger Dryas. The occurrence of this dark band at many Paleoindian sites correlates with a more humid climate associated with the Folsom culture (Fiedel 1999a, 2002). The Black Mat is also used as a regional indicator for the megafaunal extinction and the end of Clovis. Hence, an analogous stratigraphic marker might exist in Middle American deposits or, at the very least, in northern Mexico.

Summary of Middle American Paleoenvironments

To recapitulate, northern Mexican deserts were cooler and wetter during the Late Pleistocene and supported a mixed community of mesic woodland species and xeric taxa which has no analog today (Van Devender and Burgess 1985; Metcalfe et al. 2000). A cold and dry climate prevailed in the Central American Neotropics following the LGM. Evidence from Hispaniola demonstrates that the islands of the Greater Antilles were probably as cool and arid as the Middle American mainland during the Pleistocene (Schubert 1988). Displacement of the ITCZ further south and/or lower SSTs in the Gulf of Mexico resulted in longer dry seasons and low annual precipitation. Most regions of Middle America were characterized by more equable climates and reduced seasonality. The frequency and magnitude of the ENSO were considerably diminished during the late Pleistocene and may not have generated such erratic weather patterns as it does today (Rodbell et al. 1999). Open montane forests expanded in many areas as tree lines were depressed by as much as 1000 m in some areas. These forests often contained a mix of lowland and highland taxa which became allopatric during the Holocene. Late glacial forests appear to have been more open and strewn with shrub and grasses, forming a more diverse and complex vegetation mosaic with no contemporary associations (Toledo 1982; Guthrie 1984; Bush and Colinvaux 1990; Bush et al. 1992; Piperno et al. 1992; Colinvaux 1997; Metcalfe et al. 2000). Pleistocene lakes were considerably reduced and even dry at times. Although glacial advances may have raised water levels in the Basin of Mexico (Bradbury 1989), pluvial lakes were not present in Middle America when humans first arrived. Vegetation at lower elevations such as in the Peten, the Yucatan Peninsula, and the Pacific coastal plain of Costa Rica and Panama was characterized by thornscrubs and grassy savannas. While there may not be evidence for a continuous savanna corridor linking North and South America at the end of the Pleistocene (Horn 1985; Ranere and Cooke 1991; Piperno et al. 1992; Cooke and Ranere 1992c; Cooke 1998), pollen data from the

Pacific lowland of Panama do indicate that an open, grassy expanse was in place along much of the west coast of lower Central America (Piperno 2001, pers. comm.).

Pleistocene Megafaunal Communities of Middle America

Central America constitutes an important biogeographic zone which acted as a connecting corridor during the early Pleistocene and allowed North and South American species to inter-mingle. This process, described as the Great American Faunal Interchange (Marshall et al. 1982; Stehli and Webb 1985; Marshall 1988; Webb 1991, 1997), began approximately 2.5 MYA with the final emergence of the Panamanian land bridge and closure of the last marine corridor between the Pacific and Atlantic oceans (Coates 1997). Some of the northern species that crossed the Isthmus into South America included gomphotheriids (*Cuvieronius*), horses, llamas, deer, peccaries, tapirs, and rabbits (Webb 1991). Among the immigrants from the south were several types of armadillos (*Holmesina, Glyptotherium, Chlamydotherium*), ground sloths (*Megalonyx, Eremotherium, Glossotherium*), toxodonts (*Mixotoxodon*), porcupines, opossums, anteaters, and monkeys. At first, the passage of animals across the Isthmus was facilitated by the presence of a continuous savanna corridor spanning both continents (Webb 1978, 1991). By the end of the Pleistocene, however, a more humid environment began to prevail in lower Central America which culminated in the modern Neotropical realm. Some time after humans entered the picture, the expanse of land between Nicaragua and Panama became less of a conduit and more of a filter that slowly prevented xeric adapted animal and plants from entering.

Fossil remains of late Pleistocene megafauna have been discovered in almost every part of Middle America including the Greater Antilles (Figure 6). Table 3 presents a list of some of the larger mammals found at paleontological and archaeological localities. Most finds are not directly dated and are assumed to be late Pleistocene based on stratigraphic position and/or taxonomic associations. A rapid glance at Table 3 reveals that mammoths (*Mammuthus colombi*), horses (*Equus*), and camels dominate the record north of the Isthmus of Tehuantepec. South of this juncture, gomphotheres, ground sloths, and toxodonts become more abundant in Central America, followed by an increase in horse and camelids in South America.

The largest concentrations of extinct faunal remains have come from the Basin of Mexico and central Costa Rica. Mexican assemblages are extremely rich and contain a wide variety of species (Silva-Bárcenas 1969). San Josecito Cave is perhaps the richest of all despite the fact that it does not contain many of the larger genera (Jakway 1958; Silva-Bárcenas 1969; Arroyo-Cabrales et al. 1989, 1993, 1995; Arroyo-Cabrales and Johnson 1995). More recently, the remains of seven mammoths (*Mammuthus colombi)* were discovered near Tocuila in the Valley of Mexico (Morett et al. 1998a, b; Siebe et al. 1999). This latest find is significant since the bones were embedded in a lahar bracketed between 12,615 ± 95 (AA 23162) and 10,220 ± 75 (AA 23161) ^{14}C yr B.P. However, geologists determined that the massive ash flow was triggered approximately 3000 years after the eruption and was not directly responsible for killing the mammoths. It is believed that the mammoths died as a result of the initial ash fall (ca. 14,000 ^{14}C yr B.P.) which may have buried the surrounding vegetation and/or worn down the mammoths' molars, preventing them from consuming sufficient fodder to survive (Siebe et al. 1999:1560).

It is believed that South American ground sloths of the Megalonychidae family swam to the islands of the Greater Antilles approximately eight million years ago (Webb 1997). Remains of the most common of these edentates, *Megalocnus rodens*, have been found at many cave sites in Cuba and Hispaniola (Matthew and Couto 1959; Morgan and Woods 1986; Rodríguez Suárez and Vento Canosa 1989; MacPhee 1998). Most interesting, however, is that these insular ground sloths did not go extinct at the end of the Pleistocene but appear to have survived well into the late Holocene. For example, broken and burned sloth bones have been found at many archaeological sites in Cuba (Rodríguez Suárez et al. 1984), Haiti (Miller 1929), and the Dominican Republic (Morbán Laucer 1984) indicating that these animals were hunted by the first human to inhabit the islands. Relative, non-radiometric collagen dates on Cuban remains vary from 5360 ± 200 to 3250 ± 200 years ago (Rodríguez Suárez and Vento Canosa 1989:19) and a radiocarbon date of 2790 ± 190 ^{14}C yr B.P. was obtained from a bone recovered at a site near Santo Domingo (Rodríguez Suárez et al. 1984:564). It is impossible to tell at the moment what caused the final demise of these sloth populations. One thing is certain, however, ground sloths were no longer present on any of the Caribbean Islands by the time Columbus arrived.

The remains of mammoth (*Mammuthus colombi*) and mastodon (*Mammut americanum*) have been discovered as far south as Costa Rica (Lucas and Alvarado 1991; Lucas et al. 1997). The presence of large grazers in Costa Rica supports palynological studies which indicate that forests were more open and herbaceous during the Pleistocene. Bison, on the other hand, do not appear to have expanded further south than Nicaragua (Howell 1969). Footprints of humans and ungulates believed to be bison were discovered on an ancient lava flow at El Cauce, Nicaragua (Richardson 1941; Richardson and Ruppert 1942; Williams 1952; Webb 1997). However, attempts to date these deposits have indicated that the flow is probably Holocene in age (Bryan 1973 b).

Two undated megafaunal localities have been reported in Panama which may be late Pleistocene in age (Gazin 1956). Both sites were found near springs and seasonal ponds located on the Azuero Peninsula. The assemblages were dominated by the remains of *Eremotherium* and *Mixotoxodon*, with a few teeth and tusk fragments belonging to *Equus* and *Cuvieronius tropicus*. Of note, three additional fossil localities (Llano Hato, La Trinidaita, and Cerro Gordo) were discovered on the Azuero Peninsula during the course of my research (Figure 46). The Llano Hato deposit contained bones of *Eremotherium*, a smaller sloth (*Glossotherium*?), and turtle. A charcoal sample recovered among the remains gave an AMS date of 47,040 ± 900 ^{14}C yr B.P. (CAMS-78192). The second site was found near the small village of La Trinidaita and yielded bones of *Eremotherium* and *Cuvieronius*. Charcoal from this site was dated at 44,880 ± 700 ^{14}C yr B.P. (Beta-158916). The last locality consisted of an isolated gomphothere molar found near Cerro Gordo. Fossils were discovered lying on ancient creek beds and within clay deposits that had accumulated in small ponds. Environmental conditions were clearly wetter on the Isthmus during this time which seem to support the notion that extreme aridity at the end of the Pleistocene may have been the principal cause of the megafaunal extinction in Central America.

Chapter V

LATE PLEISTOCENE-EARLY HOLOCENE ARCHAEOLOGICAL RECORD OF MIDDLE AMERICA

First Discoveries

As with many other regions of the New World, early human research in Middle America began as an outgrowth of paleontology and geology in the 1800s. This historical connection is not surprising given that paleontologists were the only scientists probing the appropriately-aged deposits at the time.

Some of the earliest discoveries were made by French geologists of the *Commission Scientifique du Mexique* in the latter half of the XIXth century (Guillemin-Tarayre, 1867; Hamy, 1878, cited in Rodriguez-Loubet 1988). These scientists reported finding a retouched blade, a large scraper, and a small triangular biface associated with extinct Ice Age fauna at three separate Mexican localities (Aveleyra 1964). In 1870, a camel sacrum carved into the shape of a canid's head was discovered in Pleistocene deposits, some 12 m below the surface, at Tequixquiac in the Valley of Mexico. These finds went largely ignored until the Folsom discovery was reported in 1927, after which time archaeologists recognized the existence of "glacial age men" in the Americas (Figgins 1927).

A key turning point in Middle American Paleoindian archaeology was the discovery of Tepexpan Man in 1947 (De Terra et al. 1949; Heizer and Cook 1959). Although it has since been demonstrated that this skeleton actually belonged to a woman and is no older than 2000 radiocarbon years (Table 4) (Stafford 1994), it temporarily focused early human research on the Valley of Mexico and initiated other studies that led to important discoveries (Aveleyra 1964).

Since these pioneering studies, Middle American Paleoindian archaeology has advanced in a sporadic manner, characterized by periods of slow progress interspersed with important discoveries, such as those at Santa Isabel Iztapan (Aveleyra and Maldonado-Koerdell 1953; Aveleyra 1956) and Tamaulipas in Mexico (MacNeish 1958), Los Tapiales in Guatemala (Gruhn and Bryan 1977), Guardiria (Turrialba) in Costa Rica (Snarskis 1979), and Lake Alajuela/Madden (henceforth Alajuela) and La Mula-West in Panama (Bird and Cooke 1978; Cooke and Ranere 1992b; Ranere and Cooke 1995; Ranere 2000).

Distribution of Clovis-Like Points in Middle American

According to Bray (1978, 1980), the earliest account describing a fluted point in Middle America (and the New World, for that matter) was made by Francisco Ximenez who lived in Guatemala in 1722. However, Ximenez's description has been interpreted in different ways (Rovner 1980), and without an available drawing of the object in question, it remains a subjective matter with many equally valid explanations.

The first tangible Middle American Clovis-like point was apparently discovered on the Pacific Coast of Costa Rica and purchased by archaeologist C.V. Hartman in 1903 (Swauger and Mayer-Oakes 1952). The point was not recognized as particularly significant at the time and its exact provenience is unknown (It has been suggested that the point was discovered at Las Huacas near Nicoya [Bird and Cooke 1978:263]).

Since then, diagnostic Paleoindian points have been recovered in all Middle American countries except the Caribbean Islands, El Salvador, and Nicaragua. Approximately 81 fluted Clovis-like points and preforms have been discovered between the Rio Grande and Colombia (Table 5). Later Paleoindian point types such as Folsom, Plainview, Golondrina, and Cody have also been found in Mexico (MacNeish 1958; Epstein 1961) and possibly Belize (MacNeish et al. 1980b). Unfortunately, all but a few have been surface finds with no means of direct dating.

Figure 7 shows the geographic distribution of sites where Paleoindian projectile points have been reported (see also Table 6). In Mexico, a noticeable concentration of fluted points was discovered on the east side of the Gulf of California with one from San Joaquin on the Baja Peninsula. Two fluted Clovis-like points were collected at the Ladyville site in Belize during the Colha Project and the Belize Archaic Archaeological Reconnaissance (BAAR) surveys (Hester 1979; Hester et al. 1980a, 1982, 1986; MacNeish et al. 1980b). Further south, a complete fluted point made of obsidian was discovered in 1956 near San Rafael, Guatemala (Coe 1960). Since then, the base of an additional fluted point was discovered at Los Tapiales (Gruhn and Bryan 1977), as well as a complete specimen from the Chajbal localities in the Quiche Basin (Brown 1980). Clovis-like points have not been reported in Honduras, El Salvador, or Nicaragua and one must jump from Guatemala to Costa Rica to find the next examples. Since the discovery of the Hartman point in 1903, a minimum of 18 finished points and fluted preforms have been discovered at the Guardiria site located in the Turrialba Valley of central Costa Rica (Snarskis 1977, 1979; Castillo et al. 1987; Acuña 2000; Ranere and Cooke 1991). A nearly-complete specimen was also discovered on the shore of Lake Arenal during the *Proyecto Prehistorico Arenal* (Sheets and McKee 1994). Finally, in Panama, two Clovis-like points were discovered along the Canal Zone (Balboa and Lake Alajuela) with an additional 17 fluted fragments and numerous broken bifacial pieces from the La Mula-West site (Cooke and Ranere 1992b; Ranere and Cooke 1995, 1996; Ranere 2000; Cooke 1998; Ranere and Cooke 2002).

Except for a noticeable absence in the central regions of northern Mexico, the Yucatan Peninsula, and Nicaragua, Clovis-like points appear evenly distributed throughout Middle America.

The lack of points in some regions and high concentrations in others is most likely an artifact of survey coverage, visibility, and sampling than a reflection of Paleoindian settlement patterns.

Distribution of Fishtail Projectile Points in Middle American

Over the years the term "fishtail" has been used loosely to describe may types of points with constricted or stemmed bases. Often-times the inclusion of some specimens in this category has been subjective and questionable (e.g., Bullen and Plowden 1963). Although many Middle American FPPs show similarities with South American specimens (Bird 1969; Bird and Cook 1978), key differences suggest that they should be considered separate until more information is available.

At least 15, and perhaps as many as 30, FPPs have been discovered in Middle America (Table 7). The geographic distribution of FPPs suggests that they were fabricated and used between the isthmuses of Tehuantepec and Panama. Significantly, all Middle American FPPs which have an intact base are fluted. The Los Tapiales base fragment could also represent an additional example since it possesses the remnant of a possible shoulder (Gruhn and Bryan 1977:248). As with Clovis-like points, the majority of Middle American FPPs were recovered from undatable open air sites.

The northernmost examples of FPPs were discovered at the Los Grifos site in Mexico (García-Bárcena 1979; Santamaria 1981) with two others reported from Belize (MacNeish et al. 1980b; Pearson and Bostrom 1998). Two fluted stemmed points from the La Esperanza site in Honduras may also represent additional specimens (Bullen and Plowden 1963). A complete FPP and the base of a possible second were also recovered at the Guardiria site in Costa Rica (Snarskis 1977, 1979; Ranere and Cooke 1991). In Panama, a total of seven FPPs were discovered along the exposed shoreline of small islands in Lake Alajuela (Sander 1959, 1964; Bird and Cooke 1977, 1978; Ranere and Cooke 1991) with an additional example from Cañazas (Ranere and Cooke 2002).

Distribution of Other Paleoindian Projectile Point Types in Middle America

Approximately eight possible Folsom points have been discovered in Mexico (Table 6). Interestingly, one example from Oaxaca, if indeed a true Folsom, would considerably expand the geographic range used by these bison hunters. Perhaps as many as 58 late Paleoindian projectiles points have been found South of the Rio Grande. Most of these are Plainview points from northern and central Mexico (Epstein 1961, 1969; MacNeish et al. 1967), with one example from Belize (MacNeish et al. 1980b). Two possible Cody points have also been reported from the Mexican Basin (Aveleyra 1956, 1964), demonstrating again that bison ranges and the groups that relied on them for subsistence may not have been restricted to North America. More equivocal are 27 Agate Basin specimens reported from the Tehuacan Valley of Mexico by MacNeish and colleagues (1967:62).

Other projectile points from the Tehuacan Valley, such as those belonging to the El Riego phase, could represent additional Paleoindian examples (MacNeish et al. 1967:58).

Other early point types usually associated with South American groups have also been found in Middle America. Among these are two possible El Jobo points (Cruxent 1956, 1962; Bryan et al. 1978; Ochsenius and Gruhn 1979) recently reported from Panama. The first consists of a possible base fragment recovered on the surface of a quarry/workshop during my survey at Lake La Yeguada (Figure 38c) (Hall 1999; Pearson 2000a, b) while the other is a small mid-section found on the surface near Lake Alajuela by Junius Bird (Ranere and Cooke 2002). It is important to underscore that since these points are incomplete their affiliation with El Jobo assemblages from Venezuela must remain tentative.

A stemmed point with a flute-like basal thinning scar on one side of its fragmented base was also discovered at Lake La Yeguada in 1999 (Figure 38b) (Hall 1999; Pearson 2000a, b). This point was fashioned on a jasper flake and recalls Broad Stemmed examples from El Inga in Ecuador (Bell 1965; Mayer-Oakes 1986a) and La Elvira in Colombia (Illera and Gnecco 1986; Gnecco and Illera 1989). Lithic assemblages from Lake La Yeguada will be discussed in more details in Chapter 7.

The discovery of possible El Jobo and La Elvira points in Panama would extend the geographic distributions of these types and also reinforce the notion of widespread contacts and/or movements between Panama and northern South America during the terminal Pleistocene.

Chronology

A list of available early chronometric dates from various Middle American localities is presented in Table 4. The majority are from Mexico and range from 37,000 to less than 1000 ^{14}C yr B.P. It goes without saying that not all pre-12,000 year old dates are accepted since the origin and context of many of the dated charcoal or bone samples are problematic. Unfortunately, dates from early occupations that lack diagnostic artifacts appear more secure. This is the case, for sites such as Cueva Blanca and Santa Marta Rockshelter in Mexico (Flannery et al. 1981; García-Bárcena and Santamaria 1982; Stark 1981; Marcus and Flannery 1996), Piedra del Coyote in Guatemala (Gruhn and Bryan 1977), and the Corona and Aguadulce Rockshelters in Panama. Until this study, only the Los Grifos and Los Tapiales sites provided chronometric dates associated with fluted points in buried contexts.

At the Los Grifos Cave a waisted Clovis-like point and two FPPs were discovered in a stratigraphic unit bracketed between 9460 and 8930 ^{14}C yr B.P. (Santamaria 1981). Of note, lithic artifacts associated with a radiocarbon date of 9540 ^{14}C yr B.P. and an obsidian hydration date of 9330 were also discovered below the points.

At Los Tapiales, a total of 10 radiocarbon dates were secured from charcoal samples recovered from hearth features as well as from scattered fragments lying on possible living floors (Gruhn and Bryan 1977). The investigators rejected all hearth dates as being too young, as a result of possible contamination. Based on the oldest dates and on stratigraphic comparisons with the nearby-dated deposits from Piedra del Coyote, Gruhn and Bryan believe Los Tapiales was occupied approximately 10,700 ^{14}C years ago (Gruhn and Bryan 1977:245).

Attempts to date the cultural material at the Guardiria site in Costa Rica were also carried out using river terraces as relative horizontal time markers. Interestingly, the Clovis-like material lay on the highest terrace while the complete FPP was discovered on the lowermost suggesting that it might be younger (Castillo et al. 1987; Ranere and Cooke 1991).

Although fluted points from the La Mula-West site in Panama have not been dated, it is worth noting that several years prior to their discovery Crusoe and Felton (1974) located an 11,350 ± 250 (FSU-300) ^{14}C year old hearth in the same area. Additional early radiocarbon dates have come from rockshelters discovered during a survey of the Santa Maria watershed in the mid 1980s (*Projecto Santa Maria* hereafter referred to as the PSM survey [Lange 1984; Cooke and Ranere 1992a]). One of these, the Corona rockshelter, contained evidence of a bifacial industry dated at 10,440 ± 650 yr B.P. (Beta-19105) (Valerio-Lobo 1985; Cooke and Ranere 1992b). At the Aguadulce Rockshelter, dates of 10,725 ± 80 (NZA-10930) and 10,529 ± 184 (NZA-9622) ^{14}C yr B.P. were obtained on phytoliths from a level containing a bifacial industry (Piperno et al. 2000).

With so few dated Paleoindian sites in Middle America, it is not surprising that the temporal relationship between Clovis-like and FPPs remains unresolved. If we can rely on the evidence from Los Grifos, the relative superposition of both point types suggests that they were either 1) used by a single group, or 2) Clovis and FPP groups occupied the cave successively but within a short time span, or 3) the two groups were coeval.

Human Fossil Remains and Molecular Data

Mexico is the only Middle American country where early human remains have been found (Figure 8 and Table 8). It is important to note, however, that ages of some Mexican skeletons were derived indirectly and their alleged antiquity remains suspect. For example, the dates for some skeletons were deduced by comparing their fluorine content with those of radiocarbon dated megafaunal bones. Some of these animal bones were also associated with obsidian fragments possessing hydration rinds that were similar to others found near human remains (Aveleyra 1964). One of these, the Astahuacan skeleton, had a high fluorine content and was associated with obsidian flakes with thick hydration rinds comparable to fragments found next to a mammoth and an associated date of 9640 ± 400 ^{14}C yr B.P. at San Bartolo Atepehuacan (Romano 1970:28). Great antiquity has also been suggested for a number of human bone fragments recovered near lakes Chapala and Zacoalco, based on their association with extinct megafaunal remains, degree of mineralization, and "primitive" robusticity (Haley and Solórzano 1991; Lobdell et al. 1998; Dixon 1999; Irish et al. 2000). This last observation is very interesting since one of these individuals displays a large supra-orbital torus reminiscent of some of the more robust Lagoa Santa calottes from Brazil (Bryan 1978). Thus far, the individuals unearthed at Tlapacoya and El Peñon are the most reliably dated specimens (Table 8). Direct AMS dates on the skeletons range between 12,000 and 10,755 ^{14}C yr B.P. (Jiménez López 2002, pers. comm.).

Redating of Tepexpan Man, using the AMS method, bracketed this famous skull between 1980-920 ^{14}C yr B.P. (Stafford 1994). These new analyses demonstrated the problems associated with the use of relative dating techniques to determine contemporaneity between buried bones and other objects. Direct dating of all purported Paleoindian skeletal remains from Mexico (whenever possible) should be undertaken to dispel all doubts concerning their age.

To date, ancient DNA analyses have not yet been carried out on Paleoindian individuals and results from comparative craniometrics are only available for a few Mexican skeletons (BBC 2002). Most genetic studies in Middle America have concentrated on modern and Holocene Precolumbian mtDNA haplogroup distributions.

Compared to North and South America, an appreciable lack of genetic variability has been recorded in modern Middle American natives. Unfortunately most of our information has come from samples collected at the extremities of this region, (i.e., Mexico and lower Central America). Thus far, results indicate a correlation between decreasing mtDNA variability and geographic constriction as some haplogroups become scarcer towards the Isthmus of Panama.

Starting with populations living around the Isthmus of Tehuantepec, we find a predominance of haplogroup A (33%-92%), followed by B (7%-33%), C (6%-33%), and no D (Merriwether et al. 1995). The Maya of the Yucatan Peninsula are the only population sampled thus far that possess haplogroup D (5-7%, Bailliet et al. 1994; Torroni et al. 1994a). Haplotypes X, X6, and X7 have not been identified in any of these groups (Easton et al. 1996; Merriwether and Ferrell 1996; Merriwether et al. 1996; Brown et al. 1998). This contrasts with the results obtained by Bailliet et al. (1994) and Bianchi et al. (1995) who identified haplotype E (X?) and compound haplogroup A/B in some Maya and Mixteca Baja.

As one approaches the Isthmus of Panama, haplogroups C and D become less common. Proportions of remaining haplogroups vary from 85%-21% for A, and 72%-15% for B (Torroni et al. 1994a). Haplogroup D (D1), although rare, has been detected in a single Boruca Indian and seven Huetar (Torroni et al. 1994b; Santos et al. 1994, Forster et al. 1996). As Kolman et al. (1995:279) state, this "strikingly depauperate mtDNA haplotype diversity" has been observed in most every

Chibchan tribe such as the Teribe, Huetar, Guatuso, Bribri, Ngöbé, Cabécar, and Kuna (Torroni et al. 1994b; Batista et al. 1995; Kolman et al. 1995) (Note: The term "Chibchan" is defined here as those people who spoke historically related languages grouped in a Macro-Chibchan or Chibcha Paya phylum). This remarkable genetic homogeneity is not limited to Restriction Fragment Length Polymorphism (RFLP) analyses, it is also evident in the Control Region (CR) nucleotide sequences which show the lowest levels of diversity among all Amerinds in the New World (Batista et al. 1995; Kolman et al. 1995). For example, nucleotide diversity scores for the Kuna (.59), Ngöbé (.76), and Huetar (.71) are quite low compared to other Amerinds such as the Mapuche (.91) and the Nuu-Chah-Nulth (.95) (Batista et al. 1995:924; Forster et al. 1996). An important regional polymorphism designated as the "Huetar deletion" has also been observed in many Chibchan tribes (Santos and Barrantes 1994a,b; Santos et al. 1994). This unique 6-bp deletion has high frequencies among the Bribris (74%) and the Huetar (59%) (Santos and Barrantes 1994b). Similar to Mexican tribes, haplogroups X, X6, and X7 are all absent from Chibchan Indians, although one example of type A/B has been recorded among the Boruca (Bailliet et al. 1994:30).

Statistical tests indicate that Paleoindian colonists went through an initial bottleneck after their entry into the Americas followed by a large population expansion (Bonatto and Salzano 1997). Based on mismatch distributions of several lower Central American tribes, Batista et al. (1995) were able to determine that a second bottleneck occurred among Chibchans c. 10,000 years ago. Persistence of genetic homogeneity in Costa Rica and Panama through Precolumbian times suggests that human interaction and/or gene flow across the Isthmus must have decreased at some point (Batista et al. 1995; Lorenz and Smith 1996; Ward 1996).

Results from aDNA analyses of Pre-Colombian human remains are presented in Table 9. The occurrence of haplogroups C and D among Mayans reflects contemporary types from the Yucatan Peninsula (Bailliet et al. 1994; Torroni et al. 1994a). This is quite different from modern Mayan populations of the rainforest who belonged mostly to haplogroups A and B. Merriwether et al. (1997) explain this discrepancy by their inability to amplify certain sites defining haplogroups A and B. However, a more recent analysis by González-Oliver and colleagues (2001) demonstrated that 84% of their late Classic-Postclassic (AD 600-1521) Mayan sample from the Xcaret site in Quintana Roo belonged to haplogroup A. Interestingly, one individual could not be assigned to any of the four most common founding haplogroups. This skeleton was simply typed as "other" and was not tested further to see if it belonged to haplogroups X (González-Oliver et al. 2001:233)

Overall, craniometric and aDNA analyses of late Pleistocene-early Holocene Middle American skeletons is lagging behind compared to what has already been done in North and South America. Of course, our small sample size has impeded research and contributed to the problem. The scarcity of haplogroups C and D in contemporary lower Central American groups is difficult to interpret and may be related to a second genetic bottleneck in the Isthmian region at the beginning of the Holocene. This and other hypotheses regarding the peopling of South America are examined in the next chapter.

Chapter VI

CURRENT IDEAS AND INTERPRETATIONS

Paleoindian-Megafaunal Interactions in Middle America

As Paleoindians expanded into Middle America, they traversed several biogeographic zones and experienced latitudinal shifts in local megafauna. As a result of the Great American Faunal Interchange, clines between North and South American megafauna may have helped Paleoindian adaptation as they moved southwards. In other words, selective pressures acting on tool kits and hunting techniques, requiring intimate knowledge of individual animal behaviors (Kelly and Todd 1988; Webb and Rindos 1997), may have been gradual instead of rapid and drastic at least until they reached South America (Ranere 1980; Lynch 1983).

Herd animals such as grassland bison were no longer available south of Nicaragua, and hunting techniques best suited for open landscapes may not have been applicable in slightly more forested regions. Paleoindian hunting strategies may have shifted considerably in lower Central America to take advantage of the many genera of ground sloths, glyptodonts, and toxodonts present in this area. Moreover, gomphotheriids were possibly the only proboscideans south of Costa Rica and may have behaved differently from mammoths and mastodon. Consequently, lower Central American hunting strategies may have alternated between search-and-encounter tactics in forested regions and communal or intercept hunting in more open savannas and thornscrubs.

The animals in Table 3 represent only a small fraction of the actual diversity that existed at the time, and all of the species listed may or may not have been economically important or even available to Paleoindians. Taphonomic factors and recovery techniques have filtered or selectively removed smaller bones from many of these assemblages so that the remains of other potential prey species such as lagomorphs, turtles, and birds may not be accurately represented (Meltzer 1993; Lyman 1994). Interestingly, high frequencies of horse and camel bones in Mexican archaeological sites support the idea that they may have held larger roles in Paleoindian economies in North and Central America (Frison et al. 1978; Haynes and Stanford 1984; Lara 1999; Frison 2000; Kooyman et al. 2001), as they did in South America (Lynch 1983, 1998; Borrero and Franco 1997; Borrero et al. 1998; Morrow and Morrow 1999:228; Alberdi et al. 2001).

Although the nature of the interaction between North American Paleoindians and proboscideans is still debated (i.e., opportunistic killings and scavenging versus active hunting, see G. Haynes, [1985, 1991]; Pearson, [2001]), the existence of such contacts is not questioned. Species exploited in North America included *Mammuthus colombi*, *Mammut americanum*, *Mammuthus primigenius*, and perhaps *Cuvieronius tropicus* (Webb 1992:28). Save for woolly mammoths, all proboscidean species were available to Paleoindians expanding into Middle America (García-Bárcena 1989).

Considering that remains of *Cuvieronius* and *Haplomastodon* are well documented at several South American archaeological sites such as Taima-taima in Venezuela (Bryan et al. 1978; Ochsenius and Gruhn 1979; Gruhn and Bryan 1984), Tibitó in Colombia (Correal Urrego 1981), La Cumbre in Peru (Ossa and Moseley 1971), Tagua Tagua (Montané 1968; Nuñez et al. 1994) and Monte Verde in Chile (Dillehay 1992), as well as the Lapa dos Borges and Lagoa Santa caves in Brazil (Prous 1986a, b), it is logical to assume that these pachyderms were also hunted or scavenged in the interim regions of Middle America.

In spite of this, evidence of direct association between Paleoindians and proboscideans in Middle America has only been recorded in Mexico (stone objects found associated with gomphotheriids at El Bosque in Nicaragua [Gruhn 1978], and Tibás in Costa Rica [Snarskis et al. 1977] are no longer considered cultural and these sites should be regarded as paleontological localities [Cooke and Ranere 1992c]). Mexican sites where evidence for human-proboscidean interaction has been purported (Table 3) include Santa Isabel Iztapan (Aveleyra and Maldonado-Koerdell 1953; Aveleyra 1956), Tlapacoya (Mirambell 1978; Lorenzo and Mirambell 1999), the Valsequillo localities (Irwin-Williams 1967, 1978), Chimalhuacan (García Cook 1968), El Cedral (Lorenzo and Mirambell 1981), Atepehuacan, Los Reyes Acozac, lakes Chapala and Sayula, and Tamazulapan (Aveleyra 1964). Context at some of these sites is problematic however, and the association between stone tools and megafaunal remains has not always been convincingly demonstrated.

To this day, the excavations at Santa Isabel Iztapan provide some of the best evidence for proboscidean exploitation in Middle America (Aveleyra and Maldonado-Koerdell 1953; Aveleyra 1956). They consist of two sites located in the Valley of Mexico, each containing the remains of a mammoth associated with stone tools. Artifacts at the first locality include two medial sections of obsidian prismatic blades and a half-patinated Scottsbluff-like point showing a post-patination break (Aveleyra and Maldonado-Koerdell 1953:336; Wormington 1964). These objects suggest that deflation and post-depositional mixing may have occurred at the site.

The arrangement of bones and the presence of cutmarks at the second locality indicated that the animal was butchered on-site (Aveleyra 1956). Two bifaces and a projectile point were discovered amidst the remains. One of the bifaces is bipointed or willow-leaf shaped with a serrated knife-like edge and recalls what MacNeish (1958) has called Lerma points (Wormington 1964). The projectile point is especially interesting since it exhibits both similarities and differences with Clovis points. It is lanceolate in shape with a slightly expanding base which tapers to a narrow tip. The margins are finely retouched and the acute angle of its distal half may be the result of resharpening. Although it does not appear to be fluted, it possesses a large longitudinal end-thinning scar on one side of its base that extends to its mid-line and was partially "flaked over" by subsequent lateral removals. It is difficult to tell from published pictures and line drawings if this large scar is the remnant of an old flute or is merely a pseudo-flute. Geologic dating of the deposits indicates that this potential kill site is approximately 11,000 ^{14}C yr B.P. (Table 4) making it contemporaneous with Clovis occupations further north.

At the Arenillas locality in the Valsequillo Reservoir a projectile point fragment was found embedded in a mammoth mandible (Armenta 1978). An examination of the bone around the lesion indicated that the mammoth did not die from this wound. The projectile point itself does not show any diagnostic technological traits associating it with known Paleoindian industries. Other signs of butchering and consumption at Valsequillo include unmistakable cutmarks, burnt bones, and breakage (Armenta 1978). More recently, an age of 16,000-14,000 ^{14}C yr B.P. was suggested by Pichardo (2000) for the Iztapan and Valsequillo archaeological sites, based on regional stratigraphic correlations and tephrochronology.

In addition to the Mexican evidence, possible cutmarks were reported on a sloth bone recovered near the Rio de la Pasion in Guatemala suggesting that the animal may have been butchered by humans (Woodburn 1969:122).

The late Pleistocene paleontological record of Middle America is too scant at the moment to help answer questions regarding the possible cause(s) of the megafaunal extinction. It is still impossible to determine what role, if any, humans may have played in the extinctions that occurred between North and South America. We know that at least 15 genera of large herbivores (Martin 1967, 1986; Janzen and Martin 1981) and 10 animal families (Webb 1997) died out in Middle America at the close of the Pleistocene. Although the Younger Dryas was not a return to full glacial conditions, its sudden cooling and the rapid warming that followed caused significant stress on the existing plant and animal life. Mass extinctions may have resulted from this exceptional "back-to-back" combination of drought, rapid cooling, and warming (Haynes 1999). This could also explain why large scale extinctions did not occur during previous stadials and interstadials, as they were more gradual.

Paleoindian Technology in Middle America

Technological and typological analyses of entire assemblages can not only reveal what activities were carried out at specific sites but can also yield key information regarding similarities and differences between North, Middle, and South American Paleoindian adaptive strategies.

Tool Types

Table 10 presents a comparative checklist of major non-projectile point tools that have been found at North American Clovis sites (Stanford 1991; Gramly 1992) compared to artifacts found in Middle

America. Perhaps the most significant technological difference between North and Middle American late Pleistocene lithic assemblages is a conspicuous absence of large prismatic blades in the latter. Indeed, macroblades and large polyhedral blade cores similar to those from the Blackwater Draw (Green 1963; Montgomery and Dickenson 1992; Boldurian and Cotter 1999), Keven Davis, Pavo Real, Gault, (Collins 1999), Adams (Sanders 1990), Martens, Bostrom, Klostermier (Morrow 1996), or Carson-Conn-Short (Broster and Norton 1996) (see Collins [1999] for a more complete list of Clovis blade sites in North America) sites are very rare in Neotropical Paleoindian assemblages recorded to date. Indeed, the only convincing evidence for large Clovis-like blade production south of the Rio Grande has come from the El Bajio and Rancho El Aigame sites in Sonora, Mexico (Robles Ortiz 1974; Sanchez and Carpenter 2000), where a macroblade and a core platform rejuvenation tablet were found.

Gruhn and Bryan (1977:252) illustrate two of five triangular blades discovered in situ at Los Tapiales. These examples are small (widest measuring 13 mm [Gruhn and Bryan 1977:251]) and no Clovis-like blade cores or blade manufacturing by-products were found during the excavations. Brown (1980:317) also noted an absence of blade tools among the artifacts collected at other Guatemalan localities in the Quiche Basin. Although the lithic assemblage from Guardiria contained many blade-like flakes and ridge spalls, true prismatic macroblades and manufacturing by-products, such as exhausted cores and rejuvenation tablets, were not observed during my analysis (Pearson 2003, in press). In Panama, a few bladelets and blade-like flakes were discovered at the La Mula-West site and a single large blade was collected at Lake Alajuela (The lithic assemblages from Guardiria, La Mula-West, and Lake Alajuela will be discussed in more details in the following section).

With the exception of projectile points and certain scrapers, there appears to be an absence of formalized lithic tool types in Middle America. In fact, a large portion of Middle American Paleoindian tools were fashioned on amorphous flakes with no real standardization in shape or form. This seeming technological expediency may have been an adaptive response to particular late Pleistocene-early Holocene seasonal resources or simply a reflection of lithic material abundance and/or near-quarry use and discard behavior.

As for bone, ivory, and wood technology, taphonomic factors in the Neotropics are certainly responsible for the present lack of Paleoindian tools made from these organic materials. While there have been many claims for anthropogenetically modified bones in Mexico (Solórzano 1989), unequivocal Paleoindian bone tools from datable contexts have yet to be discovered in Middle America. It is perhaps only a matter of time before bone/ivory tools are found in cave sites or in arid regions of northern Mexico.

Lithic Reduction Strategies

Not unexpectedly, very little has been written on Middle American Paleoindian stone tool technology given the meagerness of most assemblages recovered thus far. Some notable lower Central American exceptions include the collections from Guardiria and La Mula-West, which will be examined in more detail in the following chapter.

Clovis-like Versus FPP Manufacturing Techniques

Morphologically, many Middle American fluted lanceolate points tend to have constricting or "waisted" outlines (Snarskis 1979; Morrow and Morrow 1999). It has been argued that Clovis point bases underwent gradual change from straight (i.e., parallel-sided), to waisted, and stemmed as their makers moved from North to South America (Snarskis 1979). According to this hypothesis, South American FPPs are seen as the final stage of an evolutionary transformation that began with southern Plains Clovis. While Snarskis (1979) has argued for an adaptive explanation for this phenomenon, Morrow and Morrow (1999) have suggested that simple stylistic drift could explain these morphological changes.

Flaking scars on a few Middle American Clovis-like specimens (Snarskis 1979; Hester et al. 1980a, b; Ranere and Cooke 1991) indicate that some were manufactured by removing large transversal thinning flakes from opposite margins which traveled beyond the preforms' mid-line. Once the desired thinness was achieved, bimarginal retouch was used to shape the points. This last step removed the initiation and termination scars of the previous lateral thinning flakes, leaving broad transverse concavities on the central surfaces with blades surrounded by small parallel flakes scars (Snarskis 1979, Hester et al. 1980a, b; Ranere and Cooke 1991).

As for Middle and South American FPPs, many began as large, flat flakes (Bird and Cooke 1978; Ranere and Cooke 1991; Morrow and Morrow 1999) that were bifacially thinned by removing a series of expanding flakes from opposite margins. These flakes overlapped at the points' mid-line often leaving their central surfaces thinner than their edges. Final shaping was accomplished using bimarginal percussion and pressure (Ranere and Cooke 1991; Pearson and Bostrom 1998). On occasion, sufficiently flat and thin flake blanks required only a minimum of bimarginal retouch to obtain a finished tool. Such points exhibit large intact portions of the original flake blank's ventral surface which appear as pseudo flutes (Bird 1969). Conversely, fluted lanceolate points were fashioned by multi-stage, bifacial reduction of large flake blanks to achieve desired shape and thinness (Callahan 2000; Bradley 1982, 1991, 1993).

Although much emphasis has been placed on these contrasting reduction strategies (Bird and Cooke 1978; Ranere and Cooke 1991; Pearson and Bostrom 1998; Morrow and Morrow 1999), it should not be forgotten that some lower Central American Clovis-like points (e.g., Swauger and

Mayer-Oakes 1952, Sheets and McKee 1994:232, and possibly Snarskis 1979, fig. 2b), as well as North American examples (Leonhardy 1966:21; Hemmings 1970:117; McCary 1985; Davis 1993:270; Morrow and Morrow 1999:223; Holen 2001:182) were also manufactured with minimal retouch on large, flat flakes. Since we know that lower Central American Paleoindians used many different ways to manufacture their projectiles, the posited technological dichotomy between Clovis-like and FPPs may, in fact, be more apparent than real. Perhaps the question we should now pose is whether FPPs were fashioned exclusively on large, flat flakes. As our sample size increases, the idea of mutually exclusive manufacturing techniques for Clovis-like and FPPs may no longer be tenable (Morrow and Morrow 1999:223). The presence of mixed technologies in Lower Central America could represent a form of cultural transition or amalgamation which could support the ideas that the Isthmian region and Northern South America were zones of significant evolutionary change or contact between distinct North and South American Paleoindians (Bryan 1973a).

Middle American Paleoindian Lithic Material Procurement Strategies

The lack of information on the provenance of lithic materials exploited prehistorically in Middle America has made it almost impossible to construct models of seasonal hunter-gatherer movements incorporating stone procurement strategies. Geographic sources of lithic materials found at Middle American Paleoindian sites have only been identified for a few assemblages in Mexico, Belize, Guatemala, Costa Rica, and Panama. In many of these cases, however, provenance of lithic materials is known simply because the sites in question are quarry/workshops. Fortunately, research in Precolumbian obsidian trade and commerce has initiated a program of trace element characterization and localization of geologic sources for many Mesoamerican obsidian types (see Braswell et al. [2000] for a review of obsidian sourcing studies in Maya regions). Active prospecting and research in the chert bearing zones of Belize (Shafer and Hester 1983; Oland 1999) has also identified several types of chert exploited prehistorically since Paleoindian times (Hester et al. 1982). Nevertheless, the majority of non-obsidian lithic material source in Middle America remain unknown.

If we examine the geologic history of the Central American Neotropics, we find that it presented a treasure trove of cryptocrystalline stones for Precolumbian groups. First, the many volcanic chains provided a host of usable igneous stones such as obsidian, ignimbrite, rhyolite, and basalt. The spatial distribution of these lithic materials would obviously follow the TVMB and the CAVA which longitudinally divide and span the southern half of the continent. Second, the emergence of marine sedimentary basins forming most of the continental margins brought important sources of cherts and jaspers. Rivers flowing out to the oceans on either side of the continental divide transported these stones and redistributed them at lower elevations downstream. Since Central America is crosscut with innumerable streams, lithic materials available to Paleoindians may only have been a river away. Hence, it is conceivable that Central American Paleoindian lithic material procurement strategies relied primarily on a ubiquity of secondary sources. This might explain why large bifacial cores and lithic caches do not appear to have been used in Middle America.

In North America, Clovis lithic material procurement strategies have been characterized by the use of high quality cryptocrystalline stones (Goodyear 1979), often necessitating long distance travel to acquire (assuming they were procured directly). The discovery of a Clovis point at the Kincaid Rockshelter in Texas, fashioned from Mexican obsidian from the El Paraiso source, more than 1000 km away (Hester et al. 1985; Hester 1988), suggests that Clovis lithic procurement strategies and/or social activities, (Bamforth 2002) may have been similar in Mexico. However, it is difficult to determine if, or how, the exploitation of lithic materials changed beyond the Isthmus of Tehuantepec.

In Guatemala, for example, three different types of obsidian were identified at the Los Tapiales site (Stross et al. 1977). Two of these sources, the Rio Pixcaya and San Bartolome Milpas Altas, are located at distances of 50 and 75 km respectively, while the third lies approximately 55 km away near the Tajumulco volcano (Stross et al. 1977:116). While most of the lithic material found at Los Tapiales was composed of local basalt, at least 20% of the debitage was obsidian.

Paleoindians at the Guardiria quarry/workshop in Costa Rica used chert river cobbles available on-site (Snarskis 1979; Castillo et al. 1987). Although this material contains many impurities and is of mediocre quality, substantial manufacturing activities were carried out at Guardiria (Pearson 1998). Flintknappers used these stones to fashion both fluted points and expedient tools. Signs of heat treating was observed on one fluted point (Snarskis 1979:128) and may have been a common practice to improve the quality of the material. It is interesting to note, however, that at least one fluted base (Figure 15i) found at the site was fashioned from a different, high quality, jasper. Unfortunately, it is impossible to tell if this jasper represents a true exotic, an import from another nearby source, or simply the odd cobble among the local cherts.

Paleoindians at La Mula-West used a local translucent and brittle agate to fashion their fluted points (Ranere and Cooke 1992b, 1996). Broken preforms and manufacturing waste found at this site display square and crenated longitudinal fractures and spalls resulting from heat stress. Most curious is the fact that the agate cobbles used at La Mula-West are found within large accumulations of better quality jasper nodules.

Paleoindian Economies and Settlement Patterns in Middle America

At present, archaeologists can only speculate on the frequency of residential moves and distance traveled each year by the first Middle Americans (Surovell 2000). Nevertheless, certain geographic, biotic, and climatic characteristics of Middle America can help us formulate testable models.

From a general perspective, Middle America can be described as a narrowing corridor between North and South America. Physiographically speaking, it is characterized by three principal zones: 1) coastal lowlands, 2) intermediate basins and valleys, and 3) relatively uninterrupted mountain ranges from Mexico to Panama. As if going through a funnel, Paleoindians moving south began to colonize narrower and narrower combinations of these three major habitats. Consequently, environmental differences, from an altitudinal point of view, were more rapid and pronounced as early colonizers approached South America. This is perhaps the single most important factor that can help us understand the many facets of Middle American Paleoindian lifeways. Whereas archaeologists studying Paleoindians in open regions have often adopted a "horizontal" perspective to explain settlement patterns, lithic procurement strategies, and general economies, a "vertical" approach is necessary to reach the same goals in Middle America. That is to say, many hallmarks of North American Paleoindian adaptive strategies cannot be applied uncritically or even be expected to be relevant in many Middle American regions.

As demonstrated by the palynological record, North and South America were not linked by a *continuous* open savanna corridor during the late Pleistocene (Ranere 1980; Horn 1985; Ranere and Cooke 1991; Piperno et al. 1992; Cooke and Ranere 1992c; Cooke 1998) as previously suggested (Lothrop 1961; Lynch 1983). This assertion was based primarily on the belief that Paleoindian subsistence economies were centered on megamammal hunting and that groups circumvented enclosed forests and restricted themselves to open ranges. Nevertheless, it has now been demonstrated that a large expanse of open grassy savanna and thornscrub was present along the Panamanian Pacific lowland, which may have accelerated human dispersal along this coast (Piperno and Jones, in press). Since fluted points were discovered at Lake Alajuela, less then 30 km from the tropical forest identified at Lake Gatún, we must conclude that Paleoindians were familiar with, and exploited resources within these more enclosed tropical biomes (Ranere and Cooke 1991; Piperno et al. 1991; Roosevelt et al. 1996; Cooke 1998; Roosevelt 1998). The sudden increase in charred phytoliths c. 11,050 ^{14}C years ago at Lake La Yeguada suggests that Paleoindians might also have intentionally kept the encroaching forest at bay for some time. Interestingly, increased charcoal production was also recorded at Lake Quexil before 10,750 ^{14}C yr B.P. (Leyden et al. 1994:200) and in the Bald Hills area of Belize at 11,210 ^{14}C yr B.P. (Kellman 1975). A similar pattern has been emerging in South America where high concentrations of late Pleistocene charcoal have been interpreted as having anthropogenic origins (Heusser 1994; Behling 1996; Moreno 2000). However, it has been suggested that this charcoal increase could represent a natural world-wide tropical phenomenon associated with the Younger Dryas event (Haberle and Ledru 2001).

Other sites such as Los Tapiales, located at an altitude of 3150 m, or Guardiria, discovered at an elevation of 700 m, demonstrate that they were surrounded by alpine páramo or montane forest when occupied. Thus, the geographic distributions of Paleoindian sites suggests that the first Middle Americans were able to exploit resources within tropical forests, montane forests, and dry savannas (Cooke 1998; Piperno and Pearsall 1998). It is likely that late Pleistocene groups living in the Central American Neotropics were seasonally mobile. Hunting bands may have shifted between mountainous forest and low-lying semiarid prey species as availability dictated. Encampments located in semiarid thornscrubs probably took advantage of such resources as succulents, mesquite, nuts, rabbits, and lizards which may have been an integral part of these late Pleistocene hunter-gatherers' economies (Piperno et al. 1991; Flannery et al. 1981; Marcus and Flannery 1996). The presence of numerous large keeled scrapers and planes with silica sheens found at some sites indicates that plants were processed on a regular basis. We must also consider that coastal resources such as fish, marine mammals, and shellfish may have contributed to some Middle American Paleoindian diets (Orr 1962; Llagostera 1979; Stothert 1985, 1988; Sandweiss et al. 1989, 1998; Chauchat 1992; Dixon et al. 1997; Fedje and Christensen 1999; Keefer et al. 1998; deFrance et al. 2001; Rick et al. 2001). Unfortunately, bone and plant macrofossil preservation is poor in open air tropical sites so we can only speculate as to the species listed on Middle American Paleoindian menus until more evidence becomes available.

We should also not forget that fresh water was a scarce commodity during the long and arid late Pleistocene summers and must have been an important determining factor in the settlement patterns of Middle American Paleoindians. Seasonal ponds and creeks, springs, and swamps may have been vital gathering places for both animals and humans. Movements between the dry lowlands and more temperate highlands may have been determined by the seasonal availability of potable water. Although abundance rather than quality of stones may have been a key variable in determining lithic material procurement strategies (Andrefsky 1994), access to fresh water during dry seasons may have overridden all other factors and could explain why low quality stones were sometimes used to manufacture fluted points. Thus, early Middle Americans may have been tethered to water sources during summer months (cf. Taylor 1964). Viewed in this manner, it might be possible to test if a correlation exists between the quality of lithic materials found at sites and seasons of occupation.

All in all, it is safe to assume that Paleoindian adaptations to Neotropical environments were extremely plastic, and the ecological variability encountered by these early hunter-gatherers did not present a serious obstacle and may, in fact, have been advantageous.

Art and Belief Systems

Clovis mobiliary art in the form of engraved limestone tablets has been found at the Gault site in Texas (Collins et al. 1991; Collins et al. 1992). Although there is no Middle American counterpart for these types of artifacts, Paleoindian bone carvings have been discovered in Mexico. The first is the Tequixquiac camel sacrum, which was carved into the shape of a dog or wolf's head. The others consist of a collection of megafaunal bones that display etched drawings of animals and geometric shapes recovered from the Valsequillo localities (Armenta 1978). Among these is a proboscidean pelvis with carved images thought to represent a tapir or feline, a mammoth or mastodon, and a bison (Armenta 1978, fig. 70). It should be mentioned, however, that the authenticity of the artwork remains in doubt (García-Bárcena 1989). Thus far, the use of ochre, which was prevalent at many early sites in North and South America, has not been documented in Middle America.

Early Migrations to the Caribbean

Renewed interest in prehistoric maritime travel to and within the Americas (Stanford and Bradley 2002) leads us to ponder if Paleoindians ever colonized the Caribbean Islands. Although the term "Paleo-Indian" has been used on several occasions to describe the earliest insular populations (Cruxent and Rouse 1969; Kozlowski 1974, 1980), late Pleistocene diagnostic projectile points have yet to be discovered on the islands (Bullen 1976). Thus far, the earliest sites belong to the Casimiroid and the Mordanoid complexes of Hispaniola. Material from the Casimira site is believed to be 7000 ^{14}C years old (Cruxent and Rouse 1969; Rouse and Allaire 1978) while the earliest dates from the Mordan site are no earlier than 4500 ^{14}C yr B.P. (Cruxent and Rouse 1969; Rouse and Allaire 1978).

One of the models put forth to explain the colonization of the Caribbean Islands traces the origins of the earliest migrants to the El Jobo and El Inga industries of Venezuela and Ecuador (Raggi Ageo 1971; Kozlowski 1974, 1980; Veloz Maggiolo and Vega 1982; Veloz Maggiolo and Martin 1981; Callaghan 1990b). For example, Veloz Maggiolo and Martin (1981; also Veloz Maggiolo and Vega 1982) have argued that the macroblades and keeled scrapers characterizing the Mordanoid complex resemble unifacial tools found in El Jobo assemblages. Based on these similarities, the authors suggest that the first humans that navigated to the islands were descendants of early Venezuelan Paleoindians. Callaghan (1990a, b) posits that the early Sand Hill complex of Belize (c. 9500-8000 ^{14}C yr B.P.) (MacNeish et al. 1980b) is also related to Joboid and Mordanoid industries. If this is the case, it may add support to the existence of an early circum-Caribbean Paleoindian culture area (Pearson and Bostrom 1998). Similarities between projectile points from Panama and Florida (Faught and Dunbar 1997) suggest that population movements along the Gulf of Mexico were possibly widespread and bi-directional (Faught and Anderson 1996; Faught and Dunbar 1997; Faught n.d.).

Finally, although highly suspect, it is worth mentioning the discovery of a human skeleton at the Cueva del Túnel in Cuba estimated to be 10,550 ^{14}C yr B.P. (Callaghan 2000, pers. comm.). This date was obtained by plotting the collagen weight of the human bones on a radiocarbon regression line. The predictive equation was derived using nine different bone samples of known age and collagen content collected throughout Cuba (Vento Canosa et al. 1981). Despite the fact that results among the control sample showed some correlations and potential application for this indirect dating technique, none were older than 1620 ^{14}C yr B.P. Moreover, site specific taphonomic factors and soil chemistry were neither assessed nor controlled for by the authors. Hence, until this human skeleton is dated directly, it cannot be considered as evidence of a Paleoindian presence on the Greater Antilles.

The First South Americans

Skeletal Studies

Recent craniofacial analyses of early North Americans (Steele and Powell 1992, 1994, 1999; Chatters et al. 1999; Owsley and Jantz 1999; Powell and Neves 1999; Powell and Rose 1999; Jantz and Owsley 2001) have corroborated what South American researchers had claimed for some time—that the earliest inhabitants of the New World were physically different from contemporary Native Americans.

The Lagoa Santa human remains, for example, have been something of an anomaly ever since their discovery (Laming-Emperaire et al. 1975). Although the unusual characteristics of the skeletons composing this ancient Brazilian population have been explained in many different ways, most interpretations conclude that the Lagoa Santa humans were quite different from contemporary groups. In an attempt to solve this enigma, Neves and Pucciarelli (1989, 1991) compared the Lagoa Santa skeletons to other South American Paleoindian remains as well as many Old World populations. The Brazilian crania were dolichocranic and did not display specialized Mongoloid traits. Using principal components analyses they observed that South American Paleoindians clustered with South Pacific Asian populations and Australians. Neves and Pucciarelli did not suggest that direct migration between the two continents was responsible for the similarity. Rather, they interpreted this as evidence that both early South Americans and Australians shared common ancestors. The team suggested that both the Americas and Australia may have been colonized by a generalized Asian population related to the humans discovered in the Upper Cave at Zhoukoudian (Kamminga and Wright 1988). According to this model, some of these non-Mongoloids moved south from China and settled Southeast Asia and Australia while others moved north and eventually crossed the Bering Land Bridge (Neves and Pucciarelli 1991:270). At the center of this controversial hypothesis stands "Luzia", a woman found at Lapa Vermelha IV believed to be 11,500-11,000 years old (Neves et al. 1998; Neves and Blum 1999). According to Neves and colleagues, the facial structure of Luzia resembles that of Australian Aborigines as well as some Africans. These researchers believe that Luzia was a member of a small, initial population that might have gone extinct following the radiation of Mongoloids into South America.

Another comparative analysis of the Lagoa Santa remains was carried out by Soto-Heim (1994). Her study compared 40 skeletons from two caves (Sumidouro and Escrivania III) to other early human remains from Central and South America. Soto-Heim appears to have independently reached the same basic conclusion as Neves and Pucciarelli (1989, 1991). Her Lagoa Santa sample shared similar features as other South American Paleoindian remains but were clearly not related to Mongoloids. Soto-Heim suggested that these humans were characterized by plesiomorphic pre-Mongoloid structures and had undergone separate evolution from Asiatic Mongoloids (1994:81).

Other early Brazilian skeletons from the provinces of Rio Grande do Norte and Piauí show similar generalized and robust traits, attesting to a widespread population (Peyre 1993, 1994; Peyre et al. 1998). One female in particular, discovered at the Toca dos Coqueiros rockshelter, was found associated with both an unfluted stemmed and triangular bifacial point (Lessa and Guidon 2002).

Brazilian researchers also examined Archaic and later skeletons but were unable to detect signs of gradual evolutionary processes that might explain the transition from a dolichocranic pattern to a meso- or brachicephalization (Munford et al. 1995). Consequently, this dichotomy has been interpreted as evidence that South America was colonized by at least two distinct populations.

Additional support for this idea has come from studies of Fuegian populations who display peculiar cranial morphologies attributed to cold adaptation (Rothhammer and Silva 1990) combined with a retention of non-mongoloid Paleoindian characteristics (Lalueza Fox et al. 1996; Hernandez et al. 1997). Indeed, humans who lived at the southern tip of the continent possessed many of the same characteristics observed in the Lagoa Santa remains and resemble Ainus, and Australians. Lalueza Fox et al. (1996) and Hernandez et al. (1997) suggest that these Fuegian-Patagonians may be relic populations that first arrived in Tierra del Fuego 12,000-10,000 years ago and evolved in relative isolation following the post-Pleistocene sea level rise. As with the more ancient South American skeletons, statistical tests incorporating the Fuegian groups demonstrated that they did not cluster with typical Mongoloids (Neves et al. 1999a; González-José et al. 2001).

Lahr (1995) believes Fuegians represent peripheral groups of an ancient non-Mongoloid radiation that may have encompassed the entire circum-Pacific including Southeast Asia, Northeast Siberia, and the New World. Although she agrees with many researchers who posit that the Americas were first colonized by generalized Sundadonts, she does not believe this is necessarily evidence for close genetic affinity with other Southeast Asians or Australians considering that most modern humans living during the Pleistocene were less specialized and considerably more robust. Since the Sinodont-Mongoloid morphological pattern evolved from these generalized Sundadonts, both populations were contemporaneous before Sinodonts became dominant in northern Asia and the New World. Hence, representatives of both these populations could have traversed the land bridge and make their way to the New World (Lahr 1995:170).

Generalized physical features were also recorded on the individual unearthed at Pali Aike Cave in 1937 (Bird 1988). Although Turner and Bird's (1981) initial study classified the Pali Aike dentition as Sinodont, several re-investigations have now demonstrated that this skeleton is distinct and its dentition unlike any modern Native Americans (Steele and Powell 1993, 1999). Moreover, a craniometric analysis revealed that the Pali Aike cranium was similar to those from Lagoa Santa (Neves et al. 1999a, b).

Molecular Studies

As stated in Chapter 5, modern Chibchan mtDNA from Panama and Costa Rica is composed mainly of haplogroups A and B (Torroni et al. 1994b; Batista et al. 1995; Kolman et al. 1995). The absence of haplogroups C and D among these lower Central American groups has been explained by genetic drift during the Chibchan ethnogenesis (Kolman et al. 1995) and/or a population crash following the Spanish conquest (Crawford 1992; 1998). South of the Isthmus, mtDNA diversity increases once again with the reappearance of haplogroups C and D.

Researchers working in South America have been able to sample a great number of Native Americans still extant on that continent. Genetic information has been gathered from the Amazon basin, the high Andes, and as far south as the Magellan Straits. If we examine haplogroup distributions, following a north-south cline, we find that all four haplogroups are present in northernmost South America with a predominance in A, followed by similar percentages of C and D, and very little to no B in some populations (Merriwether et al. 1994). A different picture emerges in the southern regions of the Brazilian Amazon. The general mtDNA pattern in the tropical forest is characterized by a marked increase in types C and D associated with a decrease in haplotypes B and A which are at times completely absent in some tribes (Merriwether et al. 1994; Monsalve et al. 1994; Torroni et al. 1994a). Results from one study demonstrated that 92% of Brazilian Indians from 9 tribes (n=201) did not possess haplogroup A (Merriwether et al. 1996). Some exceptions showing high incidences of haplogroup B include the Kraho (57%, Salzano et al. 1997), the Xavante (84%, Ward et al. 1996), and a grouped sample of eight Amazon Indians (28%) analyzed by Santos et al. (1996).

Haplogroup B has its highest expression in highland Aymara and Quechua groups along the Peruvian and northern Chilean Andes. The 9-bp deletion appears fixed among some tribes such as the Guanacagua and the Ilapata (Merriwether et al. 1994, 1995b). A similar 6-bp deletion as the "Huetar deletion" (Santos and Barrantes 1994a, b; Santos et al. 1994) was also observed in some Aymara individuals but this South American version was associated with a D background (Merriwether et al. 1995b).

A new study of 681 Colombian Natives by Keyeux and colleagues (2002) has recently produced some notable results. While haplogroups A (31%), B (30%), and C (26%) were distributed more or less equitably, haplogroup D was quite rare (6%). Furthermore, mtDNA from twenty individuals, which did not belong to the four major founding haplogroups, was characterized by an ad hoc designation (haplogroup E) which might contain haplogroup X (Keyeux et al. 2002:222).

Investigators also observed that haplogroups A and D appeared geographically segregated. The high occurrence of A in the north and D in the south was explained by a dual migration into South America.

Along the southern extension of the Cordillera, mtDNA haplogroups are characterized by low percentages of A and B, and a co-dominance of C and D among the Mapuche and Peheunche (Ginther et al. 1993; Bailliet et al. 1994; Merriwether et al. 1994, 1995a; Moraga et al. 1997). This overall trend continues to the tip of the continent where haplogroups A and B eventually disappear in Fuegian populations (Llop et al. 1995; Moraga et al. 1997; Moraga et al. 2000).

The absence of haplogroups A and B among the southernmost populations is interesting and could denote a stochastic loss of alleles through time or a separate migration event or process (Moraga et al. 2000). Ancient DNA studies can help identify which of these hypotheses best explains South American haplogroup distributions. Analyses of Precolumbian skeletons from South America, and especially from the southern cone, are important since possible descendants of early Americans found here are less likely to have been admixed by subsequent migrations from the north.

Analyses of eight mummies from Colombia (Monsalve et al. 1994, 1996), dating between 101 and 1750 years, showed a predominance of haplogroup A (n=5), followed by C (n=2), and B (n=1). Another aDNA study of 60 skeletal remains belonging to four extinct Fuegian populations revealed that only haplogroups C and D were present in Patagonia (Lalueza Fox 1996a, b). Lalueza Fox (1996b:50) also reported that Haplogroup B was not found in a 10,000-9500 year old individual from Chile. Haplogroups A and B were also absent from a sample 24 Fuego-Patagonians estimated to be between 4000 and 200 years old (García-Bour et al. 1998). According to some authors, the overall geographic patterns in ancient mtDNA distribution in South America does not support a genetic drift model but rather a "two-wave" migration scenario (Demarchi et al. 2001).

Chapter VII

RECENT STUDIES IN LOWER CENTRAL AMERICA

This section presents results from collections analyses, surveys, and excavations I carried out in Costa Rica and Panama between 1997-2002. Survey areas and site locations are presented in Figures 9 and 10.

Guardiria

I. Setting and Context

The Guardiria site occupies a series of terraces in the Turrialba Valley (700 m a.s.l.) on the Atlantic side of the Costa Rican divide (Figure 11). In 1975, Snarksis (1979:126) found artifacts dispersed on three terraces encompassing 100,000 m^2 on a point of land at the confluence of the Reventazón and Tuís rivers. This ideal location served both as a camp and a procurement area for river cobbles. However, the available cherts contain many large quartz crystal inclusions and are best described as "coarse-grained" (Luedtke 1992:70). Many of the point preforms I examined during my analysis were fractured along macrocrystalline veins or geode pockets, attesting to the unpredictable nature of the stones. Nevertheless, the discovery of 18 fluted bifaces in different stages of manufacture attests to substantial workshop activities at the site. Guardiria contained three types of Paleoindian points: parallel-sided, waisted, and fishtail.

Stratigraphy and Deposits

Plowing at the site has destroyed the stratigraphic integrity of the cultural remains. Paleoindian tools were sometimes found next to ceramic sherds and modern glass was observed at 20 cm below surface (Castillo et al. 1987:20). During his excavations, Snarskis (1979:126) noted that, on average, artifacts were shallowly-distributed between 20-40 cm below surface.

Field Methods

General surface collections and excavations were first carried out by Snarskis in 1975 (Snarskis 1977, 1979). Additional excavations were made 1976, followed by a more systematic and large-scale intervention in 1981 (Castillo et al. 1987). Most artifacts were surface collected and plotted horizontally.

Chronology

The site is located on a seasonally burned sugarcane field, which has precluded the likelihood of obtaining secure radiocarbon dates for its cultural remains. It should be noted, however, that nearly all

Paleoindian points were recovered on the highest terrace which was dated between c.10,000-12,000 ^{14}C yr B.P. by geologist Richard Kesel (Snarskis 1979:126).

2. Technological Observations

Stones collected by Paleoindians from the Tuís River were reduced following a series of specific steps that factored in cobble shape variability to maximize flake and tool production (Pearson 1998, 2002 in press). Reduction of chert nodules started by delivering a transverse blow to one of the cobbles' extremities to create a striking platform. If this did not remove enough cortex, cobbles were struck again to detach a tablet (Figure 12). Blade-like flakes and ridge spalls were then detached from the cores' periphery to eliminate the surrounding cortex. The production of large flake blanks for points and other tools followed decortication. Unidirectional flake removals continued until unrecoverable fractures and/or obtuse angles prevented further reduction. At this point, instead of rejuvenating the original platform, cores were turned over and a second platform was created by striking off their distal end (figure 13). This strategy was observed on many pieces of the collection and is considered diagnostic of this reduction process. Flake production proceeded along this new platform while making greater use of fortuitous angles as cores were reduced to exhaustion. Both the proximal and distal platform preparation segments were, in turn, used as either secondary flake cores or transformed into keeled scrapers and/or planes (Pearson 1998). Another type of core found at Guardiria consisted of a single, large bifacial flake core (Figure 14).

Technological characteristics and formal tools from the Guardiria collections were recorded and then compared to North American Clovis assemblages. Some of the more sensitive or diagnostic Clovis technological attributes and tool forms (Bradley 1982, 1991, 1993; Rogers 1986; Wilke et al. 1991; Morrow 1995, 1996; Frison and Bradley 1999) used for comparisons during my analysis included the presence or absence of:

1. Large bifacial thinning flake overshots (*outrepassés*) and overshot flake scars on bifaces.
2. Ground and isolated platform lobes on the lateral edges of unfinished bifaces.
3. Sequences of large, overlapping thinning flakes traveling beyond the midlines of bifaces.
4. Ground nipple on bases to facilitate fluting.
5. Fluted bifacial preforms.
6. Biface bases broken by reverse hinge fractures (i.e., failed fluting attempts).
7. Squared edges (flat surfaces) on bifaces.
8. Large bifacial flake cores.
9. Blade production (blades, blade cores, rejuvenation tablets).
10. Spurred end scrapers, large scraper-planes, and snubbed-nosed scrapers (*limaces*).

All of the above characteristics were recorded at Guardiria, save the production of blades. Many bifacial preforms were fluted in the early stages of production (Figure 15 and Table 11) (Snarskis 1979, fig. 4) and thinning flake scars showed typical Clovis removal sequences (Bradley 1982), as well as overshots (Figure 16, lower right). Broken point preforms indicate that some flutes were removed from ground nipples.

In addition to projectile points, diagnostic tools included snub-nosed or keeled scrapers, and spurred end scrapers (Figure 17 and Table 12). Large *limace*-like scrapers were manufactured using a tribedral flaking technique on thick flakes and were apparently used as planes considering the great effort flintknappers put into flattening their underside. First, the bulb of force and other irregularities on the ventral surface were removed by retouch. This was accomplished by striking the margins of the tools head-on at low angle in order to detach long straight flakes on the underside of the scrapers (Figure 18). Flintknappers used both longitudinal and transverse blows to flatten these tools, leaving scars unlike those created by battering and hacking. This strategy created large step or hinge fractures on the ventral surface and can be compared to core platform rejuvenation techniques. Second, the dorsal keels were shaped by removing flakes struck from both the ventral face and the dorsal apex. Thick silica sheens were detected on the working edges of some specimens indicating that they were used to process some kind of plant or woody material (Snarskis 1979:131; personal observation 1997).

Formal burins were not identified but numerous snapped and broken pieces were used expediently for the same purpose. For example, a medial segment of what could be a pseudo-fluted FPP (Figure 15f) displayed multiple small step fractures on one of its broken edges, suggesting that it was used on a hard surface.

Despite earlier claims for the presence of blades at Guardiria (Snarskis 1977, 1979), detailed examination of the lithic collection did not reveal any evidence for this type of industry at the site. Artifacts previously described as blades were either blade-like flakes or ridge spalls—both common by-products of flake core reduction. Large blade cores and true prismatic blades, such as those found at several North American Clovis sites (Collins 1999), were not observed in the Guardiria assemblage.

Lake Alajuela (Madden) and Canal Zone (Balboa)

1. Setting and Context

Paleoindian artifacts were first discovered in the Panama Canal Zone in the 1950's (Figure 19 and Table 13) (Sander 1959, 1964; Brown 1971). One Clovis-like and seven whole or broken stemmed fishtail points were collected from the eroding shores of small islands in Lake Alajuela between 1952 and 1976 (see Bird and Cooke [1977, 1978] for a detailed history of early discoveries). The blade of a probable Clovis point was dredged up from the entrance of the Canal near Balboa in 1963 at a depth of approximately 15 m below sea level. Then, in 1988, Ranere and Cooke came across a biface workshop

(Westend site) on an island near Marcelito where one of the most complete fishtail points had been found (Cooke and Ranere 1992:259). This site contained a broken biface and numerous large bifacial thinning flakes. Unfortunately, no diagnostic points were discovered among the debris and investigators could not tell if Clovis-like or FPPs were being manufactured at the Westend site (Ranere and Cooke 2002). Other artifacts of potential significance discovered at Lake Alajuela by avocational archaeologists consist of possible Archaic points (Mitchell 1959), and scraper-planes made on very large blade-like flakes. More recently a possible mid-section of an El Jobo point (Figure 19k) was discovered by Cooke (Ranere and Cooke 2002) among previously collected artifacts from Butler Island where the first FPP was discovered. Since artifacts collected at Lake Alajuela were recovered from secondary contexts on disturbed or exposed surfaces, no radiometric dates have been secured with these finds.

2. Technological Observations

The two Clovis-like points found in the Canal area display the characteristic waisted outlines typical of many Middle American specimens (Figure 19a, b). On the other hand, shoulders on Panamanian FPPs are slightly broader and more angular than classic South American Fell I types, which tend to taper gradually towards the stem (Bird 1969, 1988; Schobinger 1973; Bird and Cooke 1978; Politis 1991). Two small, stubby examples (Figure 19d, f) retained their angular shoulders suggesting that they were resharpened in the haft.

Since projectile points from the Canal area appear to have been broken during use or lost/abandoned in the final stages of production it is difficult to determine with great detail how they were manufactured. Fortunately, a few examples were discarded soon after completion due to broken stems, leaving large surface of their blades untouched by resharpening. Although not pseudo-fluted per se, the points often show remnant scars of the large, flat flake blanks on which they were manufactured. Examination reveals that FPPs from Panama were thinned by removing flakes from opposite margins of blades that overlapped at the midline.

An examination of the large bifacial thinning flakes from the Westend site reveals that flintknappers would either isolate and grind platforms on the sides of bifaces or strike minimally-prepared beveled edges (Figure 20). Two fragments of one such biface were also found at the site (Figure 19i). The symmetry and thinness of the biface indicates that it was not a core but a preform for a projectile point or other tool (Bamforth 2002:65).

Other significant discoveries at Lake Alajuela include spurred tools, a retouched blade, and many large scraper planes or snub-nosed/keeled scrapers (Figure 21, 22 and Table 14). The blade (Figure 21b) is especially interesting and represents the most convincing example of a possible Clovis-like macroblade in Central America. The scraping tools were manufactured on large triangular or trapezoidal blade-like flakes (Figure 22a) and shaped by bifacial or trihedral reduction. Many display the same ventral flattening technique observed at Guardiria in Costa Rica.

La Mula-West

I. Setting and Context

The La Mula-West site was discovered by A. J. Ranere in 1988 (Ranere and Cooke 1991). The occupation lay on a small, elevated point of land along a seasonal stream in the *albinas* (salt flats) which formed in front of a large archaeological site known as La Mula Sarigua on the southern edge of Parita Bay (Figure 23) (Clary et al. 1984; Hansell 1988). Regrettably, deforestation, repeated burning, and erosion has left the terrain around the site resembling a denuded "lunar" landscape. Most of the Paleoindian artifacts found by Ranere and Cooke at La Mula-West had already washed down the hill or lay as lag deposit on the exposed bedrock (Figure 24). However, a small buried portion of the occupation was still eroding out of a cut bank at the back of the hill (Figure 25).

Thus far, about a dozen fluted point fragments and preforms have been recovered, as well as numerous biface fragments, spurred end scrapers, large overshot thinning flakes, and channel flakes (Cooke and Ranere 1992b; Ranere and Cooke 1995,1996; Ranere 2000; Cooke 1998). Accumulations of cryptocrystalline chert, jasper, agate, and chalcedony cobbles are located near the site and were probably the reason why Paleoindians stopped to manufacture tools at La Mula-West. In fact, the geomorphological setting of the site is not unlike that of Guardiria in Costa Rica. Although the stream which runs immediately north of La Mula-West is small today, it was certainly quite large in the past and the accumulations of cobbles found downstream were probably part of its channel bed.

Stratigraphy and Deposits

Excavations along the exposed bank revealed that the fluted material lay in an eroded red clay layer (10-20 cm thick) immediately overlying the bedrock (Figure 26) (Ranere and Cooke 1991). An unconformity above the clay suggests that portions of the site were disturbed sometime in the past and re-buried by mixed (eolian?, colluvial?) sediments. Deposits containing the Paleoindian material appeared to have been part of a gully fill (Ranere and Cooke 2002).

Field Methods

Excavations at La Mula-West began in 1989 with an initial 1 m^2 test pit along the eroding bank. This was followed by several shovel tests on the top of the hill behind the site by Ranere and Hansell in 1990. Since then, the La Mula-West site has been sporadically surface collected over the years.

Chronology

Very little charcoal was present in the basal clay and attempts to date the occupation were unsuccessful as "dates on total organic content of the soils were several thousand years too young" (Ranere and Cooke 1991:249). Soil from above the layer containing the Paleoindian artifacts gave radiocarbon dates of 3730 ± 290, 3060 ± 90, and 2820 ± 80 ^{14}C yr B.P. (Cooke 2002, pers. comm.). A single bulk sediment date of 2700 ± 170 was obtained from the underlying clay. Context and dates indicate that the fluted point material was secondarily deposited in a run-off channel after having laid on an exposed surface.

2. Technological Observations

Over 80 biface fragments, in different stages of production, have been recovered from the La Mula-West site (Figures 27, 28, 29, 30, and Tables 15, 16, 17) (Ranere and Cooke 2002). Similarities between the reduction strategies observed here and those from North American Clovis sites include the fluting of preforms, the use of isolated nipples and occasional guiding channels for basal fluting, and the overshooting of thinning flakes (Ranere 2000). Manufacturing errors such as basal fragments broken by reverse hinge fractures, unrecoverable overshooting scars, and snaps caused by large lateral thinning attempts, show that manufacturing steps at La Mula-West were similar, if not identical, to those associated with Clovis industries.

Except for a few pieces made on jasper (Figures 27d, 29f), all bifacial artifacts were manufactured on local, translucent, milky or root beer-colored agates. Curiously, these often brittle and heterogeneous stones were apparently preferred over the better-quality jaspers and cherts from the same source.

Based on a few late stage preforms (Figure 27a, b), we can infer that the fluted points from La Mula-West had contracting proximal sections and slightly concave or flat bases. None of these specimens show obvious waisted outlines ("lateral indentation", [Morrow and Morrow 1999]) or prominent ears. Nevertheless, at this stage of their production, the points appear different from both parallel-sided Clovis examples and Simpson types from Florida (Goodyear et al. 1983; Daniel and Wisenbaker; Dunbar 1991). A bifacial fragment illustrated on Figure 28g is very small and might represent a miniature projectile point (Storck 1991).

Initial reduction of blanks at La Mula-West was accomplished by removing sequences of large thinning flakes from both sides of the preform. Biface fragments retain many ground edges where platforms were strengthened. Flintknappers used previous arrises and depressions to guide and allow lateral thinning flakes to travel beyond the tools' midline. Scars on broken preforms show that many of these thinning flakes terminated in *outrepassé* fashion. Dorsal scar patterns and thickness of overshots indicate that this technique was used mostly in the first half of the manufacturing process

(Figure 31 and Table 18). Moreover, flat surfaces on distal ends suggest that this may have been used as a strategy to remove square edges on early-stage preforms.

Several types of scrapers and large planes were also collected on the site's surface. Among these, a double-spurred end scraper is certainly the most typologically significant (Figure 32g and Table 19) (Cooke and Ranere 1992b, fig. 5a). At least one of the broken point preforms (Figure 27l) had retouch on its broken edge indicating that it may have been recycled into a scraping or burin-like tool.

An ensemble of bladelets made from a spotted, golden-olive chert was also recovered at the site (Figure 33 and Table 20). The small blades were apparently struck from the same core and represent a single reduction event. Although the core itself was not found, 11 complete or fragmented platform rejuvenation tablets (Figure 34 and Table 21) indicate that it was small (c. 30-40 mm^2). Technologically, the La Mula-West bladelets differ from later Formative period examples, which have large, flat, unprepared platforms. Nor do they resemble the large prismatic blades sometimes found at Clovis sites (Collins 1999). Some of the La Mula-West blades were struck from the base of the core, indicating that it was bi-directional. Another possible blade is illustrated on Figure 33l. This example is made on translucent chalcedony and has a small platform but is unique in the collection thus far.

The dynamic geomorphological processes that have shaped the La Mula-West site are not only visible from its stratigraphic profile but can also be observed on its lithic assemblage. Patination and breaks on artifacts reveal that considerable post-depositional processes were at work at the site. For example the preform shown in Figure 27c is patinated only on its lower half and displays non-contemporaneous breaks (i.e., differential patination on broken surfaces). The presence of uneven patina offers strong corroborating evidence that the site may have suffered from deflation in the past which left objects semi exposed to the elements. The medial fragment illustrated on Figure 28a has an impact on the blade surface, which may have been caused by trampling or other post-depositional force. Another interesting characteristic of the La Mula-West assemblage concerns the high percentage of artifacts displaying yellowing, potlids, crenated (transverse) fractures, and/or crazing as a result of being exposed to flames or intense heat (Purdy 1986; Patterson 1995). Since these marks are present on the surfaces of broken preforms and points they cannot be attributed to heat treatment (Rondeau 1995). For example, one broken point (Figure 27d), made on what appears to be an unusual brown chert, has large potlids, has a waxy luster, and shows signs of crazing. This artifact was most likely made from red jasper which later came in contact with flames. Exposure to extreme heat has transformed the La Mula-West lithic assemblage into a collection of shattered bits and pieces. The majority of fragments show that preforms and nearly complete projectile points broke in three or more pieces. Although the presence of "burned" artifacts on such a scale might suggest that we are dealing with grave goods or offerings (cf. Deller and Ellis 1984), the fact that the La Mula-West assemblage is dominated by unfinished projectile points implies that they were discards. Regrettably, it is difficult to determine if these alterations are contemporaneous with the Paleoindian occupation or a consequence of later fires.

It should be mentioned that east of La Mula-West, investigators found an Archaic locality which was designated as La Mula-Central (Figure 23). Artifacts recovered in this part of the *albinas* consisted of corner notched stemmed points characterized by wide blades (Hansell 1988; Cooke and Ranere 1992b; Ranere and Cooke 1996). Unlike la Mula-West, however, the majority of tools at this locality were made from jaspers. Additional Archaic artifacts and other bifacial tools were discovered during a small reconnaissance of the La Mula Sarigua area which I conducted in 2000. Among them was a discarded bifacial preform and a uncommon stemmed point (Figure 35a, b and Table 22). The base of an unfinished (lanceolate?) point made on green chert was also found on the surface at some distance further east (Figure 35c). Interestingly, this fragment shows that the ancient flintknapper thinned the piece by removing the flake blank's bulb of force by an oblique blow next to the platform. The last of these recent discoveries was found in a private collection and consists of a thick biface made on translucent chalcedony (Figure 35d). The object in question was apparently discarded after a series of blows to remove a high mass failed and broke the piece. It is a unique-looking artifact and is not readily assignable typologically or chronologically.

Lake La Yeguada

1. Setting and Context

Lake La Yeguada is located 650 m a.s.l. in Veraguas Province on the Pacific side of the Continental Divide (Figure 36). The lake's dimension varies annually between the dry and rainy seasons. Its level has been artificially raised since the 1950s by the construction of dykes. At the end of a normal wet season, it measures 1.5 by .75 km and fluctuates in depth from 15 to 6 m (Bush et al. 1992). Today the lake is surrounded by a protected, reforested pine reserve (Figure 37).

The archaeological potential of the La Yeguada area was first tested in 1985 during the PSM survey (Cooke and Ranere 1992b). The investigation recovered a broken bifacial stemmed point (Figure 38a and Table 23, see also Ranere and Cooke 1996, fig. 3.4e) on the lake shore, indicating that early occupations were present at La Yeguada. A subsequent palynological study (Piperno et al. 1990, Bush et al. 1992; Piperno 1993) revealed a sudden increase in particulate carbon in the lake's sediments c. 11,050 yr B.P. accompanied by secondary growth (i.e., *Heliconia*). This combination of proxy records suggested that Paleoindians were repeatedly burning the surrounding vegetation either to attract game, facilitate the growth of favored plants, and/or to clear areas for camps.

As part of a follow-up project, I conducted a more comprehensive survey in 1999, aimed at locating early Preceramic sites along the shores of the lake and the surrounding mountainous zones

(Hall 1999; Pearson 1999a, 2000a, b). The main objective of this project was to verify if other groups had frequented the area during late Pleistocene-early Holocene times and assess the age, density, and nature of these occupations. In addition, since Lake La Yeguada formed c. 14,000 yr B.P. ago (Bush et al. 1992), it presented a good opportunity to search for possible pre-Clovis sites associated with early colonists who might have ventured into the Panamanian highlands.

Field Methods

Using topographic maps, aerial photographs, and visual reconnaissance, I was able to identify zones of high potential for investigation. Surface collecting and sub-surface testing were conducted systematically to sample the widest possible area. Sectors most suited for campsites, such as the mouths or confluence of streams, rockshelters, and zones where lithic materials were exploited were tested more thoroughly. Other locations such as knolls, promontories, or points which may have served as strategic lookouts were also examined. All excavated sediments were sifted with one quarter (1/4) inch mesh screens. Active prospecting for knappable stones along exposures, stream beds, and gravel bars was carried out in conjunction with the survey.

More than thirty aceramic localities were discovered during this two-month survey (Figure 39) (Hall 1999; Pearson 1999a). This included isolated finds, open air sites, quarry/workshops, rockshelters, and numerous lithic material sources.

Quarry/Workshops

The 1999 investigation located ten quarry/workshop sites (Q1 to Q10) associated with three different types of lithic materials. Quarry dimensions were quite large (e.g., Q1 = 61 x18 m, Q2 = 65 x 54 m) and were found on denuded or poorly vegetated knobs of volcanic bedrock.

Quarry sites consisted of dense surface scatters of manufacturing debris, cores, as well as finished and unfinished implements (Figure 40). Given that this wealth of material represented several millennia of deposition from the time the sources were first discovered by humans, only the artifacts considered diagnostic were collected from the surfaces. These included several broken bifaces, bifacial thinning flakes, spurred end scrapers, keeled scrapers (*limaces*), large scraper planes, and a stemmed point. Some of the bifacial fragments were so weathered as to be completely porous and almost unrecognizable compared to the majority of the surficial material. Interestingly, the only specimens manufactured on non-local stones were also those considered to be possible Paleoindian tools based on technological attributes.

Test pits were also excavated near some quarry sites in hope of finding stratified assemblages. Buried debris was as rich as that found on the eroded quarry surfaces. Over 660 lithic artifacts were unearthed in a single 50 cm^2 test pit (40 cm deep) just north of Q1.

Rockshelters

Four rockshelters were discovered during the survey. These consisted of very large (car size to house size), free standing, erratic-like, volcanic boulders that afforded protection against the elements. Although artifacts were found on the ground around them, only the largest (hereafter referred to as BRS) was partially excavated (Figure 41). Two test pits (1 m^2 and 1 x .5 m), were excavated to a depth of 1.2 m and provided over 1500 lithic objects (Figure 42). Artifacts were encountered in the topmost, highly weathered horizons (0-40 cm below surface, Figure 43). The underlying hard clay was culturally sterile. Charcoal samples were collected but have yet to be analyzed. Abutting the side of the BRS shelter was an accumulation of stones which appeared to be a burial (Feature 1). Upon excavation, however, it was discovered to be a pile of rocks and sediments that contained prehistoric artifacts and modern objects.

Lake Shore

Beaches around the lake's periphery were scoured for artifacts as the water level gradually dropped. Among the artifacts recovered on the exposed shoreline was a concentration of bifacial thinning flakes of non-local chert and a projectile point preform (see below).

Other Sites

Sites in this category include lookouts, mountain tops, deflated surfaces, cut banks, isolated finds, etc. The most common diagnostic artifacts found at these localities were bifacial thinning flakes.

Lithic Sources

An abundance of lithic materials was found in the immediate area surrounding the lake (Figure 39). Sources on the northern shore of the lake (Q1-Q4, Q6, Q7) contained high quality nodules of volcanically metamorphosed cryptocrystalline jaspers of various colors (red, yellow, caramel). To the northwest, boulders of an off-white to gray chert (rhyolite?) were found mixed with the ubiquitous jaspers (Q8-Q10). The fifth quarry site (Q5) was found on an eroded surface on the western side of the lake where large boulders of a banded blue-black chert where exploited. Finally, nodules of olive-brown chert and yellow jasper were found eroding out of the southern banks of the lake onto the beach.

2. Technological Observations

The stemmed point collected on the shore in 1985 resembles specimens discovered at Florencia-1 in Costa Rica (Acuña 1983, 2000; Cooke and Ranere 1992b; Ranere and Cooke 1996). These Costa Rican points are believed to be early Archaic based on their overall appearance. However, this is difficult to determine since many stemmed points in South America have been shown to pre-date the Holocene (Roosevelt 2002). A second, slightly different, stemmed point was discovered at Q1 during the 1999 survey (Figure 38b). This newest example was fashioned on a jasper flake and has a flute-like thinning scar on one side of its broken base. The point recalls Broad Stemmed examples from El Inga in Ecuador (Bell, 1965; Mayer-Oakes, 1986a) and La Elvira in Colombia (Illera and Gnecco, 1986; Gnecco and Illera, 1989).

A tabular bifacial preform was also collected on the surface of Q1 (Figure 38d). Three square edges were still remaining when the piece was abandoned. It is possible to see how the ancient craftsman tried to eliminate these difficult edge angles by delivering blows on the opposite margins to overshot flakes or by hitting the preform longitudinally to detach ridge spalls.

Another important find was the base of a possible willow leaf-shaped point at Q2 (Figure 38c). The object has a biconvex cross-section recalling El Jobo and Monte Verde points (Cruxent 1956, 1962; Bryan et al. 1978; Ochsenius and Gruhn 1979, Dillehay 1989:15).

On the northern shores of the lake (Beach-2), the distal half of a projectile point preform was discovered during the peak of the dry season (Figures 38f, 44a). Several interesting technological observations can be made from this fragment. First, it displays the scar of a large flute-like end thinning removal suggesting that early stage fluting may have been a strategy employed by its maker (Note: The preform snapped as a result of a strong blow at the base that may represent a second fluting attempt). Second, It appears to have been made on a thin flake considering its width/thickness ratio (5.4) and the shape of its cross section (Callahan 2000). Third, it shows what seems to be a failed overshooting attempt possibly aimed at removing a remnant flat surface on the opposite edge. Unfortunately, the base was not found and a firm typological characterization is difficult.

On another exposed section of the lake shore (Beach-1), was a scatter of bifacial thinning flakes with pronounced lipped platforms (Figure 44b). On the dorsal surface of one of these flakes was a large hinge fracture scar from a previous longitudinal end-thinning removal (Figure 38g). It thus appears as if this particular bifacial thinning flake was struck in order to remove the hinge left by a channel flake (Bradley 1991:373, 1993:254). Amidst this scatter was a complete overshot flake which removed a considerable portion of an opposing square edge (Figure 38h and Table 18). It is interesting to note that many of the bifacial thinning flakes from the scatter were discolored and potlidded as a result of being exposed to intense heat.

The distal fragment of another overshot was recovered in Feature 1 at the BRS shelter (Figure 38i). Although very little is left of this flake it is significant that it also terminated on a square edge. A three-sided edge-ground cobble was discovered 36 cm below surface in the 1 m^2 test pit indicating that the rockshelter may have been occupied as early as 6000 to 7000 yr B.P. (Ranere and Cooke 1996). Phytolith and starch grain studies have shown that edge-ground cobble were used to prepare several cultigens, such as yuca, arrowroot, and maize (Piperno and Holst 1998; Pierno et al. 2000), and were widespread in late Preceramic and early Ceramic sites in Panama (7000-2500 ^{14}C yr B.P.). Some examples were recovered in the basal layer of the Carabalí shelter, which appear to go back to at least 8000 ^{14}C yr B.P. (Valerio-Lobo 1987).

Several scraper-planes and spurred end scrapers were also found among the lithic debris of the quarry/workshop (Figure 45 and Table 24). Again, many of these large tools had scars on their underside where flintknappers tried to flattened the ventral surface of the flake blanks. A double spurred end scraper, manufactured on a triangular blade (Figure 45c), was discovered on the surface of a deflated terrace overlooking the Barrero Valley to the west of the lake. It is made on an exotic white chert (patinated?) and shows evidence of having been hafted. Typologically, this isolated find falls within Paleoindian tool categories and could constitute more evidence of early blade making in Middle America.

Preliminary observations, based on the lithic artifacts recovered at Lake La Yeguada, corroborate the paleoecological interpretation which attributed the sudden appearance of burned phytoliths in the lake's deposits to early human agents. In all, new evidence for bifacial industries were found at sites Q1, Q2, Q3, Q7, BRS, Beach-1, Beach-2, 18, and on the summit of Cerro El Castillo. It is safe to assume that Paleoindians would have been attracted to this area due to an abundance of high quality lithic materials. In addition, albeit smaller at the time, the lake was certainly a vital source of fresh water for both humans and animals during the extended dry seasons of the Pleistocene (Bush et al. 1992; Piperno and Pearsall 1998).

Nieto

1. Setting and Context

The Nieto quarry/workshop is located on the Azuero Peninsula (124 m a.s.l.) approximately 10 km northwest of the town of Pesé (Figure 46). The site was discovered at the beginning of my 2000 survey and was investigated concurrently with the Llano Hato megafaunal locality which is situated half a km to the south. The Nieto site surrounds an exposed vein of gray-white, translucent cryptocrystalline quartz that juts from the summit of a small hill (Figure 47a, b). This outcrop forms a pillar-like wall (1 m by 10 m) that is flanked on both sides by steep colluvial slopes containing a large amount of cultural and natural lithic debris.

Not surprisingly, the majority of artifacts found at Nieto consist of cores, core fragments, flakes, and shatter with occasional broken tool preforms, flake blanks, and some finished implements. With the exception of a few bladelets and small blade cores, none of the material recovered can be ascribed to later Preceramic or Ceramic cultures. Clovis-like point preforms (Figures 47c, 48 #1) and other diagnostic tools found among the manufacturing debris indicate that Paleoindians frequently visited this source to procure translucent stone.

Although the hill is vegetated with trees (*Curatella americana*) and shrub, ongoing erosion due to heavy rain and cattle continually disturb the cultural deposits. Flakes and other manufacturing detritus were strewn on the surface as well as within colluvial deposits along the incline and at the base of the outcrop.

Field Methods

Test excavations were carried out on the north-facing slope of the quarry where a projectile point preform was picked up (Figures 49, 50). All excavated sediments were sifted with one quarter (1/4) inch mesh screens. Surface collections were more extensive and covered the entire knoll and immediate area. All tools, cores, and bifacial thinning flakes were mapped.

Stratigraphy and Deposits

Thickness of deposits varied from a few centimeters closest to the exposed vein to more than 40 cm at the base of the hill. Sediments containing cultural material were homogeneous and did not show clear weathering horizons (Figure 51). Although artifacts were encountered throughout the main excavation area, a great majority were found in a 10-15 cm-thick buried concentration (c. 20 cm below surface), which appeared to represent an old surface. Tests pits were also dug further north and east, following the slope of the hill. These units were slightly deeper but culturally poor and helped delineate the northern limit of the site.

Chronology

Charcoal samples were not collected due to the shallowness of the deposits and the risk of contamination from annual slash and burn cultivation around the site.

2. Technological Observations

The first diagnostic artifacts discovered at the quarry were bifacial thinning flakes (Figure 52a) and a Clovis-like point preform which alerted us to a possible late Pleistocene exploitation of the outcrop. The point preform (Figure 48 #1 and Table 25) has a sinuous edge due to uncorrected deep concavities left by the initial lateral thinning removals. Initial thinning and shaping has completely removed all traces of the original flake blank's surface. Significantly, several isolated and ground platform lobes are still visible on the blade's edge. On one side, the distal end of what appears to be a flute or large end thinning scar is visible just above the break. The Nieto preform could be described as a stage 4 biface following Callahan (2000) or more precisely a stage 4.1 according to Morrow's (1996) reduction scheme. Overshot thinning flakes, commonly encountered in other Clovis-related workshops, have not yet been discovered among the manufacturing debris at Nieto. A possible explanation for this could be the low quality of the lithic material that caused many thinning flakes to terminate prematurely or break. The flaking pattern indicates that flintknappers attempted to drive long flakes past the preform's midline but were rarely successful. Although the crystalline qualities of the lithic material at Nieto is aesthetically pleasing to the eye, its heterogeneous structure makes it highly unpredictable and an inferior stone for flintknapping purposes. Many of the shatter pieces and tool preforms displayed breaks along linear impurities and larger quartz inclusions. Most intriguing is the fact that the area around Nieto contains many sources of good quality cherts devoid of bifacial material.

Less then a meter north of the preform we found the base of a second unfinished projectile point (Figure 48 #3). This unground segment displays several longitudinal thinning scars or possible guiding channels and a slight nipple suggesting that it was probably being prepared for fluting. Evidence for the manufacture of another point was provided by the discovery of a channel flake mid-section of different color (Figure 48 #6). Especially interesting was a tool with a broken, bifacially-worked distal end made on a blue-green chert blade-like flake (Figure 48 #2). No debitage of this material was found at the site, suggesting that it may have been brought to the quarry and left behind after retooling (Gramly 1980). Other common artifacts included large retouched flake blanks used for the production of bifaces or projectile points. Most of these preforms broke in the initial stage of production. The majority are proximal ends that have retained parts of their platforms. A recurring pattern shows that bulbs of force were removed at the very beginning of the reduction process by a series of oblique blows at the edge of the blank's platform. This strategy flattened the ventral sides of blanks and gradually removed the square edge of the platforms. Attempts to remove bulbs of force using this technique are visible on artifacts depicted in Figure 48 #2, 7, 11, 12, 13. In other instances, where the bulbs of force were diffused, flintknappers concentrated their efforts on flattening the dorsal sides first (Figure 48 #10, #16).

Several possible blades and/or blade-like flakes were discovered during the investigation and are presented on Figure 52 and Table 20. These are tenuous examples and are presented here only because very little is known of this type of industry in Middle America during Paleoindian times. It should be noted, however, that blade cores, platform rejuvenation tablets, or other evidence of a true macroblade industry were absent at Nieto.

A concentration of large, blocky cores (Figure 53 #22) associated with equally large flakes were discovered on the southern side of the quarry and are probably representative of a flake blank production area. Other important finds included large flake cores and platform rejuvenation tablets (Figure 53 and Table 26) exhibiting identical reduction steps as those from the Guardiria quarry/workshop in Costa Rica (Pearson 1998, 2003). What is surprising is that this particular "cobble" reduction technique was applied to tabular or blocky chunks of primary-source lithic material at Nieto. One core base showed an additional reduction step that consisted of splitting it in half to create new fresh edges (Figure 53 #28). Flakes were then removed from the corners of these cortex-fee surfaces.

Among the finished tools were numerous gravers or spurred tools, denticulate scrapers, spokeshaves, keeled or snubbed-nosed end scrapers, large scraper planes, and several side scrapers (Figure 54 and Table 27). Both single and multiple spurred gravers were found at Nieto. Many appeared to have been broken in use then discarded. Large scraper planes displayed the characteristic ventral flattening retouch. One example revealed an interesting manufacturing error caused when the maker struck the tool at very low angle. Instead of removing a tablet-like flake on the underside, the blow broke off a section of the dorsal surface (Figure 54 #62).

Figure 55 show the horizontal distributions of all important finds at Nieto. The wide range of tools dispersed around the outcrop demonstrates that Paleoindians did more than simply stock up on rocks when they visited the source. Many of the artifacts found at the quarry were probably expediently-made for on-site tasks. Bands may have erected more permanent, seasonal occupations near the El Jobo creek just west of the quarry but it is unlikely that they camped on the knoll itself.

Cueva de los Vampiros

I. Setting and Context

Cueva de Los Vampiros formed in an inselberg (Cerro El Tigre), located approximately 3 km from the mangrove-lined coast of Parita Bay (Figure 23, 56a). Both the Pacific Ocean and the Santa Maria river can be seen from the site. The cave is part of what appears to be a complex of cavities and interconnecting tunnels that have dug into this isolated geological feature. The site was discovered twenty years ago during the PSM survey (Cooke and Ranere 1984). Cooke, Ranere, and Weiland excavated two test pits in 1982. The first (TP1) was placed under the present overhang while the second (TP2) was put 4 m below on the talus slope (Figures 57, 58). TP1 was dug to a depth of c. 2.8 m until excavators were impeded by a large buried roof fall. Deposits in TP1 indicated that that cave was occupied in at least two major phases. The lowermost, aceramic levels were found under a hard compact surface which was buried under more than a meter of ashy deposits containing layers of shell and fish bones (Cooke and Ranere 1984, fig. 6). Excavations in TP2 were also impeded by boulders and could not reach bedrock. Although initial testing did not uncover diagnostic Paleoindian tools in 1982, the discovery of bifacial thinning flakes associated with a date of 8560 ± 160 (Beta-5101) hinted that earlier occupations might be found below.

At the time of the PSM survey, the inselberg was surrounded by an extensive salt flat. Since then, the entire area has been partitioned into large aquaculture tanks. Heavy machinery was used to remove a considerable amount of earth around the inselberg to construct roads and levees for the shrimp farm. Several meters of soil were thus scraped off and carted away from the slope and base of the talus, destroying parts of the upper archaeological levels (Figures 56b, 57). At Richard Cooke's suggestion I initiated a follow-up research and rescue project at Vampiros with the assistance of Robert A. Beckwith and Diana Carvajal. New excavations were carried out at the cave between January and May 2002. The goals of this new investigation were two-fold:

1. Expand the old test pits, allow more room to maneuver, and attempt to go around roof falls.

2. Excavate down to bedrock and determine if older occupations were present.

Both objectives were met during the re-excavations. Sizeable sections of roof fall were encountered once more but excavations were able to proceed in spite of obstacles. Most noteworthy was the discovery of a fluted point assemblage just above bedrock in TP1. Artifacts associated with this occupation were found lying on or immediately above a hard compact and platy surface, which may have been a living floor. The only object recovered in TP2 was a projectile point tip, also lying close to bedrock. Analyses are ongoing and results presented below must be interpreted as preliminary.

Stratigraphy and Deposits

1. Test Pit No. 1 (TP1)

Two major stratigraphic zones form the deposits in TP1 (Cooke and Ranere 1984, fig. 6). The upper 1.5 m contain a series of superimposed layers of shell, fish bones, hearths, and numerous post holes within an ashy, eolian matrix (Figure 59 and Table 28). This anthropogenic accretion overlies the lower, more complex depositional zone, which is characterized by a loose, dark brown sandy loam at the back of the cave (Unit 2) and a mixed layer of cemented clay and rubble along the drip line (Unit 1). Table 29 presents results of a geo-chemical analysis of sediments from Unit 2, which contained the Preceramic occupations.

The upper and lower deposits are separated by a compact and indurated crust which sealed the lowermost sediments (Unit 7). This hard floor was formed by Formative period occupants who began the steady build up of ash and cooking refuse. The absence of roof fall in the upper levels indicates that the two stratigraphic zones also mark a major depositional and environmental change in the history of the cave. Indeed, the interface between both traces an important unconformity.

Radiocarbon dates show that reoccupation of the cave by fishing groups followed an extensive hiatus, probably related to the environment and the position of the migrating shoreline. More revealing is the fact that krotovinas in Unit 1 were filled with sediments other than the overlying ashy deposits. It is difficult to determine if the chronological gap and the smooth horizontal interface resulted from deflation, a stop in deposition, human modification and trampling, or a combination of these factors.

2. Test Pit No. 2 (TP2)

The upper deposits of TP2 are basically a downslope extension of the human-made refuse found under the cave's roof (Figure 60 and Table 30). Two important differences were noted. First, since the talus was an obvious toss zone (Binford 1978), shell and bone deposits on the incline are thicker and more accurately resemble a shell midden. Second, while the sediments on the talus are also very ashy, they did not contain layers of clearly-defined and superimposed hearths.

Immediately under these shell deposits, in the southern half of TP2, was a one-meter-thick accumulation of extremely loose rubble (Unit 6). This culturally-sterile layer was composed mostly of rounded boulders and cobbles, held precariously together by an unconsolidated matrix of sandy silt. This deposit corresponds to Unit 1 in TP1. While it is still early in the investigation, preliminary evidence suggests that the rubble represents a rapid, perhaps catastrophic, rock fall (*éboulis*). The most likely scenario would be that the brow collapsed bringing with it a large amount of sediment and rock from above. Looking at the stratigraphic profile, the rubble appears less like a stratum and more like a vertically-inserted disturbance. Several clues support this interpretation. First, the deposit is made of rounded stones of a different lithology than the more angular roof fall found underneath it. Second, the rubble begins at the drip line and ends in TP2 where it was apparently stopped by a large boulder (removed during the excavations). Third, the rubble is localized and appears to have penetrated into the underlying softer, dark brown sediments which surrounds it. This sandy loam covered the Paleoindian artifacts and is present under the cave roof in TP1 (Unit 2) and on the other side of the boulder that shielded it from the tumbling rocks in TP2 (Unit 8). Moreover, when viewed in profile on the west wall, Unit 1 forms an intrusive slope and not a dome as would be expected if Unit 2 had not already been in place. Fourth, the rubble was deposited during the hiatus, which adds support to the idea that a major ecological reorganization was taking place at the time. Finally, it is culturally-sterile and thus may not represent a gradual process of accumulation but a rapid event.

Below the rubble was a layer of light orange sand and pebbles (Unit 7). The underlying bedrock (Unit 9) was composed of large, tightly packed, polished boulders. Interstices between these rocks were filled with beach sand and gravel. This evidence suggests that the Santa Maria or one of its arms may have flowed at the base of the site or that the inselberg was once surrounded by the sea (Barber 1981). Determining the precise causes of this apparent hydrological event will require careful sedimentological analysis and additional fieldwork. The causes may be either marine or fluvial. During the Holocene marine transgression, the active shoreline must have been at the edge of Cerro El Tigre at some stage. Sediment cores taken from the El Tigre and Monagrillo albinas en the 1970s and 80s led to the reconstruction of a hypothetical facies model for local transgression, sedimentation, and delta formation (Clary et al. 1984). This model proposes that the sea transgressed over Parita Bay until about 7000 ^{14}C yr B.P., at which date the active shoreline was 2-3 km inland from Cerro El Tigre. Subsequently, the Santa Maria began to build its delta seawards. During the last 4000 years, when sedimentation would have been accelerated by inland agricultural activity, the coast has advanced at about 1 km every 1000 years. Probably the site's use as a fishing camp for smoking and drying coincides with a shoreline position. Scrutiny of air photos suggests that the current channel of the Santa Maria, which now lies just to the south of Vampiros, actually flowed north of it for a long period of time. Therefore the basal evidence for water sorting could be a result of encroachment of a river channel rather than marine input.

Field Methods

Test pits 1 and 2, which originally measured 1 x 2 m and 1 m^2, were broadened to 3 x 2.5 m and 3 x 2 m respectively (Figure 57). Excavations in the lower stratigraphic zone of TP1 followed 5 cm arbitrary vertical levels. All sediments were first dry sifted with 1/16 inch mesh screen in the field and then wet screened at the lab.

Chronology

Radiocarbon dates from both the 1982 and 2002 investigations are presented in Table 31. Occupations in the upper stratigraphic zone appear to span 2500 radiocarbon years between 3800 and 1265 ^{14}C yr B.P. A hiatus of approximately 4000 radiocarbon years seems to separate the last occupation of the lower zone and the oldest one in the upper stratigraphic section. The 7690 ± 40 (Beta-166504) ^{14}C yr B.P. date was measured on charcoal recovered from a hearth feature 20 cm below the hard floor separating the two major stratigraphic zones (Figure 59). This date also establishes a *terminus post quem* for the catastrophic rock fall described above (Unit 1). The lowermost occupation associated with the fluted point is bracketed between c. 11,500 and 9000 ^{14}C yr B.P. Artifacts in the northern half of TP1 were found directly under the rubble at the interface between unit 2 and 3. Flakes and tools found at the back of TP1 were resting on, or just above the hard platy surface on top Unit 11. A bulk sediment sample was collected under this 5 cm-thick crust on the south wall and gave a date of 11,550 ± 140 ^{14}C yr B.P. (Beta-167520). Another bulk sediment sample, taken 60 cm below the platy floor in Unit 14, was dated to 15,190 ± 60 (Beta-166594).

Charcoal sample Beta-166506 (9100 ± 40 ^{14}C yr B.P.) was associated with a reddish patch of sediment first believed to have been from a hearth under the platy floor. However, a close examination of the profile wall revealed that the red discoloration traced a krotovina that had penetrated into Unit 11. Hence, this date is associated with the subsequent filling in of the krotovina and is stratigrafically out of place. Charcoal sample Beta-165620 (8680 ± 40 ^{14}C yr B.P.) was recovered under the rubble on the other side of the drip line. This date is contemporaneous with Beta-5101 (8560 ± 160 ^{14}C yr B.P.) collected in 1982. It should be noted, however, that this original date was derived by combining four charcoal samples separated by a vertical distance of 61 cm (Cooke 2002, pers. comm.). Since no other hearth features were identified in the lower half of Unit 2, it is impossible to determine if the charcoal was anthropogenically produced or was deposited by wind and/or rain.

2. Technological Observations

Vertical distribution of Preceramic artifacts from the undisturbed southern section of TP1 suggests that the cave was occupied during two major phases (Figure 61). The first concentration was associated with the fluted point found just above bedrock while the second pulse appears to be associated with the 7690 ^{14}C yr old hearth. Unfortunately flakes were the only objects associated with this hearth feature. All of the important artifacts recovered from the Preceramic levels are presented in Figure 62 and Tables 32, 33.

Three tool fragments, found between the hearth and the fluted material in TP1, may represent another (Archaic?) occupation. The artifacts include a longitudinally-split thumbnail scraper (Figure 62a) and two bifacial fragments (Figure 62b, c). Of note, fragment 62 b resembles the broken ear of a projectile point. The thumbnail scraper was found 52 cm below the surface of Unit 1 in the eastern section of N101 E99 where the deposits of Unit 2 are thick and fairly undisturbed. However, the two bifacial fragments were discovered in the mixed rubble layer to the north and were probably not in primary context. In fact, the few artifacts recovered in Unit 1 were located in krotovinas. Future excavations in the undisturbed sections of the cave will help determine if this intermediate occupation is real or a product of post-depositional mixing.

The lowest component contained three projectile point tips (Figure 62e-g). Fragments 62e and 62f were found in TP1 while 62g was recovered at the interface between Unit 7 and 9 in TP2. A scar on fragment 62e may have resulted from impact with a hard surface. This shattered piece was made on a white and pink stone from an unknown source. Fragment 62f broke just under the distal end of a flute scar (Figures 62, 63b, c). The tip is made of yellow jasper and displays some post-fluting retouch. The blade is sinuous and lacks marginal shaping retouch suggesting that it may have been a late-stage preform. Alternatively, it may have broke while it was being resharpened. The third example, unearthed in TP2, is made of red jasper. It does not exhibit a flute and may have broke when the flintknapper attempted to remove a high mass left by a coarse grained pocket in the material. All point fragments are remarkably thin and their cross-sections indicate that they were most likely made on thin flake blanks. It is interesting that projectile point bases were not recovered during our investigation. Although, this could be a sampling problem, it might also be related to the types of activities undertaken at the site. For example, it is not certain that the tips broke during manufacture. They may have broken in used and were brought to the site while still embedded in meat packages (Hofman 1986), or perhaps Paleoindians hunted animals in the cave itself.

We recovered three overshot bifacial thinning flakes in TP1 (Note: A fourth was found during the 1982 excavations [Cooke and Ranere 1982:10]). Two of them display square edges on their distal ends similar to examples from sites discussed above (Figure 62h, i). The fourth overshot was found in the northern section of TP1 and was associated with large bifacial thinning flakes of the same mottled gray chert (Figure 62j-n). It is significant that four overshot thinning flakes made on three different types of lithic materials were scattered in an area measuring 2.5 by 3 meters. It indicates that they were not the products of isolated accidents but rather repeated flintknapping behavior.

In addition to the bifacial pieces were several retouched flakes and scrapers. One end scraper had a broken lateral spur and was found lying next to a cobble decortication flake and the fluted point (Figures 62p, u, 63d, 64, and Table 19). Additional finds included a possible macroblade mid-section (Figure 62t) and a small core base rejuvenation section (Figure 62v).

In all, 133 flakes, 12 tools, and 1 core fragment were found in the lower stratigraphic zone of TPs 1 and 2 in 2002. Surprisingly, at least 24 different types of lithic materials were represented in this small assemblage. Cortical flakes totaled 14% of the entire collection and revealed that stones were brought to the site in cobble form. Most common were red (37%) and yellow (19%) jaspers, followed by cherts, and the same translucent agates/chalcedonies found at La Mula-West. Another common pattern observed on the lithic assemblage from Vampiros was a high incidence of potlids and potlid scars (15%). Because this assemblage was found in a buried context it provides support to the idea that similar heat stress fractures on the La Yeguada and La Mula-West artifacts were contemporaneous with these occupations.

Finally, it should be noted that faunal remains were not present in the lower levels of the test pits. Although, our fine mesh wet screening technique was able to recover 35 microdebitage fragments, small mammal bones were not observed. This situation casts doubts on the purported antiquity of fish bones found in the Preceramic levels in 1982 (Cooke and Ranere 1989, 1992a).

Other Sites

1. Setting, Context, and Technological Observations

Important artifacts of Paleoindian or Archaic affiliation were also recovered at other sites during the PSM survey (Cooke and Ranere 1992b). Although the majority were bifacial thinning flakes from surficial lithic scatters, two projectile point tips were later recovered during follow-up excavations. The first was found in a disturbed context at the Corona rockshelter (Figures 11, 63a and Table 32) (Valerio-Lobo 1985). It is made on red jasper and has deep potlid scars. This point is believed to date between 7000 and 10,000 ^{14}C yr B.P. (Cooke and Ranere 1992a; Ranere and Cooke 1996:58). The second point comes from the Aguadulce rockshelter (Figure 63b). This example was also made from red jasper and bears a striking resemblance to the Vampiros specimens. While, this point was also found in an insecure stratigraphic context, new AMS analyses on phytoliths indicate that the cave was probably occupied as early as 10,700 ^{14}C yr B.P. (Table 4) (Piperno et al. 2000). This date and another of 10,500 ^{14}C yr B.P were recovered in the basal red zone at the site which contains several thinning flakes (some with ground platforms) from bifacial tool reduction.

Other interesting tools found during the PSM survey included several large finely retouched scrapers (Cooke and Ranere 1992b:255). Among them was a trianguloid, Clovis-like end scraper (cf. Morrow 1996, 1997) made on red jasper, picked up on the surface of site SA-27 (Figure 63c and Table 19) (Cooke and Ranere 1992b, fig. 5h). Finally, Haller's (2003) recent pedestrian survey of the Parita River drainage discovered two Preceramic artifacts. One is a bifacial fragment (Figure 63d) made from a light purple chert while the other is a large bifacial thinning flake that removed a square/flat section on the opposite margin (Figure 63e).

Chapter VIII

DISCUSSION

Although the collections of artifacts presented in the previous section constitute a small sample, several important observations can be made. The following discussion examines the salient technological and typological characteristics recorded thus far. One of the aims of my analysis is to understand the organization of Central American Paleoindian technology and how it was influenced by and, in turn, affected settlement patterns, economy, mobility, lithic procurement strategies, and even social activities. Information gathered from these assemblages is also compared to North and South American fluted point industries in hopes that it might shed light on their potential biological and/or cultural affinities. In attempting to make sense of the variability, I have decided to take a two-part approach to the problem. First, I examine the nature of the North and Central American historical relationships and cultural interactions. Based on these observations, a second assessment is carried out, this time examining the Central and South American connections. It is important to remember that the current paucity of data in our research does not permit the analytical process to venture beyond simple pattern recognition and the postulation of low-level hypotheses to explain them. Nevertheless, the ideas put forth below merit exploration and should guide future research.

Technological and Typological Characteristics of Lower Central American Late Pleistocene-Early Holocene Lithic Industries

Central American Paleoindian lithic assemblages can be described as flake core industries. Flake and blade-like flake blanks were used for a wide-range of tools and projectile points. Blanks were struck from primary and secondary source lithic materials following a distinct core reduction technique that removed core bases to create new striking platforms. Discarded core bases were found at Guardiria, Nieto, and Vampiros. With the exception of the Vampiros example, all were surficial finds, making it difficult to determine if this type of technique was used exclusively by FPP, Clovis-like, both, or later groups.

As I have explained in previous chapters, prior analyses of Paleoindian tools from lower Central America have concentrated on differences in the ways in which lanceolate and stemmed points were manufactured (Bird and Cooke 1978; Ranere and Cooke 1991). Judging from the preforms recovered at La Mula-West and Nieto, Clovis-like points were manufactured on large and relatively thick flake blanks. Early stage reduction (Stage 2 or edging [Callahan 2000]) consisted of; 1) flattening the ventral side of blanks by removing their bulb of force and striking platform (Hester 1972:94); and 2) removing high ridges on dorsal surfaces by detaching a series of thinning flakes around the periphery of the piece. Hence, before true bifacial flaking began, a number of early stage preforms may have appeared like unifacial tools with a plano-convex cross sections (e.g., Callahan 2000, fig. 22).

Platforms lobes on the margins of preforms were isolated and ground before lateral thinning flakes were detached. These flakes were struck with sufficient force and at an angle that would cause them to travel across the preform's entire face. This strategy effectively flattened the pieces and often produced overshooting flakes. Generally speaking, the low number of dorsal scars and the presence of square or flat edges on the distal ends of overshot flakes (e.g., Guardiria, La Yeguada, La Mula-West, and Vampiros) indicates that this technique was commonly used in the initial stages of reduction. For example, two overshots from Vampiros (Figure 62h, i) displayed a single medial arris showing that flintknappers were intentionally setting up platforms to exploit prominent ridges on the preforms and detach longer thinning flakes (Bradley 1993:254). Flutes were also removed to eliminate occasional high central ridges on preforms throughout the reduction process. The presence of complete and collapsed nipples on bases show that this type of fluting was utilized at least some of the time. Projectile points had bi-convex or lenticular cross-sections and flaking patterns were mostly horizontal and occasionally diagonal. A noteworthy aspect of the La Mula-West assemblage is that despite the fact that the majority of its bifacial artifacts are incomplete, almost none display remnant surfaces of the original flake blanks.

The La Mula-West and Nieto projectile points seem to have had excurvate blades ending in contracting proximal margins. Bases were straight to slightly concave. It should be emphasized once more that these observations are based on unfinished preforms and fragmented projectiles. Hence, the exact outline of finished points may have been slightly different. For instance, very little final shaping would be necessary to transform specimens depicted in Figure 27a, b into waisted points with deeper concave bases.

Unfortunately, point bases were not found at the Aguadulce and Vampiros sites and it is impossible to determine with certainty if the points were lanceolate or stemmed. Intuitively, the three jasper point fragments from Vampiros and Aguadulce are quite different from the La Mula-West examples made on agate. To test this hypothesis, all Panamanian points were plotted on a graph opposing their maximum width and thickness (Figure 66). The scatter plot distribution clearly segregates lanceolate from stemmed points and supports my initial assumption. We can thus tentatively argue that, based on these two variables, the projectile points recovered at the Aguadulce and Vampiros sites were not lanceolate and most likely resembled FPPs. Figure 67 presents several montages that illustrate what the fluted point from Vampiros may have looked like compared to FPPs and the Clovis-like point from Lake Alajuela (Sander 1959, 1964; Bird and Cooke 1977, 1978). The presence of overshot thinning flakes in the same deposits as this point presents a rare quandary. This combination of technologies at Vampiros might indicate that the cave was occupied during the supposed technological transition that took place between lanceolate and FPP industries (see below).

In general, lower Central American FPPs were manufactured on large, flat, thin flakes often retaining surfaces of the original blank. This presupposes that FPP blanks were detached from cores with slightly different shapes than the ones used to produce lanceolate point blanks. Flake blanks for FPPs would have been wider and possibly squarer while those intended for lanceolate points would have been more rectangular ("blade-flake", [Callahan 2000; Collins 1990]). Overshooting flake scars are not visible on finished FPPs and the flaking pattern is best described as overlapping, transverse horizontal. Blades on FPPs are wider, thinner, display flattened cross sections, and have larger tip angles than lanceolate points. Shoulders on Central American specimens are round with concave, and ground bases (Bird and Cooke 1978; MacNeish et al. 1980b; Pearson and Bostrom 1998).

Tools associated with fluted point assemblages in Panama and Costa Rica include spurred end scrapers, various types of gravers, keeled scrapers, and planes. Large scraper planes were fashioned on blade-like flakes and sometimes shaped by a trihedral flaking technique. Great efforts were made to flatten the ventral surfaces of these large scraping tools. Irregularities, such as the bulb of force, and excessive curvature were corrected by striking the blank's edges "head on" to detach large flakes that would terminate in hinge or step fractures. This tactic ensured that the retouch itself did not plunge or compound the initial problem and is comparable to core platform rejuvenation removals (Pearson 2003).

With the exception of the broken specimen from Lake Alajuela (Figure 21b), large prismatic blades and blade cores have not been found at Central or South American fluted point sites. Blades from La Mula-West and Nieto, though possibly associated with the Paleoindian material, are still very different from the large North American examples discovered at some Clovis sites (Collins 1999). Although one can point to the low quality of lithic materials at several sites to explain the absence of blade production (Pearson 1998; Morrow and Morrow 1999), this does not apply to Central American regions where obsidian and other high quality stones were available. Hence, another explanation must be sought to satisfactorily explain why Paleoindians *apparently* did not manufacture large blades in the Neotropics.

Another recurring feature of lower Central American lithic assemblages concerns their "taphonomic" history. Indeed, nearly all of the assemblages discussed so far displayed, to a degree or another, evidence of having been exposed to intense heat or fire. Most common were potlids and discoloration followed by crenated or transverse breaks and crazing (Purdy 1986; Patterson 1995). The level of fragmentation observed on some assemblages and the presence of heat damage on late stage or almost finished artifacts argue in favor of post-depositional factors as opposed to intentional heat treatment (Rondeau 1995). This phenomenon can be attributed to either cultural of natural causes.

If enough fuel was available to generate sufficient heat during forest fires, be they human-made or natural, it could have affected open air lithic scatters (Buenger 2002). In fact, based on the high amount of particulate carbon in Lake La Yeguada (Piperno et al. 1990; Bush et al. 1992), one might be tempted to suggest that the presence of so many burned Paleoindian artifacts might serve as proxy indicators for anthropogenic fires in and around early sites. On the other hand, waste flakes and broken tools may simply have been discarded in hearths as part of regular site maintenance activities (Schiffer 1987) or long term re-use of sites (Hofman 1986). This explanation is certainly more in line with what would be expected at a cave site such as Vampiros.

Technological Organization and Settlement Patterns

Lithic material sources in lower Central America during the late Pleistocene appear to have been abundant and well distributed across the landscape. This is especially true of secondary sources such as rivers and their tributaries that transported cryptocrystalline cobbles across extensive areas. Easy access to workable stone in Central America may explain why lithic caches have not been found in this region. In other words, the widespread and tightly spaced distribution of lithic materials found here offset the need to stockpile stones for insurance purposes (Meltzer 2000a, b). This same situation might also explain why large bifacial cores and tools made on bifacial thinning flakes are practically non-existent in Central America. Estimating the annual distance traveled by Central American Paleoindian groups is also complicated for these same reasons. Given that the same types of stones can be found over a very large area, it is difficult to say if, for instance, a jasper was procured from the highlands near Lake La Yeguada or at the mouth of a river on the Pacific Coast.

Very little can be added to our knowledge of lower Central Paleoindian settlement patterns from the sites discussed in the previous section. During the Pleistocene, Vampiros cave was located approximately 80 km from the Pacific Ocean on the edge of a vast plain. According to Piperno and Jones (in press), this expanse of land was covered by a grassy savanna and thornscrub. Paleoindians undoubtedly lived and hunted on this now-submerged shelf. These groups may have also followed "vertically" oriented seasonal movements between the mountain ranges and coasts, if only due to the narrowness of the Isthmus. Both upland and lowland resources were certainly exploited by early colonists (Lynch 1971) as is evidenced by high-elevation sites such as Los Tapiales, Guardiria, and Lake La Yeguada. Moreover Paleoindian occupations were found on both sides of the continental divide, indicating that they were familiar with the types of resources available on the Caribbean and Pacific coasts. However, frequency of annual movements and seasonality cannot yet be determined.

If the geographic distribution of lithic materials was not a major influence on Paleoindian mobility then what other determining factor must we consider? Stones may have been found just about anywhere but drinking water was certainly not. The arid Pleistocene climate must have caused seasonal droughts and perhaps yearlong shortages in less well drained regions as is the case today. In fact, a common theme at early human occupations throughout the Americas has been that they were under drought stress. For example, Dunbar (1991) demonstrated that the scarcity of potable water in Florida forced Paleoindians to congregated around sinkholes. Similarly, distribution patterns of FPP sites around quebrada Santa Maria in Peru were all associated with natural springs (Briceño 1997, 1999). Evidence that both humans and megafauna were under drought related stress have also been observed at other North and South American sites such as Blackwater Draw (Haynes 1984, 1991; Haynes et al. 1999), Murray Springs (Hemmings 1970; Haynes 1991), Aubrey (Humphrey and Ferring 1994; Caran et al. 1996), Kimmswick (Graham et al. 1981), Hiscock (Tankersley 1998:14), and Tagua Tagua (Nuñez et al. 1994). It is probably no coincidence that the area around the Nieto quarry/workshop is dotted with natural springs. A tentative idea that might describe the settlement patterns of Central Paleoindians is that they were not tethered to stones (Hofman 2000) but drinking water (Taylor 1964).

Origins of Fluted Points in Middle and South America

The historical development of our discipline is such that archaeologists have had no alternative but to juxtapose Central American findings with the better-known bordering records of North and South America. As a result, the Central American Paleoindian record is often interpreted according to a dichotomizing perspective based on northern and southern comparisons.

1. North and Central American Continental Interaction(s)

As a general rule, Middle American assemblages have been classified as either FPP or Clovis-like industries with the latter used as a catchall category for many non-stemmed forms. Archaeologists have also split "Clovis-like" points into "parallel-sided" and waisted sub-classes (Bray 1978; García-Bárcena 1979, Snarskis 1979; Ranere and Cooke 1991). Of these two types, the parallel-sided specimens are believed to be the oldest since they most closely resemble Clovis points found west of the Mississippi (Morrow and Morrow 1999). Just as we have contrasted the Pleistocene record of Central America with discoveries made further north and south, so must we now consider a similar, more realistic and complex colonization for this intermediate region. Current research needs to focus on the following questions:

- How many Paleoindian complexes or traditions existed in Central America?
- Which of these originated in the North, South, and/or Central America proper?

A point of chronological reference must be established before we can attempt to answer these questions. The oldest lanceolate fluted points in the Americas have come from the Aubrey Clovis site in Texas (11,540 ± 110 [AA-5271], 11,590 ± 90 [AA-5274], Ferring 2001; Fiedel 2002). This supports previous claims that parallel-sided point types in Middle America are probably the oldest (Note: A caveat to this assertion is that most fluted point assemblages from the southeast U.S. are still undated). By and large, these "classic" Clovis points share a combination of the following characteristics (Bradley 1982, 1993; Collins 1990; Howard 1990; Morrow 1996):

1. Straight or slightly concave base
2. Convergent tip
3. Straight to slightly convex edges
4. Fluted by direct percussion on a beveled base or isolated nipple
5. Absence of eared projections
6. Presence of overshooting scars on preforms and/or finished points
7. Lateral removal of distal flute scar

However, having determined which of the two Central American point types should be the oldest does not explain the nature of their relationship. In other words, we still do not know if:

- Waisted types evolved from parallel-sided points only *after* these older groups inhabited all regions of Middle America.
- Waisted types evolved from classic Clovis points *as* colonizing groups moved through Middle America.
- Each point type represents a distinct migration.
- One represents a diffusion through the region where the other was already in use.

Another problem is our poor sample size. Thus far, I have formulated the problem based on two very general point forms but we still do not know if other lanceolate types existed. We must also identify how North American Clovis points may have changed both technologically and stylistically in order to determine if the same transformations can be observed in Central America. Put another way, is there a historical relationship between North and Central American Clovis variants or do they represent two separate evolutionary lines? In general, later Clovis-related points are characterized by some of the following attributes (Storck 1983, 1991; Tankersley 1994; Morrow 1996; Morrow and Morrow 1999; O'Brien et al. 2001):

- Deeper basal concavities
- Folsom-like fluting (on well-defined nipples) and pressure used in the final preform shaping
- Waisted sides (concave proximal margins)
- Greater occurrence of pseudo-fluting (flake blanks)
- Basal ears
- Thinner blades

Fluted lanceolate points from Middle America display characteristics belonging to both early and late Clovis types. Important differences exist however. The "Folsom fluting technique" is present only on a few Folsom points from Mexico and has yet to be recorded in Central America. Deep basal concavities are also absent south of the Tropic of Cancer. It would seem that whatever influence Folsom groups and their fluting technique had on the Plains and the Northeast, it did not extend to the Neotropics. This does not come as a surprise considering that the focal point of the Folsom economy centered on hunting grassland bison (Hofman 1999; Hofman and Todd 2001). Expectedly, many of the fluted points from Mexico represent southernmost extensions of common types found in California, Nevada, Texas, etc. I have eliminated late Paleoindian points such as Plainview, Golondrina, and others, for the purpose of this analysis.

Geographic distributions of classic Clovis and waisted variants are presented in Figure 68. Both point types overlap geographically between the Rio Grande and the Equator. Moreover, there is no discernable pattern of segregation based on this sample. As I remarked before, the differences between both types is not always straightforward when assemblages contain mainly preforms and fragments (Faught n.d.). Thus, a certain subjectivity has been incorporated in the following distributions. Specimens depicted on Figure 27a, b from La Mula-West are especially problematic because one appears to fit the classic Clovis outline while the other does not. We are thus presented with several choices. Either the La Mula-West collection; 1) is a mixed assemblage; 2) is a single waisted point assemblage (i.e., Figure 27a would have eventually been waisted) or; 3) was left behind by groups that manufactured and used both types. Point morphology aside, the technological aspects of the La Mula-West bifaces leave little doubt as to their connection with Clovis. As well, the discovery of a remarkable assemblage of lanceolate fluted points and preforms at the El Cayude and Siraba sites in Venezuela (Ardila and Politis 1989; Ardila 1991; Jaimes 1999) demonstrates that a Clovis-related technology crossed the Isthmus at least as far as northern South America (i.e., Ecuador, Colombia, Venezuela, Guyana, Surinam, and French Guiana).

Several archaeologists have hinted at possible early and/or middle Paleoindian contacts or movements around the Gulf of Mexico and Caribbean (Faught and Dunbar 1997; Pearson and Bostrom 1998; Faught n.d.). This idea is based largely on the discovery of similar point styles across this region and on comparable late Pleistocene fauna especially around the Gulf Coastal Plain (Webb 1992). At least four early and middle Paleoindian point types have been identified and described in Florida. None have been recovered from well-dated contexts and the ages presented below are approximations: The following descriptions are based on Prufer and Baby (1963), Bullen (1975), and Goodyear et al. (1983):

Early Paleoindian Period (11,500-10,800 ^{14}C yr B.P.)

- Clovis:

Fluted lanceolate with straight to slightly excurvate sides, slightly concave base, ground basal edges, no ears.

- Ross County (Clovis variant):

Fluted lanceolate, waisted basal margins, flat and excurvate blade with large transverse flaking scars (sometimes overshooting) surrounded by fine bi-marginal pressure retouch on margins. Slightly concave and ground base.

Middle Paleoindian Period (10,800-10,500 ^{14}C yr B.P.)

- Suwannee:

Unfluted lanceolate, usually parallel-sided (occasionally slightly waisted) with projecting basal ears. Transverse thinning on ground and slightly concave base. Broad, expanding lateral thinning removals. Flat cross-section.

- Simpson:

Occasionally fluted lanceolate, waisted basal margins, can have a very wide and thin blade ("bull tongue"), concave and ground base, occasional small basal ears. Blades are sometimes thinned by overlapping, horizontal transverse flaking and do not show overshooting thinning scars (Dunbar 2002, pers. comm.).

From these technological and stylistic criteria, we can state that Suwannee points have as yet not been recovered in Middle America. In contrast, similarities between Simpson and Panamanian points have been noted in the past (Faught and Dunbar 1997; Pearson 2003; Faught n.d.). These suggestions were often based on stylistic attributes such as the presence of waisted basal margins. However, the Simpson flaking pattern has more in common with what has been observed on

Panamanian FPPs than Clovis-lanceolate points. In addition, large "bull tongue" Simpson points have not been discovered south of the Rio Grande. Perhaps the best example of a possible Simpson-like point is the projectile discovered on Macapalé Island in 1952 (Figure 19a).

If the Middle Paleoindian cultural links between Central America and Florida are vague, the early period interactions are much clearer. Ross County Clovis variants represent an unambiguous and reoccurring link between North America and the Central American Neotropics. Both their shape and technological characteristics are unmistakably present in Central America. Furthermore, Ross County points have been found in Texas (Long 1977) and other southeastern States (Perino 1971), which strengthens the idea of a circum-Gulf and Caribbean connection (Faught and Dunbar 1997; Pearson and Bostrom 1998: Faught n.d.). Figure 69 presents an archetypal example of a Ross County Clovis point recovered at the Sloth Hole Site in Florida (Hemmings 1999a, 1999b, fig. 8a). This point clearly displays the large lateral removals and overshooting scars as well as the fine bi-marginal pressure retouch used to shape it. Similar points have been found in Belize (Hester et al. 1980a, b, 1982), Guatemala (Coe 1960), Costa Rica (Snarskis 1979, fig.3b; Sheets and McKee 1994, fig. 11-10a), and possibly Mexico (García Cook 1973; García-Bárcena 1979). To this list, I am tempted to add the bifacial fragment found at the Tequendama rockshelter in Colombia (Correal Urrego and Van der Hammen 1977:84, 97), which seems to bear typical Ross County flaking scars (see Cooke [1998, fig. 3f] for a good illustration). This pattern is visible on many of the La Mula-West preforms and especially on the distal fragment on Figure 27d. In fact, the Ross County reduction strategy and point style reconciles what appeared, at first, to be an incongruity between a classic Clovis reduction strategy and a waisted point style at La Mula-West. I also observed another possible link with Florida based on collections from the Fossil Hole quarry (Hemmings 1999c) which contained large flake core bases exhibiting identical reduction techniques as the ones recorded at Central American Paleoindian sites.

Having made a case for a cultural network around the Caribbean and Gulf of Mexico does not, however, explain its genesis or its significance. We still don't know if Ross County points originated in Central America and then spread to Florida (and further north) or vice versa. In the absence of radiocarbon dates, I will make certain assumptions in an attempt to offer possible scenarios. If we continue with our initial hypothesis regarding the primacy of southwestern Clovis types, then it follows that Ross County points are indeed variants (i.e., younger derivatives). Since both classic Clovis and Ross County types are found in Florida we can also assume that the latter was not associated with the initial colonization of the southeastern states. On the other hand, the evidence for Classic Clovis in the Neotropics is difficult to ascertain considering that many of the purported parallel-sided points could be preforms. It is important to understand that the above statement relates to point styles and does not necessarily imply significant chronological ramifications. It is impossible to determine how much time may have separated both types or if they overlapped chronologically. I am only suggesting that the first Clovis-related groups to enter lower Central America could have been those that used a technology comparable to Ross County. These points may have originated somewhere on the Mexican Gulf shelf and were subsequently dispersed northeast (via the Mississippi Basin?) and south perhaps as far as Venezuela (Figure 70). Another model would have Ross County points follow on the heels of classic Clovis via an eastern route into Central America.

2. Central and South American Continental Interaction(s)

Several fluted and non-fluted lanceolate points have been reported from Ecuador (Carluci 1963; Mayer-Oakes and Cameron 1971) and Fell's Cave but are either equivocal or do not appear to be directly related to Clovis (Nami 1998). On the other hand, the Nochaco specimens from Chile (Seguel and Campaña 1975; Gruhn and Bryan 1977; Jackson 1995; Dillehay 2000) are the best candidates for a true Clovis presence in southern South America. Not only were gomphothere bones possibly associated with some of these points but Dillehay (2000:159, 304) reported a date of 10,400 ± 90 ^{14}C yr B.P. (lab. no.?) on charcoal found next to a buried example at the Rio Bueno site. Thus far, Nochaco points have been restricted to a small region in central Chile and have not been described in great technological detail. More information on this crucial industry is needed before its true relationship *vis-à-vis* other South American fluted points can be understood. For now, suffice it to say that fluted lanceolate points have never been discovered above or below any of the buried and well-dated FPP occupations from the southern cone.

Approximately 15 FPPs (and possibly 30, see Table 7) have been found in Central America and 335 in South America (Figure 71 and Table 34). Central American FPPs overlap with Clovis-like points between the isthmuses of Tehuantepec and Panama (Figure 68). South American FPPs are distributed in three major geographic areas: 1) northern South America; 2) The Andean Cordillera (Peru, Chile, and Western Brazil); and 3) Patagonia and the Pampas (southern Chile, Argentina, Uruguay, and Southern Brazil). Although South American FPPs show considerable variability (Politis 1991), overall technological and stylistic characteristics confirm that it is a single cultural tradition (Nami 2000). This widespread homogeneity recalls the Clovis phenomenon of North and Central America and may represent another important communications network during the late-Pleistocene. Likewise, FPPs from the southern cone have come from relatively open areas where communal hunting, focusing on horse and camelids (Lynch 1983, 1998; Borrero and Franco 1997; Borrero et al. 1998; Morrow and Morrow 1999:228; Alberdi et al. 2001), could have been practiced. Perhaps, as Lynch (1998:93) has suggested, the early Holocene environmental conditions of South America maintained an "Epi-Paleoindian" economic component among early Archaic hunter-gatherers—a pattern comparable to the one observed on the Great Plains (Hofman and Graham 1998). Consequently, since Pleistocene megamammals may have been secondary prey species for South

American Paleoindians, tool kits incorporating fluted points to hunt modern fauna may have persisted longer in the open regions of South America. It is interesting to note that FPPs have not been discovered in any of the numerous caves found in the more wooded areas of Eastern Brazil (Schmitz 1987; Kipnis 1998).

The directionality of the FPP expansion between Central and South America is also difficult to determine based on the available radiocarbon dates. Although the late dates from Los Grifos should not be dismissed out of hand (Table 4), their validity is not easy to evaluate (Santamaria 1981). The Los Tapiales date is less problematic but it is not clear if the base fragment associated with it represents a Clovis-like or FPP (Gruhn and Bryan 1977:246). If the Vampiros point fragment is indeed an FPP, then the best that we can say is that this type of point was used in Panama between 11,500 and 9000 ^{14}C yr ago.

On average, FPP occupations from the southern cone date between c. 10,800 to 10,100 ^{14}C yr B.P. (Morrow and Morrow 1999) or 11,000 to 10,300 ^{14}C yr B.P. (Fiedel 2002) (see Table 1). Since the radiocarbon data set is still too limited to provide clinal patterns, a look at technological and stylistic attributes might show revealing trends. Although FPPs from both continents show occasional remnant flake blank scars, pseudo-fluted examples have only been discovered in South America. The occurrence of fluting on FPPs also shows a north to south decrease from 100% in Central America to less than 50% in South America (Table 35). According to Morrow and Morrow (1999:223) this phenomenon represents "the decline of fluted point technology through South America rather than its development there."

Stylistically, Central American FPPs have more angular shoulders, and wider blades and bases (Figure 72) than their South American counterparts. Nevertheless, some of these more typical Central American characteristics have been observed on a few large points from the southern cone (Bosh et al. 1980; Flegenheimer and Zarate 1989). Some researchers have proposed that two types of FPPs may have been used concurrently by the same groups. This idea was put forth following the discovery of oversized examples which, it is thought, may have served as knives (Flegenheimer 2001a, b; Nami 2001a)

Technological Relationship Between Fluted Lanceolate and Stemmed Projectile Points of Central and South America

Are FPPs fluted stemmed points or stemmed Clovis-like points? This is perhaps the single most important question that needs to be answered if we hope to understand the nature of the relationship between Clovis and FPPs. Appreciating this nuance is crucial towards following the evolutionary process(es) that took place around the fluting technique—the key common denominator. Tracing the technological "genealogy" or "ancestry" of fluted stemmed point is the first step in understanding their relationship with North American Clovis industries.

If we accept the notion that the fluting technique was invented only once in North America then we must: 1) find unfluted precursors for FPPs if we wish to argue for an independent South American origin or; 2) accept the most parsimonious hypothesis, which suggests that FPPs are derived from North American Clovis. Unless the fluting technique was not invented in North America, another possibility would be that an ancient fluted point culture migrated along the Pacific Coast and modified its weaponry along the way before venturing into the interior (e.g., Dixon 1999). According to this model, FPPs and Clovis points did not have a direct evolutionary link but only shared a technological ancestor. This model could have produced two initial fronts of evolutionary development—one north to south along the coast and one west to east via the continental interior. This idea could explain the sudden appearance of the fluting technique throughout the Americas and the absence of in situ precursors.

For the moment, however, northern South America is the southernmost region where FPPs and Clovis related points overlap and appears to have been an important center of projectile point innovation. Indeed, fluting has been observed on lanceolate Clovis-like, fishtail (Broad Blade and Fell I), Restrepo, El Inga Broad Stemmed, El Inga Shouldered Lanceolate, and possibly El Jobo (Mayer-Oakes 1986a; Gnecco 1994; Jaimes 1999). Upon examining the various fluted points found in this region one gets a sense of ancient trial and errors or significant innovation and extinction or loss. This area can be described colloquially as a "melting pot" where bifaces display a mosaic of technological and typological attributes characteristic of lanceolate and FPPs. Such technological mixing has been observed at El Inga (Mayer-Oakes 1986a:108) and possibly Vampiros cave where overshooting bifacial thinning flakes were associated with fluted stemmed point industries.

Morrow and Morrow's (1999) study provides a useful discussion on the stylistic differences between lanceolate and stemmed fluted points from a latitudinal perspective. Their work follows the idea that parallel-sided Clovis points underwent a progressive narrowing of their hafting area as Clovis related groups expanded south (García-Bárcena 1979, Snarskis 1979; Lynch 1983; Ranere and Cooke 1991). The authors suggest that morphological changes between lanceolate and FPPs were the result of a gradual stylistic drift (Morrow and Morrow 1999:227). A schematic representation of this "three-step" hypothesis is presented below:

North America	Central America	South America
Parallel-sided Clovis →	Waisted Lanceolate →	Fishtail

Assuming that lower Central America and northern South America represent the fluted stemmed point center of innovation, I believe the differences between lanceolate fluted points and "FPPs", such as the ones from Panama, are simply too great for a direct evolutionary line to be plausible unless an exceptional technological reorganization occurred. Table 36 presents a list of differences between Central American fluted stemmed points and lanceolate points. In my opinion, these differences do not support a *direct* link between the two point types. A transitional form should be interposed between them; or, some of these broad, stemmed bifaces served different purposes (e.g., knives).

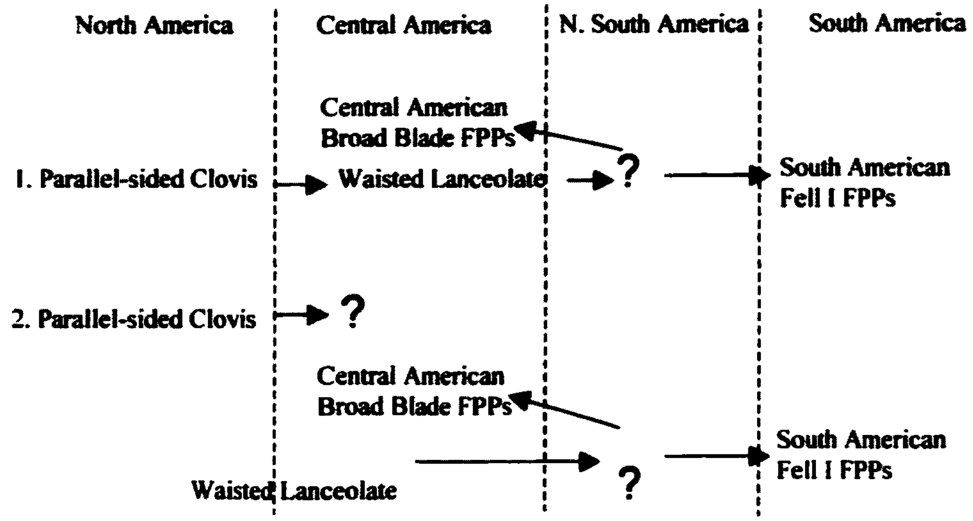
An important characteristic of Central American and northern South American fluted stemmed points is their overall larger size compared to classic Fell I FPPs. Dimensions and thickness of points from Central and South America are presented in Table 37. Many of these measurements were recorded from published line drawings and illustrations and a slight degree of error (± 1-2 mm) is likely present. Tables 38-41 display mean size and thickness of major point types and significant one-way ANOVA results at the .05 level. Blade width and thickness show significant north to south decrease in size (Tables 38-39). Minimum stem width also varies significantly between Central American and northern South American lanceolate, fluted stemmed, and Restrepo points (Tables 40-41).

Restrepo points are especially interesting since they were bifacially flaked from thick flake blanks, display large flake scars which occasionally traveled beyond the blades' mid-lines, have bi-convex cross-sections, and slender triangular blades (Ardila and Politis 1989; Ardila 1991; Cooke 1998:185). Overall, Restrepo points show more technological similarities with lanceolate projectiles than FPPs. The Macapalé Island point from Lake Alajuela, which I compared to Simpson types from Florida, is also quite distinct (Figure 19a). Although this point is often described as lanceolate, it would easily be classified as a fishtail in South America (e.g., Jaimes 1999). I believe that some of these typologically-ambiguous fluted points from the Isthmian region and northern South America may represent transitional specimens between lanceolate and Central American FPPs.

Thanks to new analyses by Nami (1997, 2001a, b) who examined Fell I FPP manufacturing strategies in South America, it is now possible to better judge the degree of affinity between these stemmed fluted points and lanceolate Clovis-like projectiles. Nami (2000) has demonstrated that several manufacturing trajectories were followed to make Fell I FPPs and that overall point variability is mainly a result of the type of blank used to fashion them combined with specific resharpening practices (see also Politis 1991). Most importantly, his study of preforms and manufacturing rejects demonstrated that some Fell I FPPs were shaped into ovate bifaces and fluted *before* final blade shaping and stemming. Flutes were removed by striking a beveled base or an isolated nipple (Nami 2001a, b). Although this does not mean that FPPs were never fluted *after* being stemmed, it is nonetheless a significant technological clue. It suggests that FPP manufacturers may have had more in common with a distant lanceolate point tradition than a non-fluting stemmed point culture that superimposed this technique on their industry. Put another way, the creation of a stem was apparently secondary and a more recent adaptation to a pre-existing lanceolate point manufacturing trajectory.

If lanceolate point-using groups began to stem their projectiles in northern South America and the Isthmian region, I believe more than stylistic drift is at play here. To examine this problem we must start by asking "what is a stem"? A stem is nothing but a solution. It is a compromise between a need for large blades while in possession of a narrower hafting system. Since hafts are less flexible components of tool inventories they often determine the size and shape of the points that can be secured to them (Bird 1969). Hence, archaeologists should investigate the possible cause(s) that would have compelled lanceolate point users to adopt narrower hafting methods or need broader bladed projectile point knives. If, as I have suggested elsewhere (Pearson 1999b, 2001), Clovis points formed a kind of technological symbiosis with large megafaunal osseous materials used to manufacture foreshafts, then perhaps the demise or unavailability of one caused a change in the other (Cooke 1998). Similarly, Guthrie (1983) proposed that the disappearance of composite osseous points with microblade insets south of the North American ice sheets could be explained by the inter-relationship between antler provided by northern caribou and the weapon system made from it. These explanations strengthen the notion of evolutionary co-dependence between material culture and targeted resources and offer worthy avenues of inquiry. Other environmental factors may also have been influential and need to be investigated. Perhaps, lanceolate points became maladaptive once confronted by new South American prey species and/or the reorganization of mammal populations towards the end of the Pleistocene. Considering the potential for group isolation and economic diversity in the environmentally and topographically complex regions of northern South America, important morphological changes in points styles could be attributed to a combination of both function and drift.

Based on my observations, I propose alternative schematic representations of the evolutionary development of stemmed fluted points in Central and South America:



My first model varies from the original three-step hypothesis in that it interposes an intermediate form to explain both Central American (Broad Blade) and South American (Fell I) stemmed points which I consider indirectly related. The second is based on the premise that parallel-sided Clovis points may not have penetrated as far south as waisted forms. According to both models, Broad Blade fluted stemmed points from Central America did not evolve directly out of lanceolate points of Ross County affinity. These new ideas combine aspects of models 1 ("Anagenesis") and 2 ("Cladogenesis") presented in Chapter 3. Based on the style and technological characteristics of our current sample, a break rather than a gradual drift or transition is observed between lanceolate and Broad Blade stemmed forms in Central America. These fluted stemmed bifaces appear to have dispersed north following the pre-existing circum-Caribbean network, which had originally distributed Clovis-like points (Figure 70). This back migration (Anthony 1990) or diffusion may account for the relatively late radiocarbon dates at Los Grifos. Although the exact reason(s) for their success might never be known, only the Fell I FPP type appear to have penetrated deeper into South America.

While I believe current data on South American fluted points are best explained by a Clovis-related human migration, the lack of a satisfactory technological intermediate between fluted lanceolate and Broad Blade stemmed points is problematic. One reason could be that Central American fluted stemmed "points" were not primarily projectiles but knives. This possibility has already been suggested to explain the co-existence of extremely large fishtail bifaces with more common smaller specimens in the southern cone (Flegenheimer 2001a, b; Nami 2001a). In this regard, it is interesting to note that both stemmed and lanceolate fluted bifaces were found in the same stratigraphic level at Los Grifos (García-Bárcena 1979; Santamaria 1981), not to mention that both technologies appear to have been used concurrently at Cueva de Los Vampiros. Another alternative could be that FPPs were not a northern South American innovation and/or Central American Broad Blade specimens are late rather than early varieties of fluted stemmed points.

One more problem that must be considered when discussing human entry into South America, is the presence of pre-established human groups possibly encountered by Clovis bands (Bryan 1983; Dillehay 2000). Was the Clovis expansion into South America a case of replacement? acculturation? both? and in what direction? And what about the apparent absence of the fluting technique in eastern Brazil? Was this the region where Clovis hunters finally abandoned this ancestral manufacturing technique or was it the last bastion of a non-Clovis cultural resistance? At this stage of research, clear evolutionary patterns of material culture in South America are still too elusive or misunderstood to trace diachronic development on a continental-scale.

Lanceolate and Fishtail Points: One or Two Populations?

If, as many data sets now seem to indicate, there were at least two late-Pleistocene migrations into the New World, which one was associated with Clovis? Did Clovis groups display generalized features or were they characterized by Mongoloid phenotypes? If several biologically and culturally different populations came into contact in the New World, how did they interact? Were non-Mongoloids already extinct by the time Mongoloids reached the New World? Is there any sign of admixture? Did one out compete the other?

Judging from a few skeletons, there are those that would say that some of these questions have already been answered. It is indeed noteworthy that for such a small sample, many early Americans show signs of having been seriously injured or killed at the hands of other humans. This list includes:

- Kennewick Man: Broken ribs and projectile point embedded in ilium (Powell and Rose 1999).
- Bonner Springs (age?): Projectile point embedded in femur (Steele et al. 1991).
- Grimes Burial Shelter: Unhealed cuts to the ribs indicating death by knife blows (Owsley and Jantz 1999).
- Spirit Cave Mummy: Fractured skull resulting from violent blow to the head (Tuohy and Dansie 1997).
- Arroyo Seco: Individual found lying face down with numerous projectile points thrust into his body while on the ground (Fidalgo et al. 1986).

Additional evidence possibly attesting to early violent conflicts has come from rock paintings in Brazil depicting executions and cartoon-like sequences of men throwing spears at other individuals (BBC News 1999). Brazilian rock art experts believe that the paintings show violent confrontations between the Lagoa Santa groups and invading Mongoloids.

It is perhaps no coincidence that northern South America is both technologically and genetically very heterogeneous compared to areas immediately north and south of it. This region may have been where northern Clovis groups came into contact with pre-established southern populations (Bryan 1983). The widespread use of the fluting technique on such a variety of typologically and technologically different points is, perhaps, the best additional support demonstrating that South America was already occupied prior to the southward expansion of Clovis.

Since the coastal and continental entryways into South America, via Panama, were extremely narrow, it is conceivable that the first humans to effectively colonize Colombia "blocked" or "buffered" subsequent inflow from the north. Thus, South America may have been peopled by less numerous "waves" (i.e., human inflow from Beringia) and experienced very little input from North America once northern Colombia was inhabited. Low genetic diversity in lower Central America (Kolman et al. 1995:279) suggests that the Isthmus may not have been an active corridor for human interaction and gene flow (Torroni et al. 1994b; Batista et al. 1995; Lorenz and Smith 1996; Ward 1996). Since humans reached South America prior to Clovis related groups, we should not expect a great deal of similarity between the archaeological records of both continents. This is not to say that early South Americans were completely isolated from northern influences—both genetic and cultural—but their overall evolutionary pathways were markedly distinct. We can also surmise that the existence of a "population barrier" in the Isthmian region could have maintained low demographic densities in South America throughout much of its initial prehistory.

The fact that South America was populated before Clovis does not seem to have impeded its southward expansion. Although, humans were already present at Taima-taima (Ochsenius and Gruhn 1979), Monte Verde (Meltzer et al. 1997), and possibly Caverna da Pedra Pintada (Roosevelt et al. 1996; Roosevelt et al. 2002), Clovis-related humans seem to have been the first to have successfully colonized South America on a large-scale. Once synthesized and combined, the archaeological and biological evidence paint a complex picture where groups of Clovis related Paleoindians infiltrated South America after considerable modification of their weapons system. Judging from the genetic and skeletal data from the southern cone summarized in Chapter 6, these FPP-using groups displayed generalized physical features and carried mtDNA haplogroups C and D. It is difficult, at this time, to evaluate the genetic and cultural contributions of pre-established non-Clovis humans. Mtdna haplogroups A and B appear to have percolated into South America at a later time and were possibly associated with a Mongoloid migration.

Chapter IX

CONCLUSION

The main objective of my research was to provide information that might help resolve ongoing debates on the origin of the fluting technique in South America. Arguments over this contentious issue have generally opposed two basic ideas—technological diffusion versus human migration. However, it is important that archaeologists, on both sides of the table, realize that these are not mutually exclusive processes. In other words, while Clovis groups could have migrated all the way to Panama, this would not necessarily have prevented the fluting technique from diffusing further south via an extant population. Nor should the initial spread of an idea have stopped Clovis bands from expanding southward. One could even look at the argument in reverse and suggest that stemming was an idea borrowed by Clovis groups after encountering pre-established South Americans populations.

Regrettably, our present ensemble of Paleoindian archaeological material from Central America is composed mainly of surface finds. Before this project began, only two sites had provided radiometric dates associated with Clovis-like and FPP material in buried context. The Los Grifos site contained both lanceolate and FPPs in the same stratum dated at c. 9500 (Santamaria 1981) while the Los Tapiales site contained an indistinct fluted base dated at c. 10,700 (Gruhn and Bryan 1977). Cueva de los Vampiros now marks the third occurrence where a buried fluted point occupation has been discovered. Significantly, the FPP unearthed at Cueva de los Vampiros rested above culturally sterile deposits dating to c. 11,500 ^{14}C yr B.P.

While it is hoped that the relative age of FPPs and Clovis-like points in Central and South America will eventually be resolved by dating additional sites, the technological characteristics of these assemblages must be identified and compared if we are to understand this relationship beyond mere chronology.

Several technological patterns were identified during the course of my study. Many of these were recorded on tools other than projectile points and were not specific to Central American assemblages. For example, similar core reduction techniques were observed in both Central America and Florida. This evidence supports the idea of a circum-Gulf and Caribbean connection, which had already been suggested based on projectile point shapes. Moreover, the presence of numerous Ross County type Clovis points in Central America and the Gulf and Southeast States seem to confirm this idea.

Since most of the material discussed in this study has not been directly dated, the antiquity of the collections can best be assessed by comparing their technological and stylistic attributes to assemblages of secure age. Unfortunately, very little is known about Clovis early-stage tool manufacturing and core reduction strategies for both primary and secondary source lithic materials (see

McCary 1961; Funk 1973; Gardner 1974; Mallouf 1988, 1989; Hill 2002), and additional research is needed to detect possible patterns and allow for proper comparisons.

Recent analyses of FPP assemblages recovered from South American workshops (Nami 1997, 2000, 2001a, b; Flegenheimer 2001a, b) have demonstrated clear technological affiliations with North American Clovis industries. This information has revealed that the manufacturing trajectories of FPPs, manufactured on thick flake blanks, were essentially the same as fluted lanceolate points up until the stemming process. Hence the technological "genealogy" or "ancestry" of FPPs appears to trace back to an ancient Clovis ancestor rather than to an unfluted stemmed point industry, which later borrowed the fluting technique.

Although I acknowledge that evidence usually brought forth in support of either human migration or technological borrowing is often subjective, I believe the overall technological similarities between North, Central, and South American fluted point industries support a migration model (the mechanisms of which, and exact route(s) taken by these early colonists is another matter altogether (c.f., Meltzer 2002, 2003; MacDonald 2003). Thus far, manufacturing trajectories and reoccurring patterns argue against diffusion or some kind of technological "syncretism" to account for Clovis-like material in Central and South America. The most parsimonious way to explain the fluting technique below the Equator is by a Clovis migration. Having said this, however, I also acknowledge that in matters of human history, Ockham's razor is often inapplicable. Thus, additional research should try to determine if secondary signals, attributable to contacts with pre-established groups, exist on the fringe of the more visible Clovis migration pattern.

If the fluting technique originated in North America, then it is safe to assume that this technological know-how was carried south *at least* as far as the Isthmus of Panama. There is also no reason to believe that this population never crossed into South America proper. Since radiocarbon dates associated with North American Clovis occupations are between 1300 to 400 solar years older than most FPP dates from the southern cone (Fiedel 1999a, 2000a, 2002), a Clovis-based origin for FPPs cannot be completely discounted (Morrow and Morrow 1999). We must concede, however, that if FPPs were a South American evolutionary offshoot of Clovis, a return migration (Anthony 1990) or reverse diffusion must have occurred in order to explain the specimens found in Belize and Mexico (Faught and Dunbar 1997; Pearson and Bostrom 1998).

FIGURES

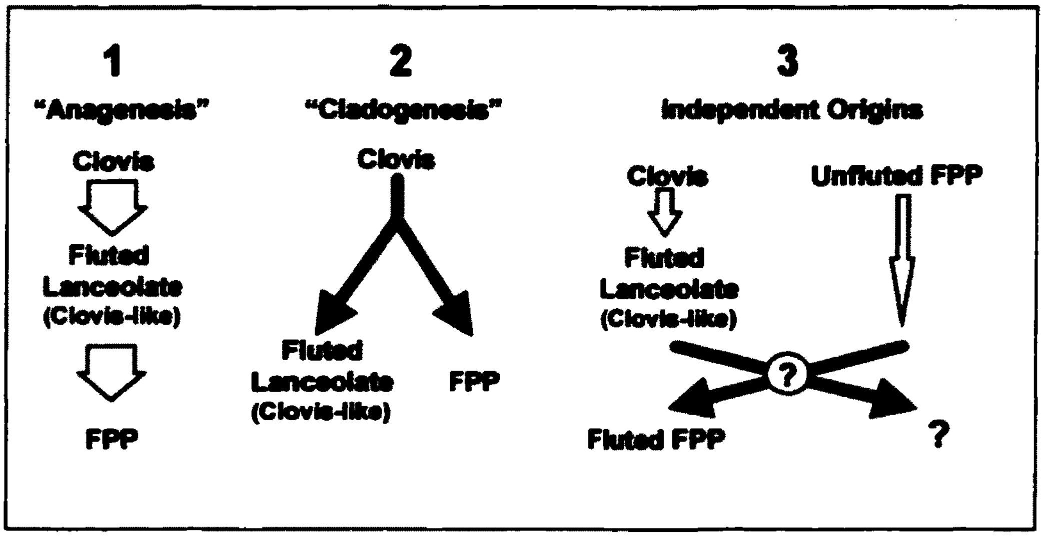
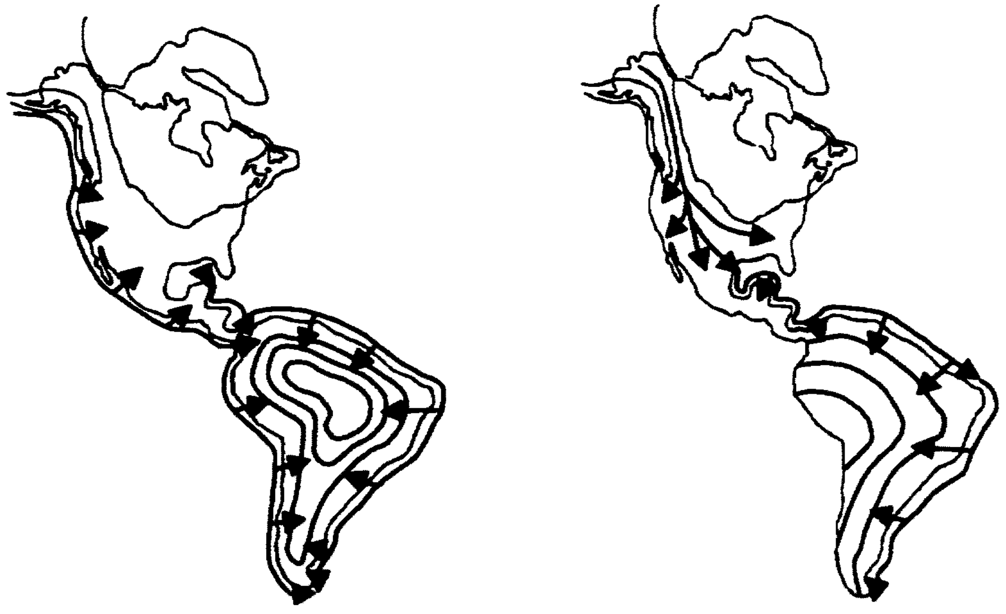


Figure 1. Chart of models illustrating origins of FPPs.

a) Interior Migration
With North-to-South Expansion in South America

b) Pacific Coast Migration
With West-to-East Expansion in South America



c) Bi-Coastal Migration
With Centripetal Expansion in South America

d) Atlantic Coast Migration
With East-to-West Expansion in South America

Figure 2. Hypothetical migration routes from North America
and population expansions in South America.

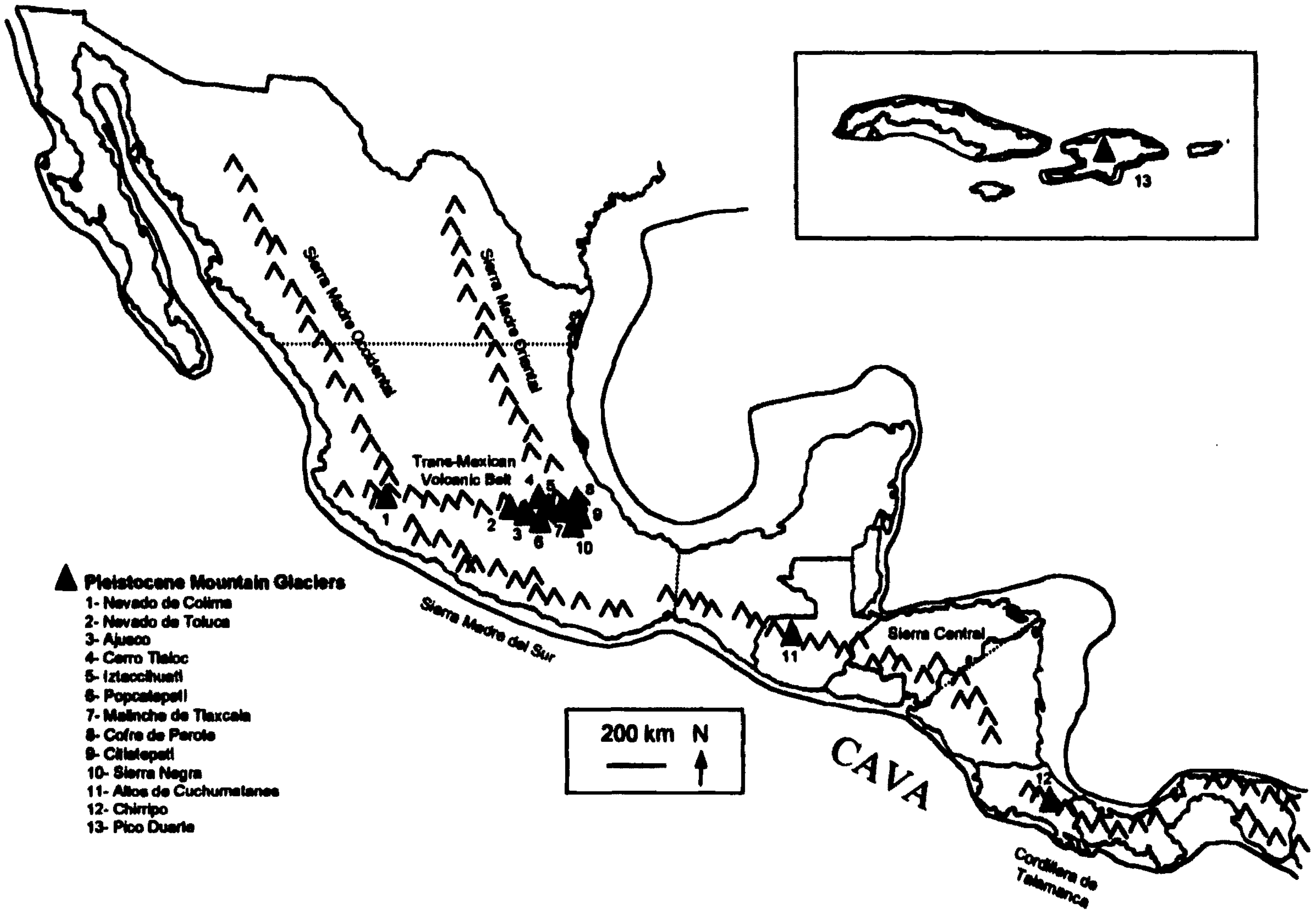


Figure 3. Map of Middle America showing major mountain ranges and Pleistocene coastline.

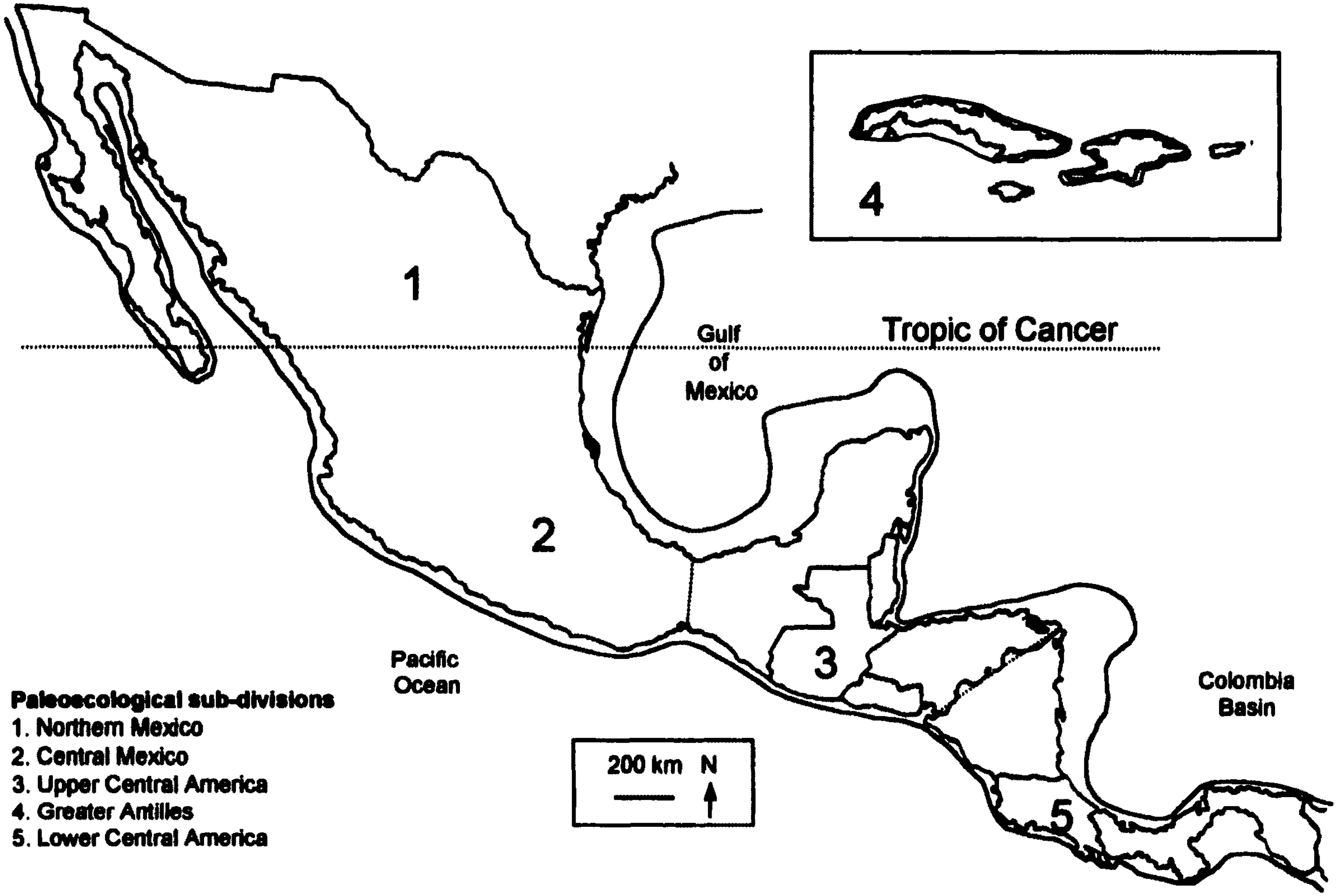


Figure 4. Map of Middle America showing major paleoecological sub-divisions described in text.

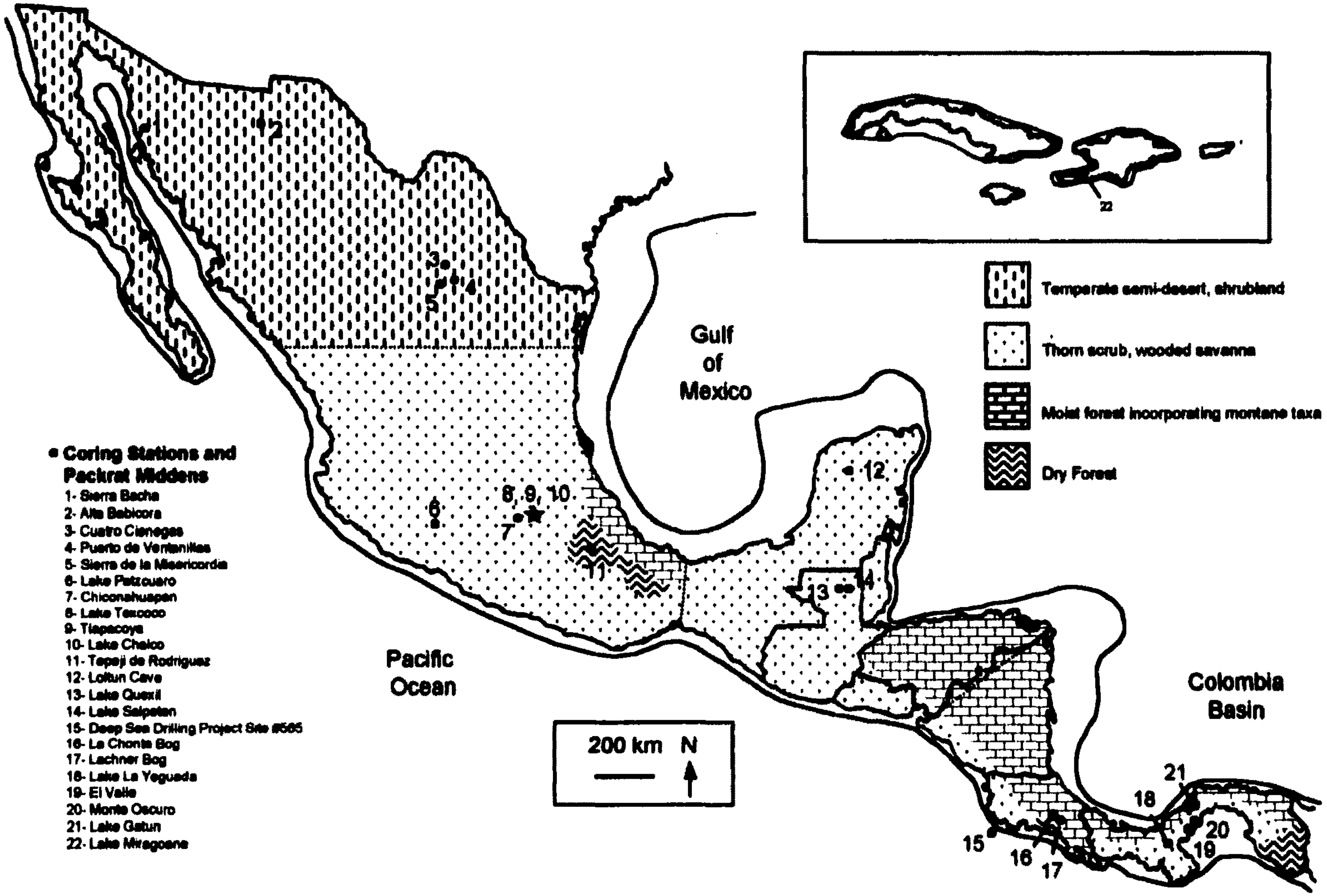


Figure 5. Map of Middle America showing general vegetation zones and location of pollen cores.

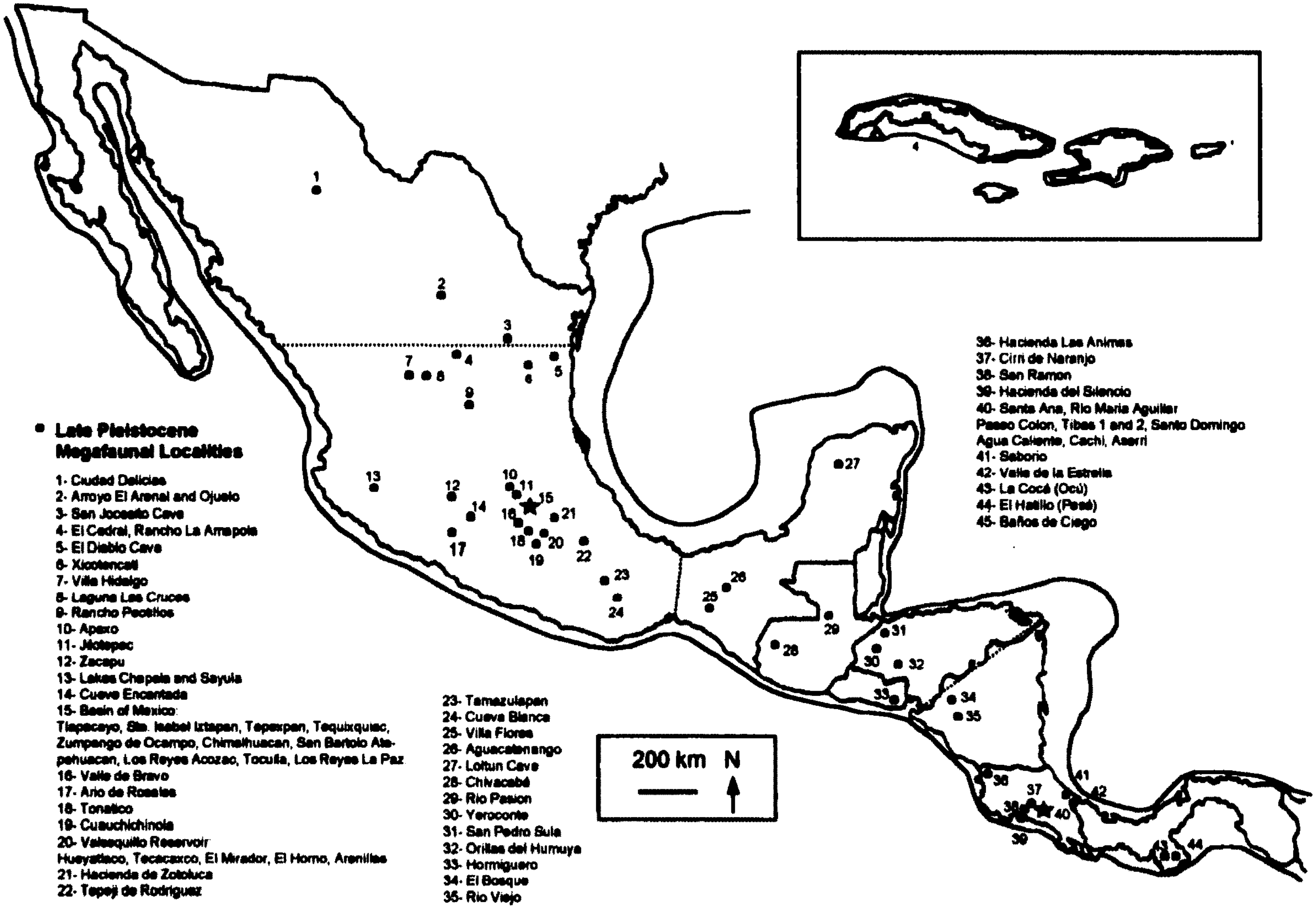


Figure 6. Map of Middle America showing location of purported late-Pleistocene megafaunal deposits.

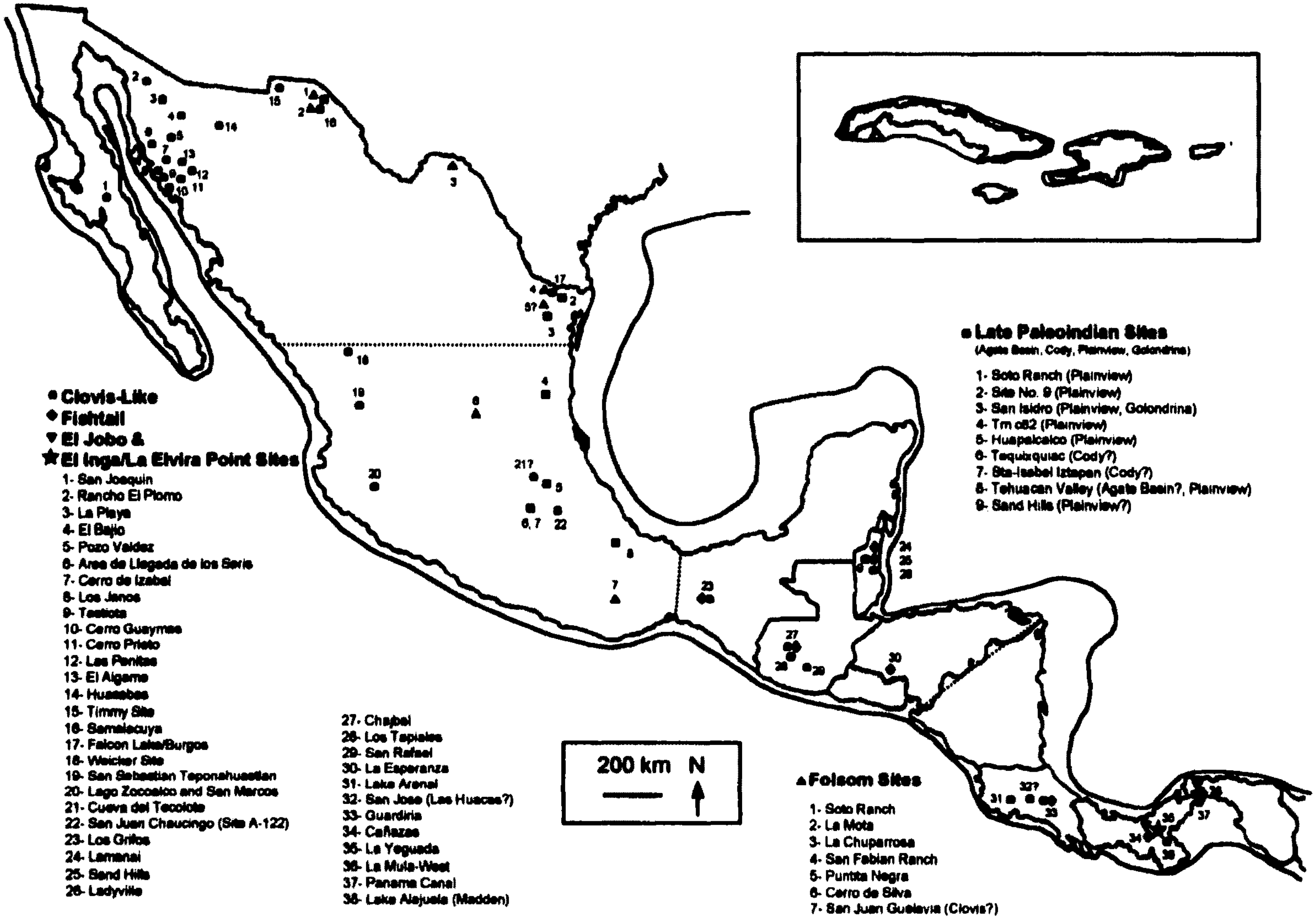


Figure 7. Map of Middle America showing location of archaeological sites containing diagnostic Paleoindian points.

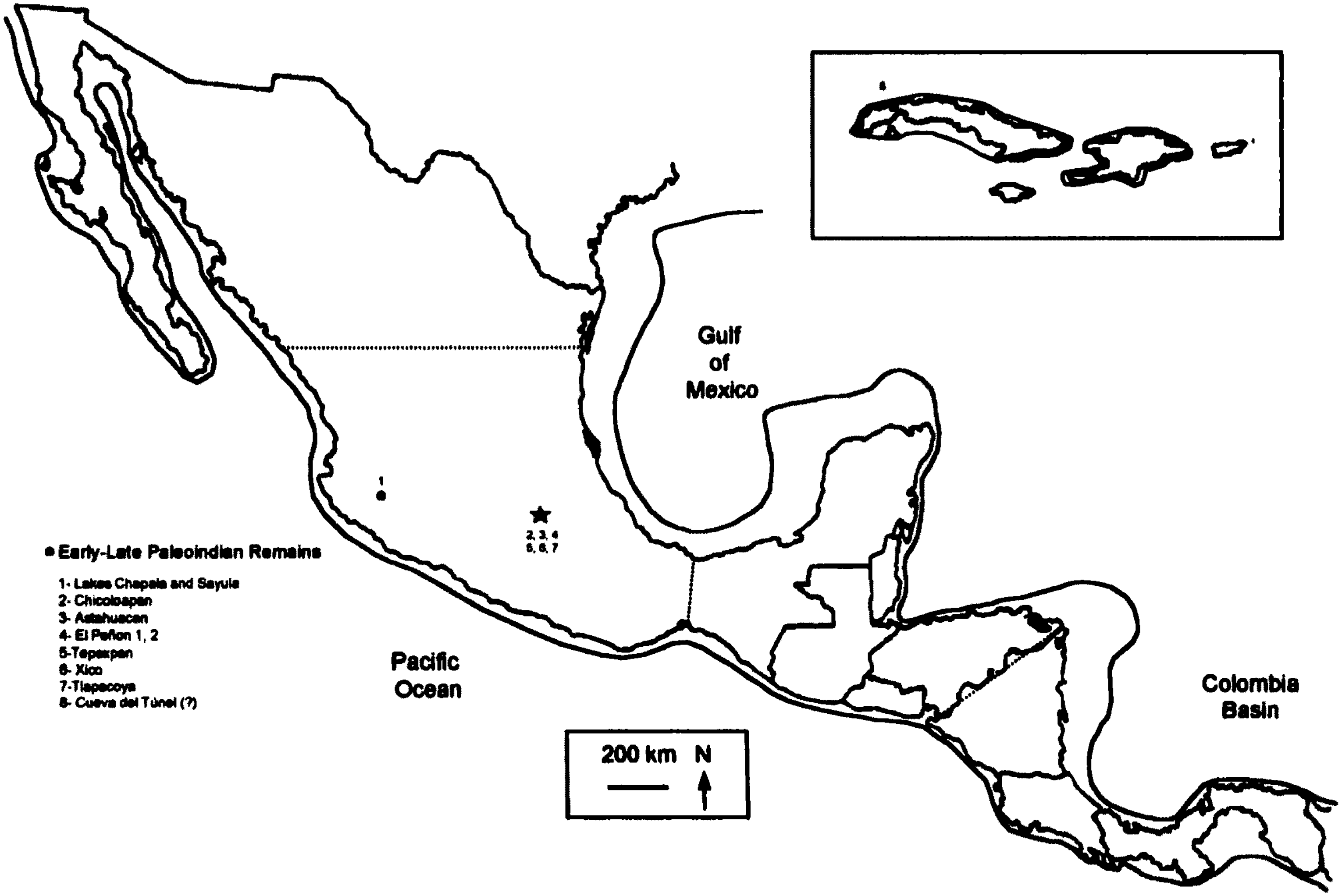
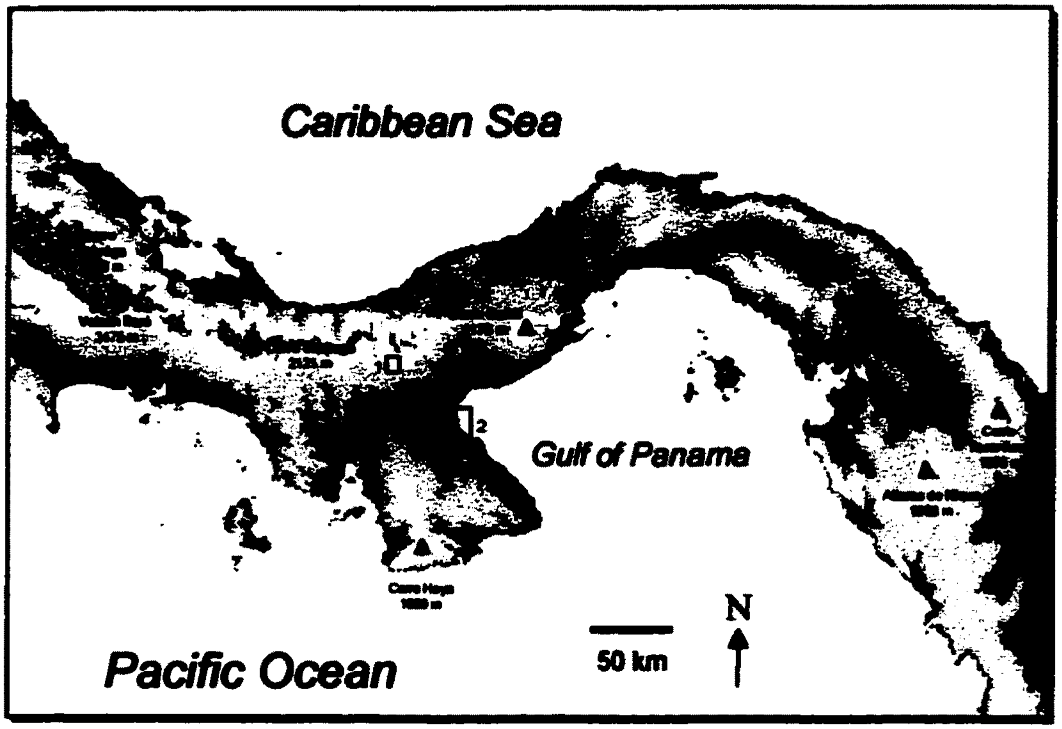
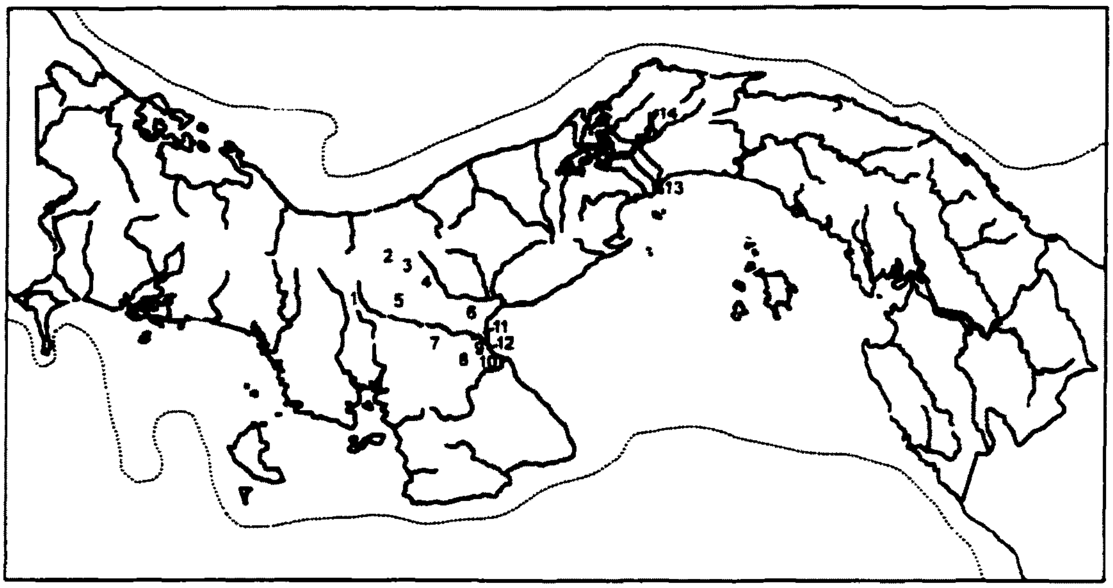


Figure 8. Map of Middle America showing location of purported Paleoindian human remains.



1. Lake La Yeguada Area
2. Nieto Area
3. La Mula-West and Cueva de Los Vampiros Area

Figure 9. Map of Panama showing major zones surveyed during this project.



1-Cañazas
2-Los Santanas
3-La Yeguada Localities
4-Corona Rockshelter
5-Carabali
6-Aguadulce Rockshelter
7-SA-127
8-Nieto
9-A-160
10-A-584
11-Cueva de Los Vampiros
12-La Mula Localities
13-Panama Canal (Balboa)
14-Lake Alajuela/Madden Localities

Pleistocene Coastline
(100 m below m.s.l.)

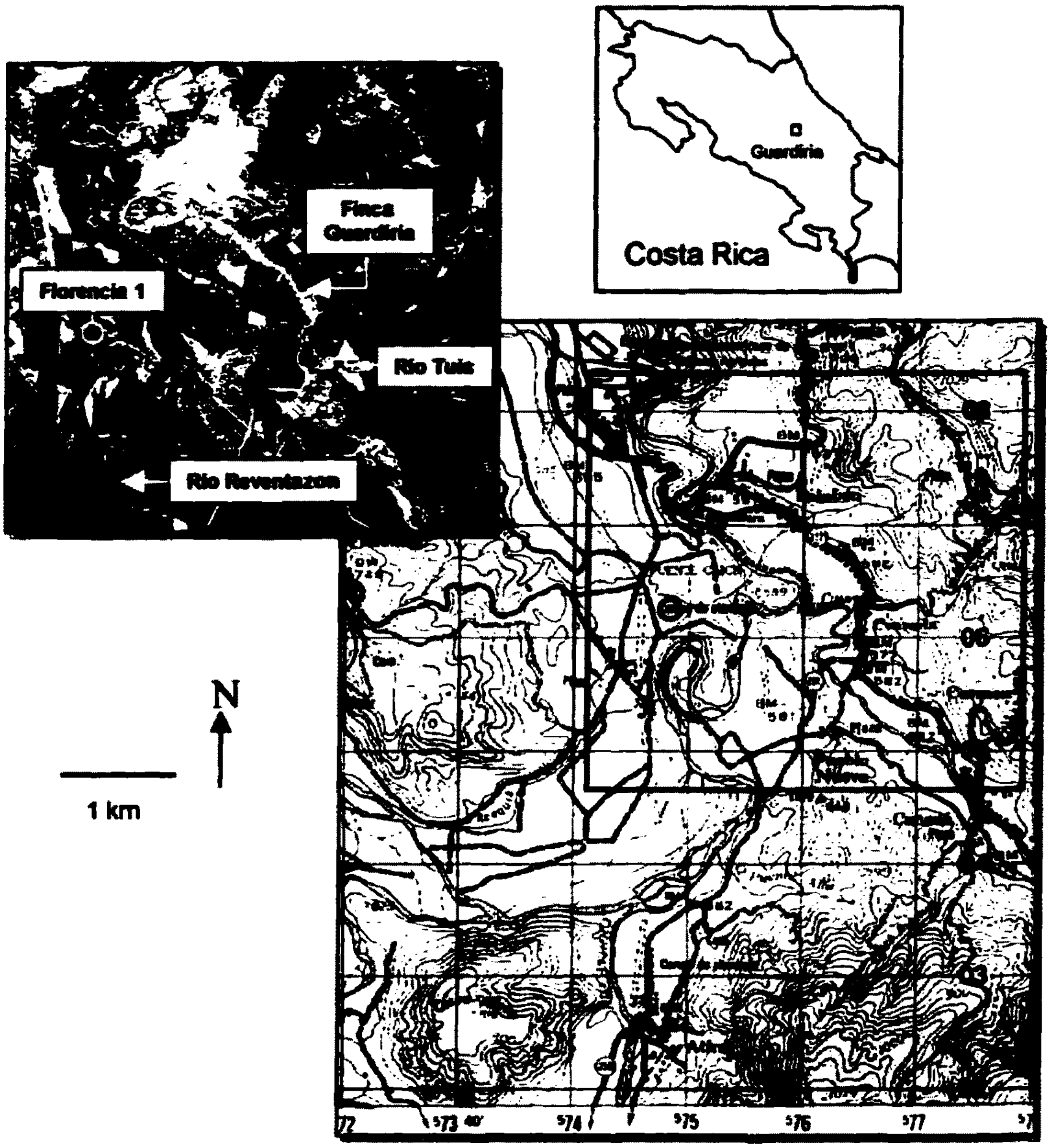


Figure 11. Guardiria, aerial view of site, Turrialba Valley, Costa Rica.

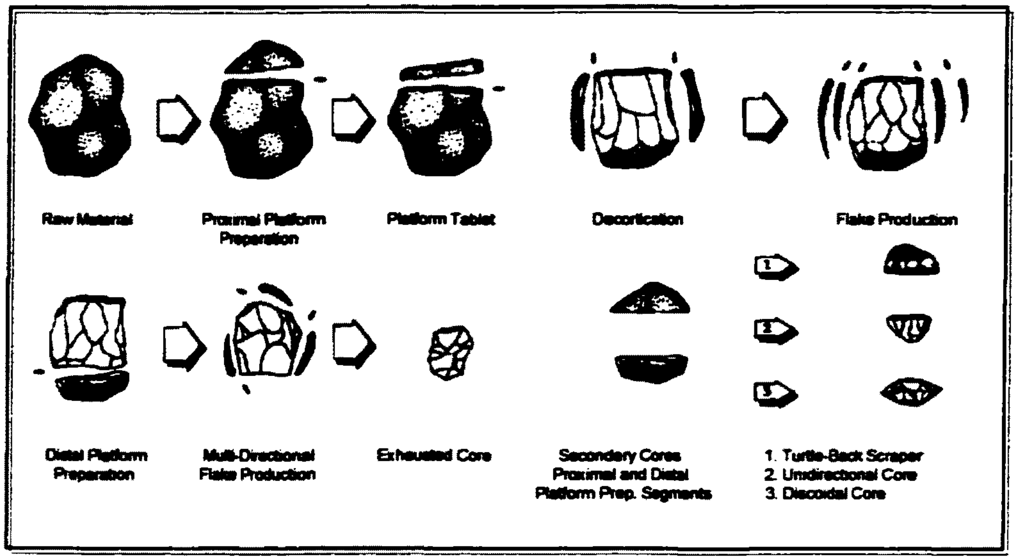


Figure 12. Guardiria, core reduction strategy.

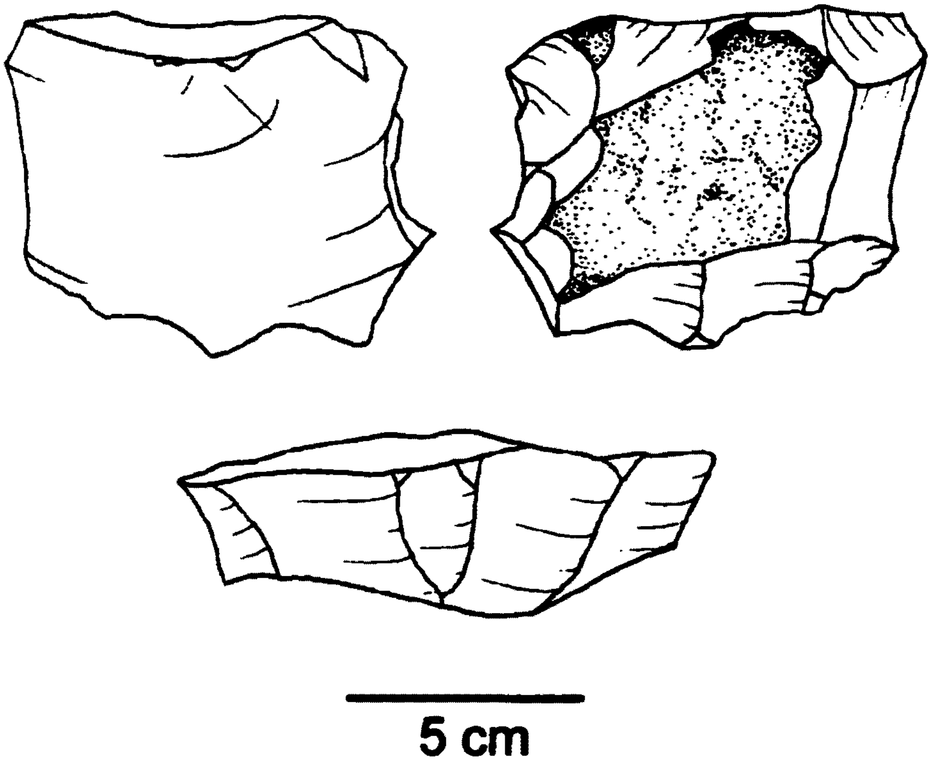


Figure 13. Guardiria, core base rejuvenation segment.

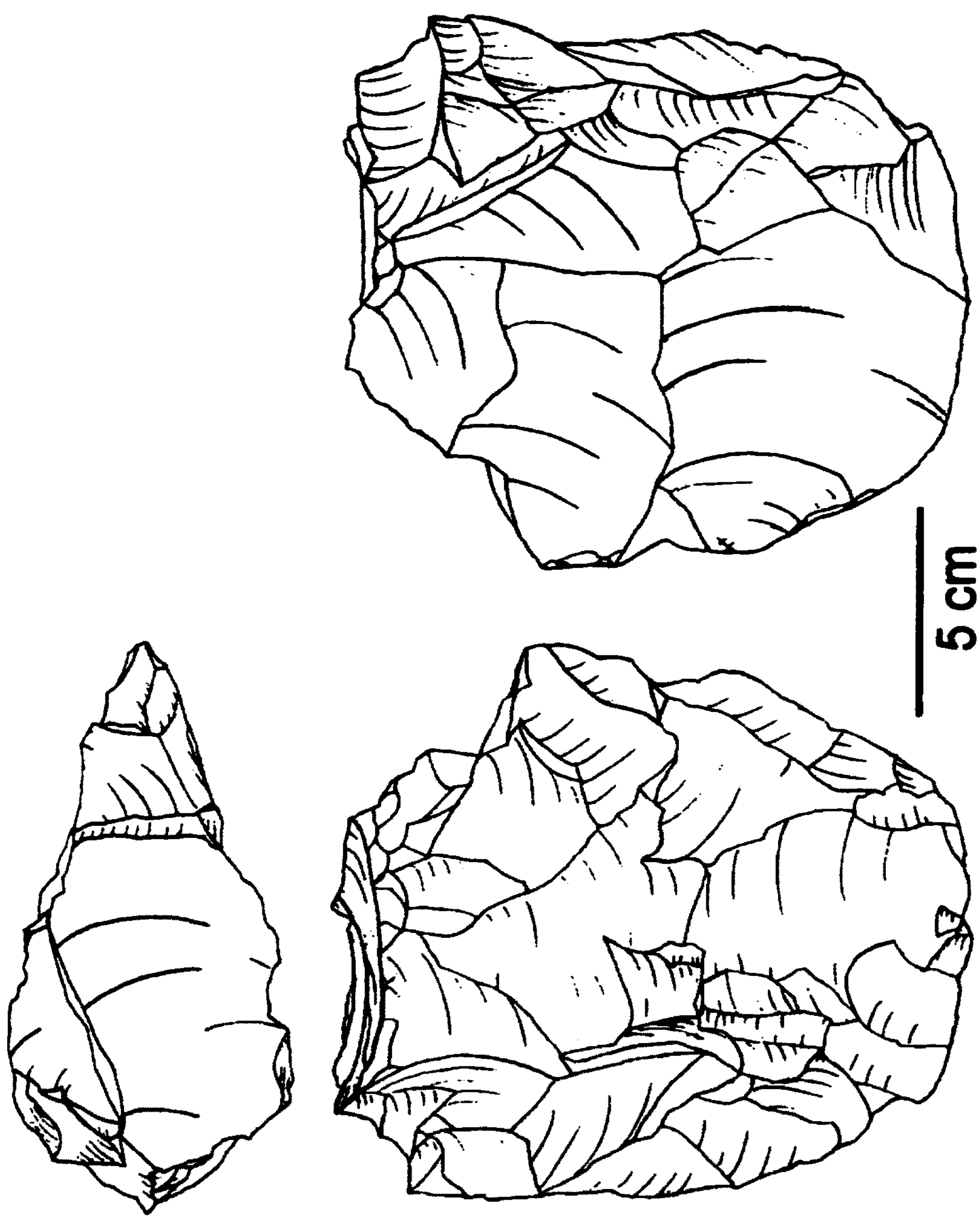


Figure 14. Guardiria, large bifacial flake core.

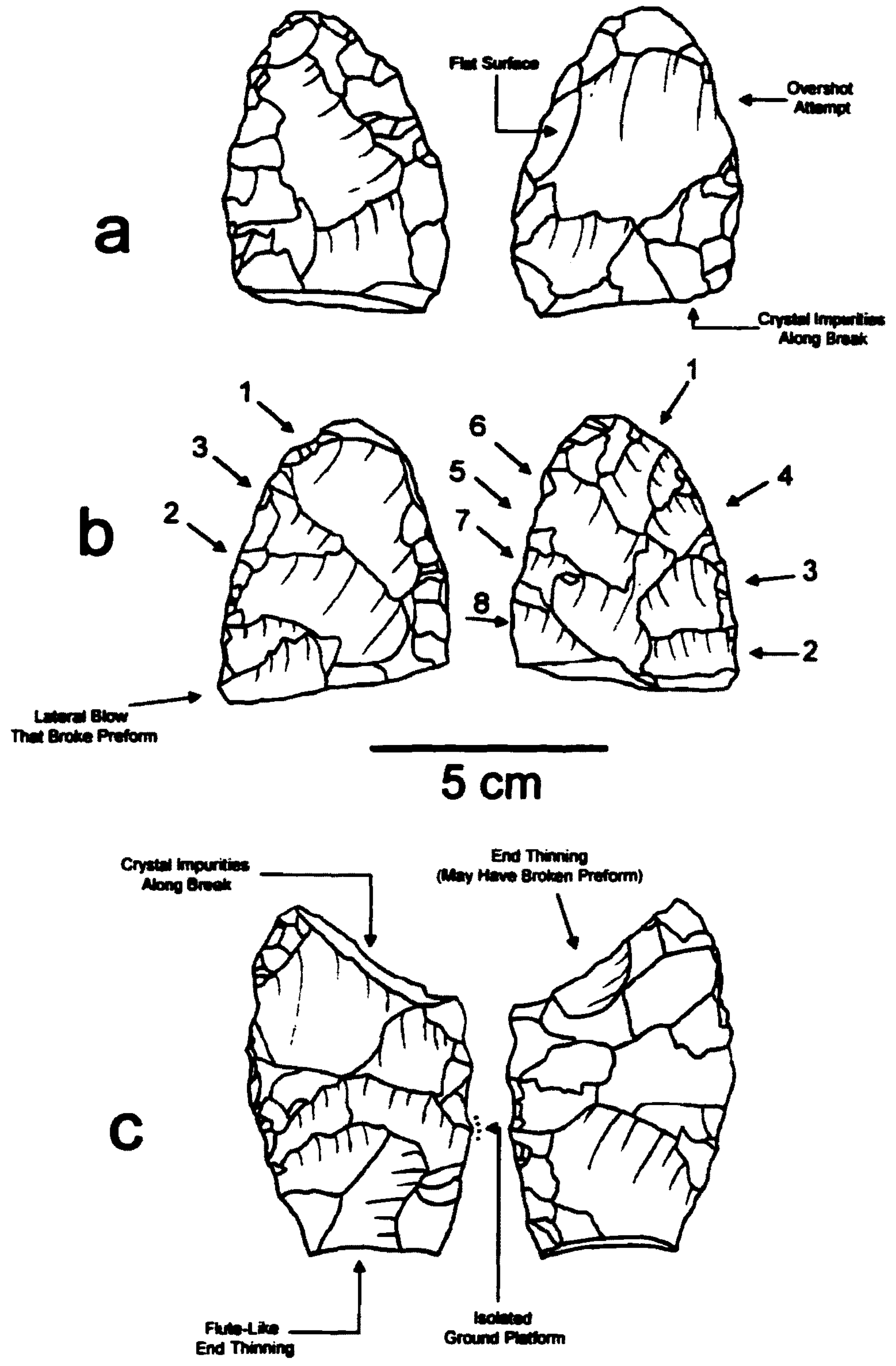
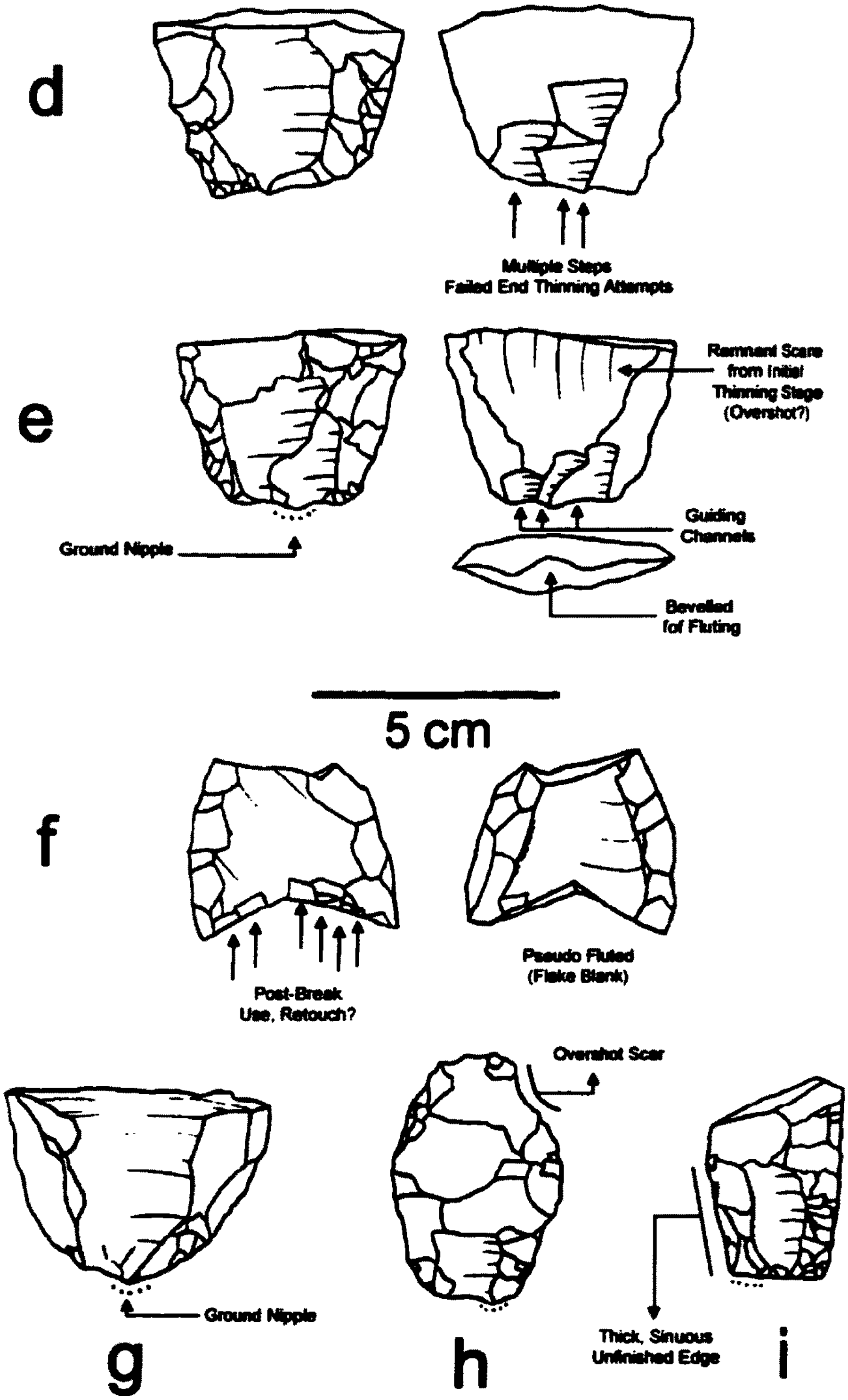


Figure 15. Guardiria, bifaces and point preforms.



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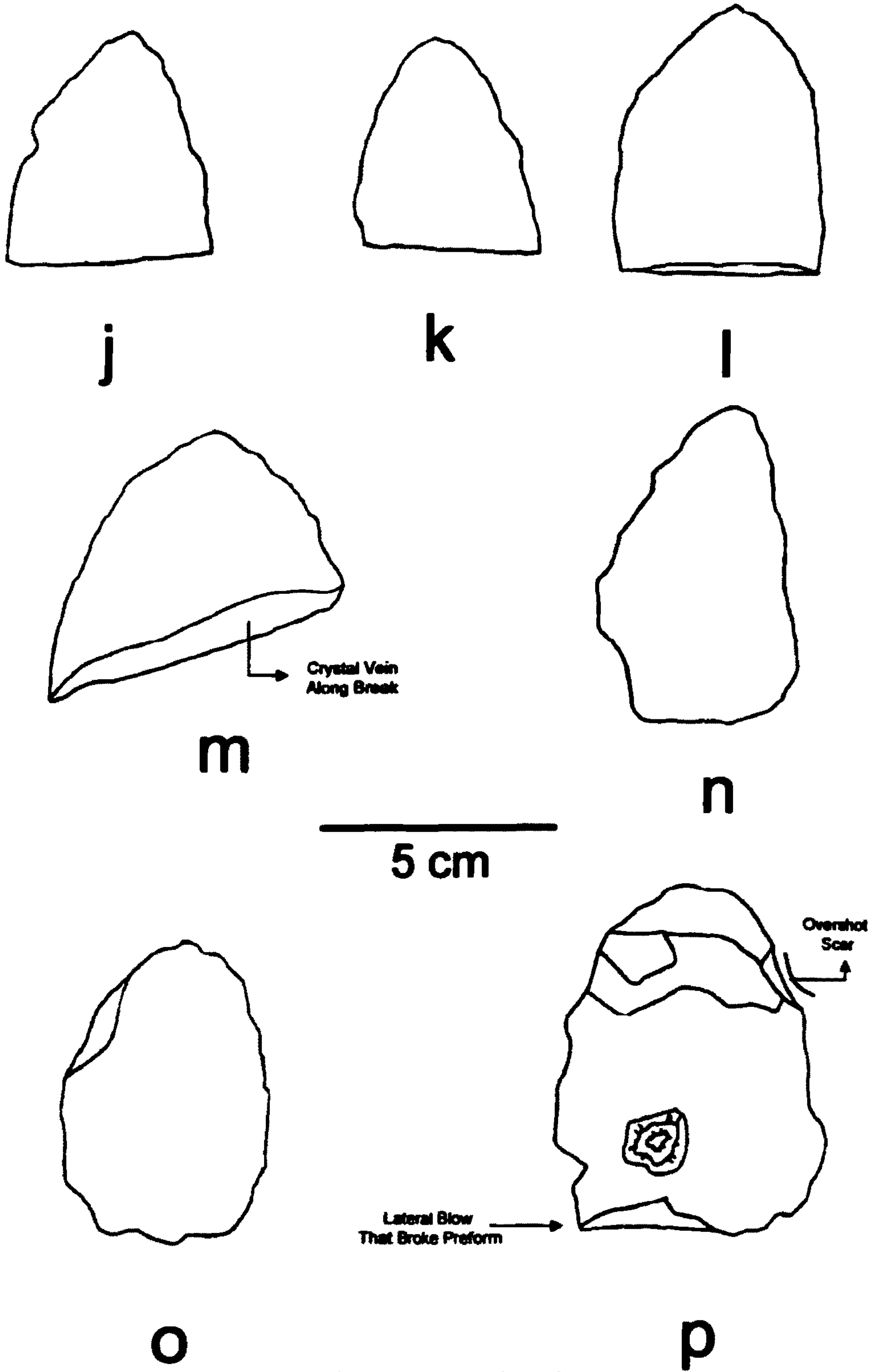

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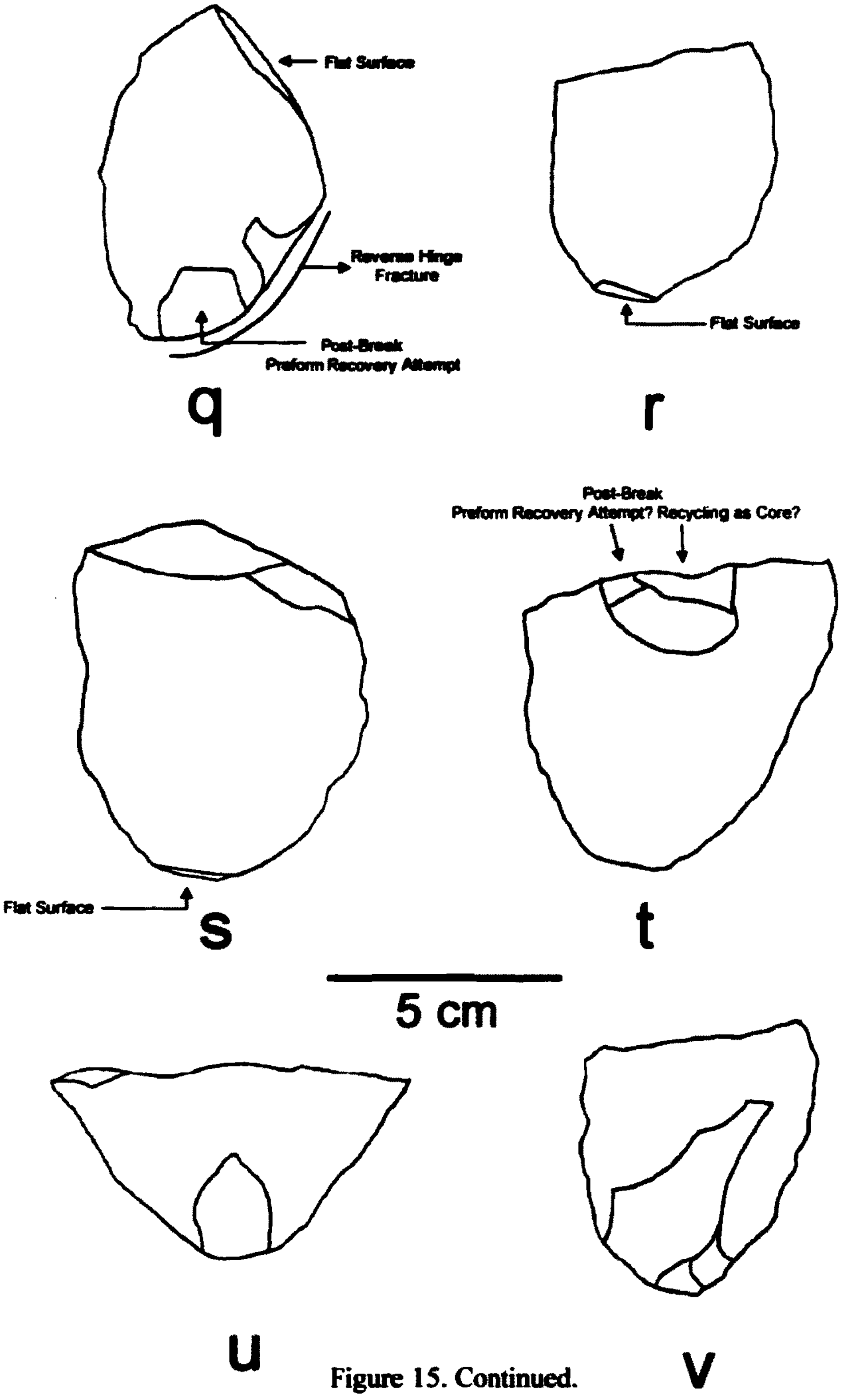

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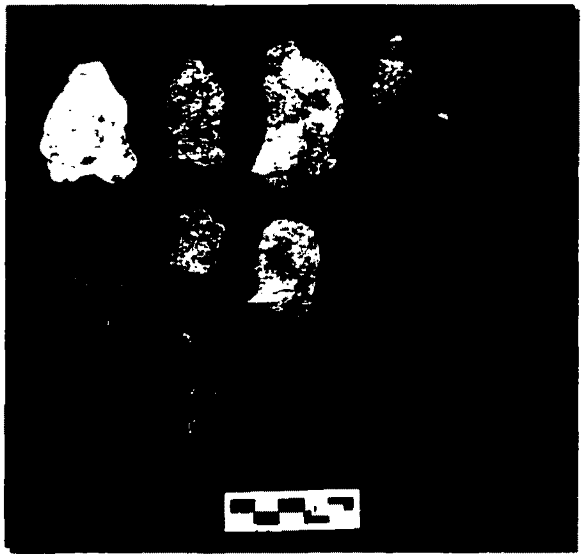


Figure 16. Guardiria, bifacial thinning flakes.

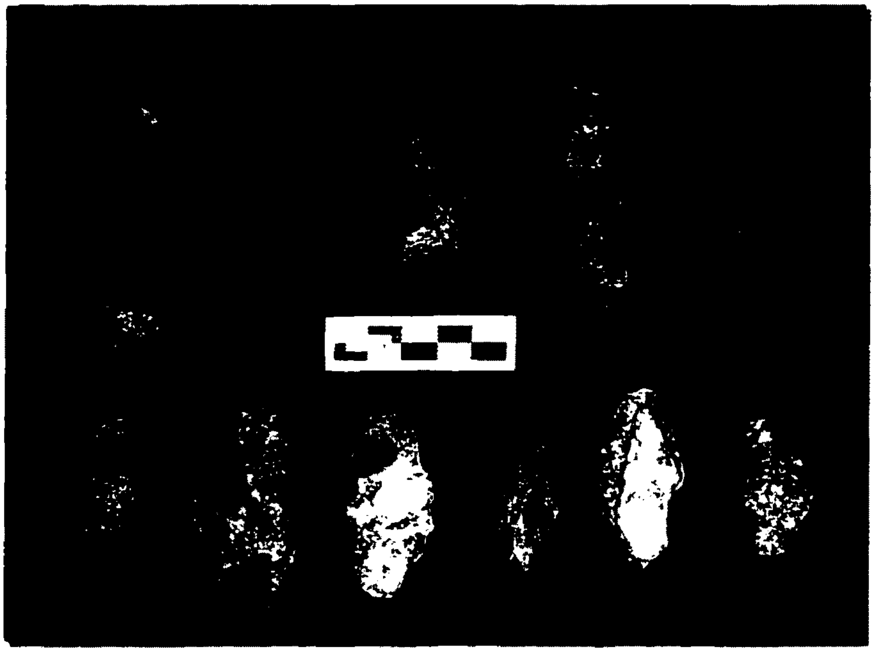


Figure 17. Guardiria, keeled scrapers and planes (*limaces*).

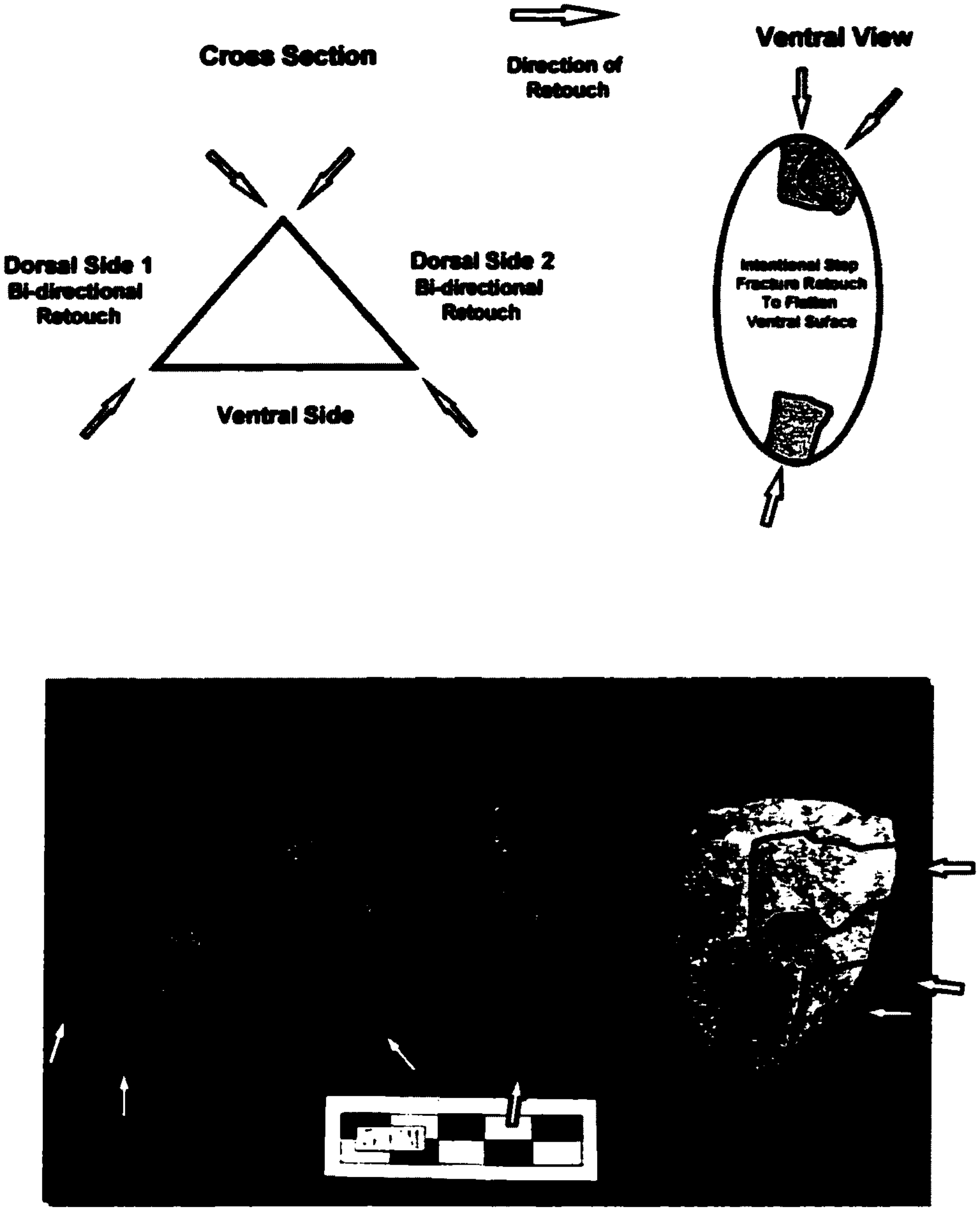


Figure 18. Guardiria, keeled scraper (*limace*) manufacturing technique.

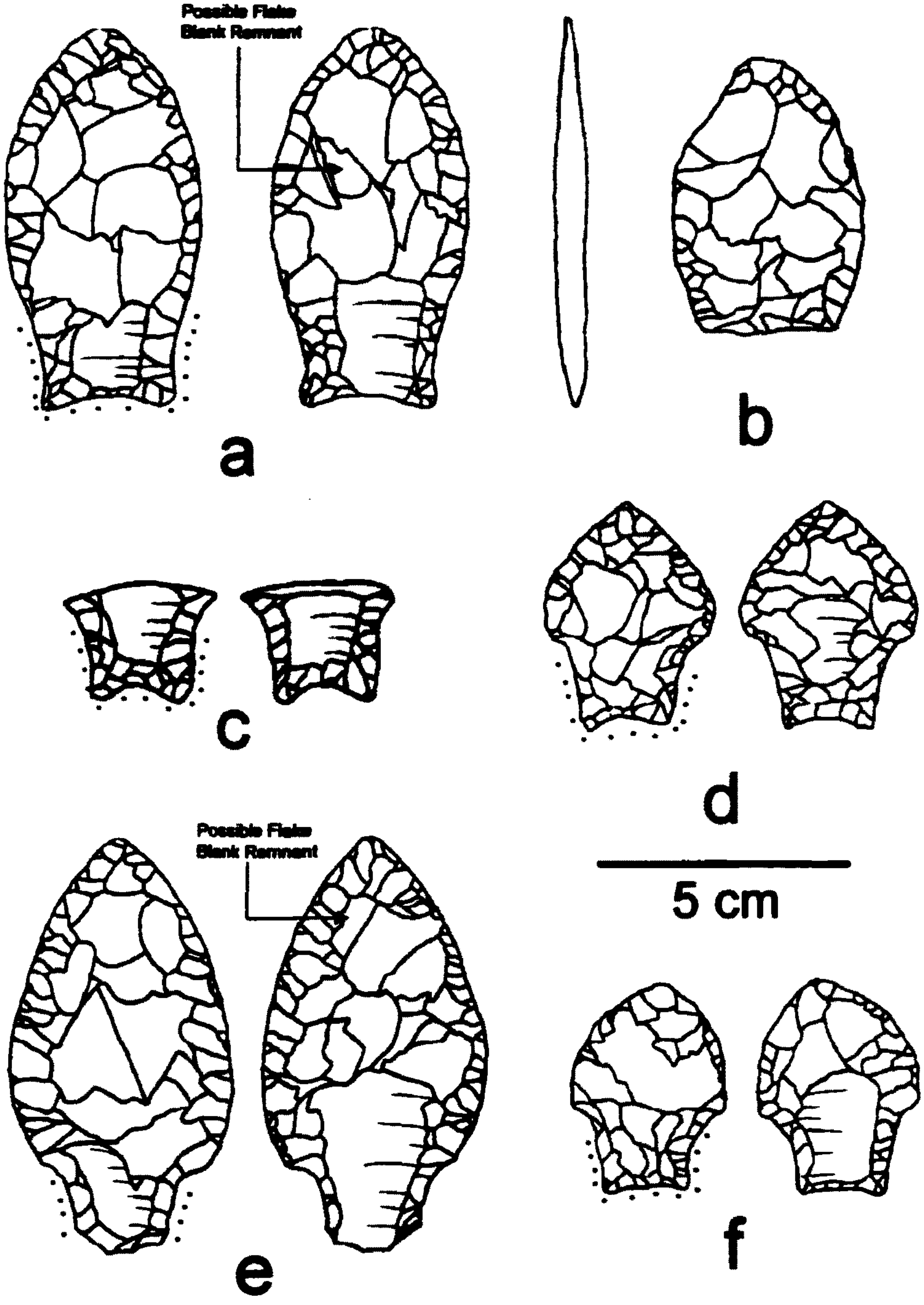
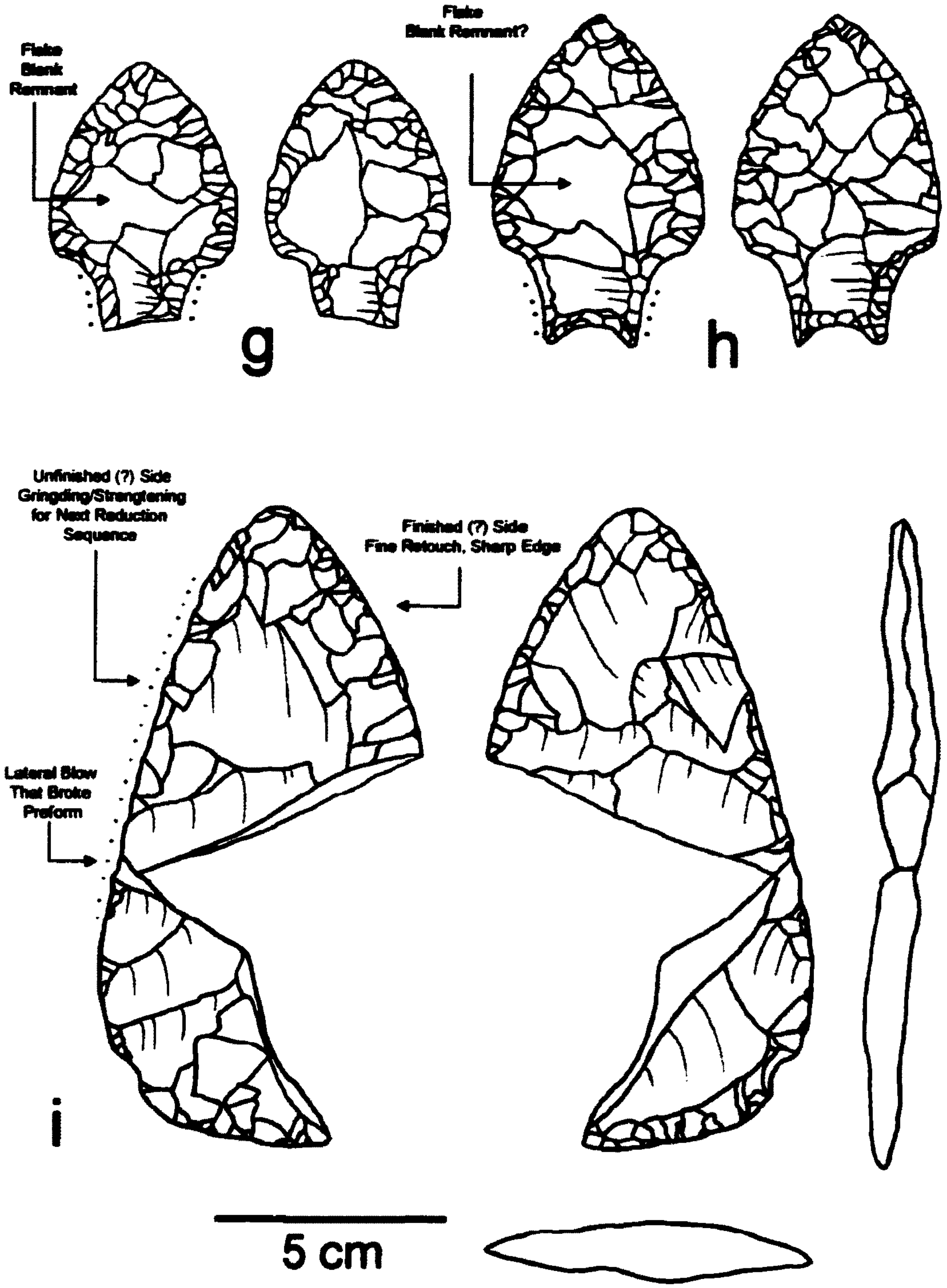


Figure 19. Lake Alajuela, projectile points and bifaces.



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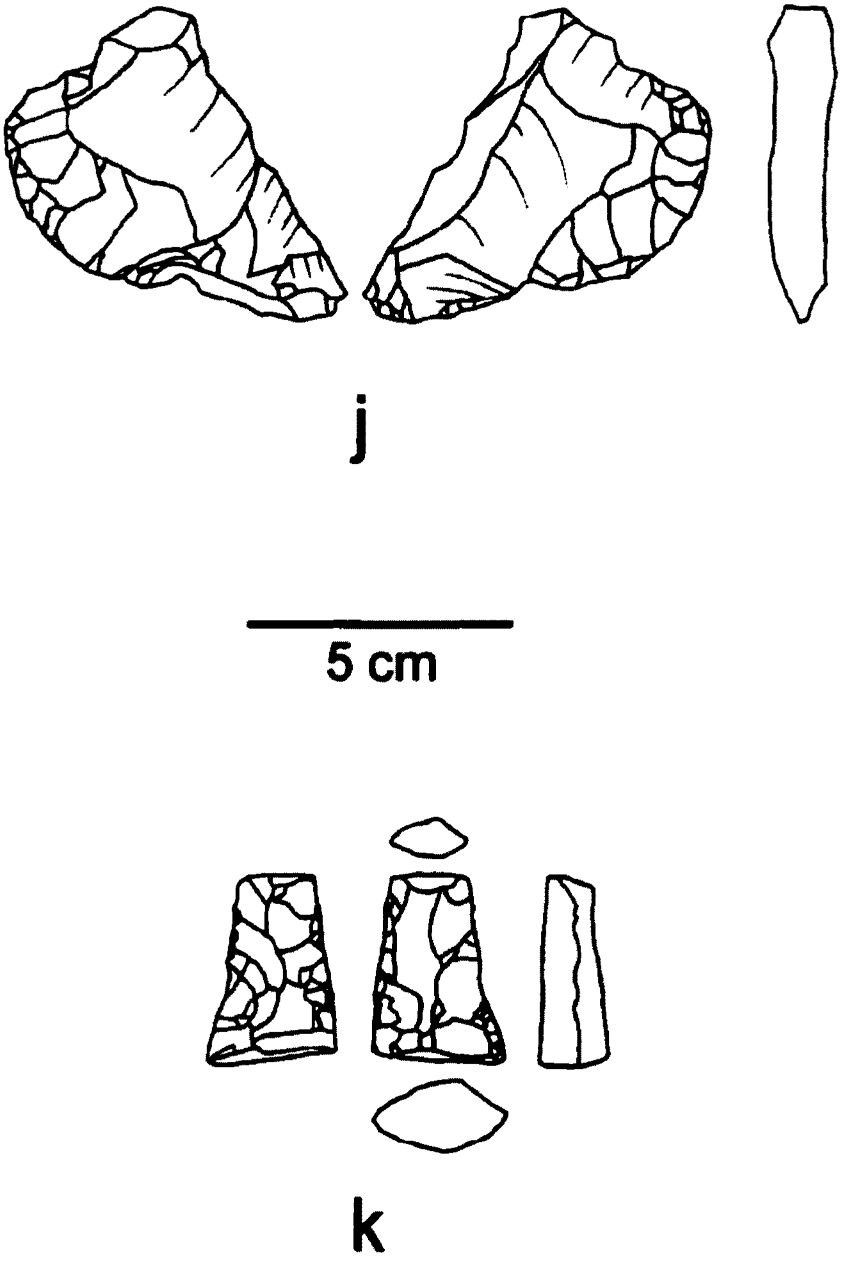

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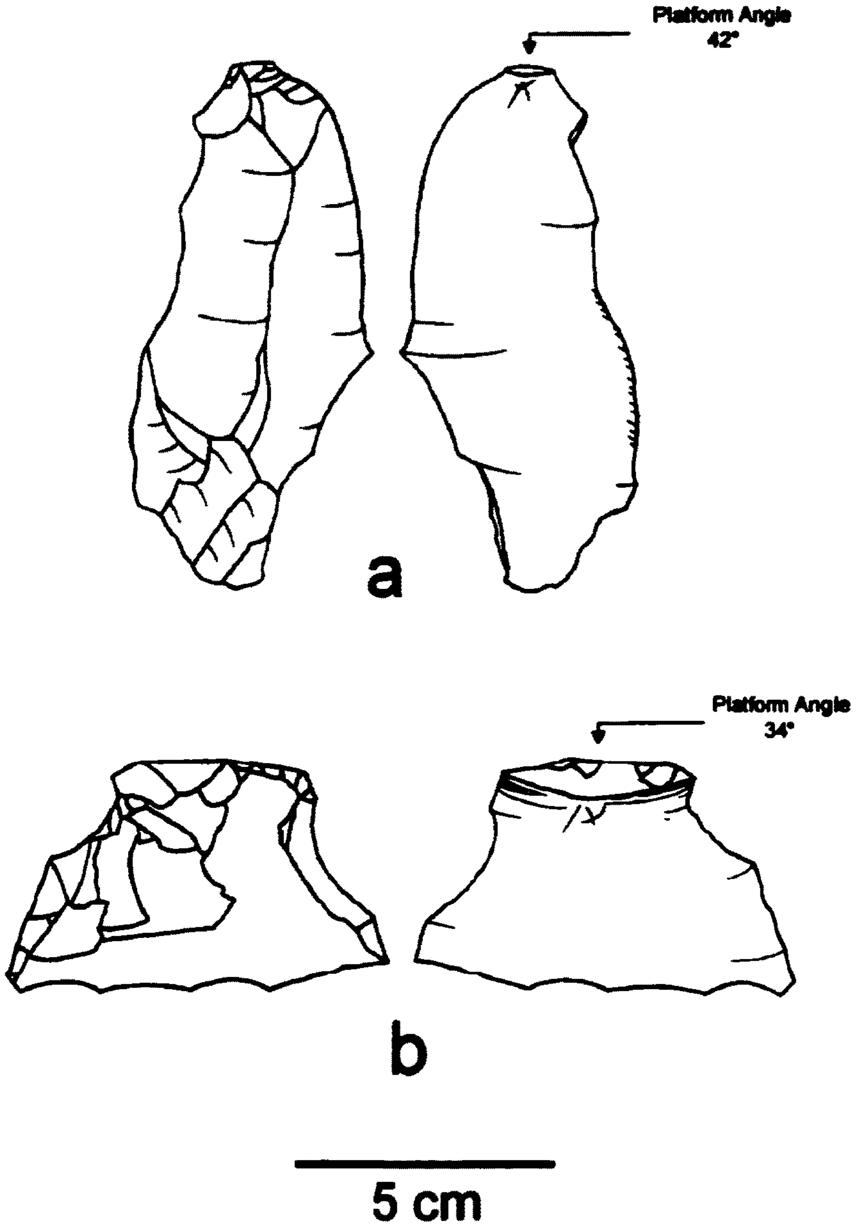
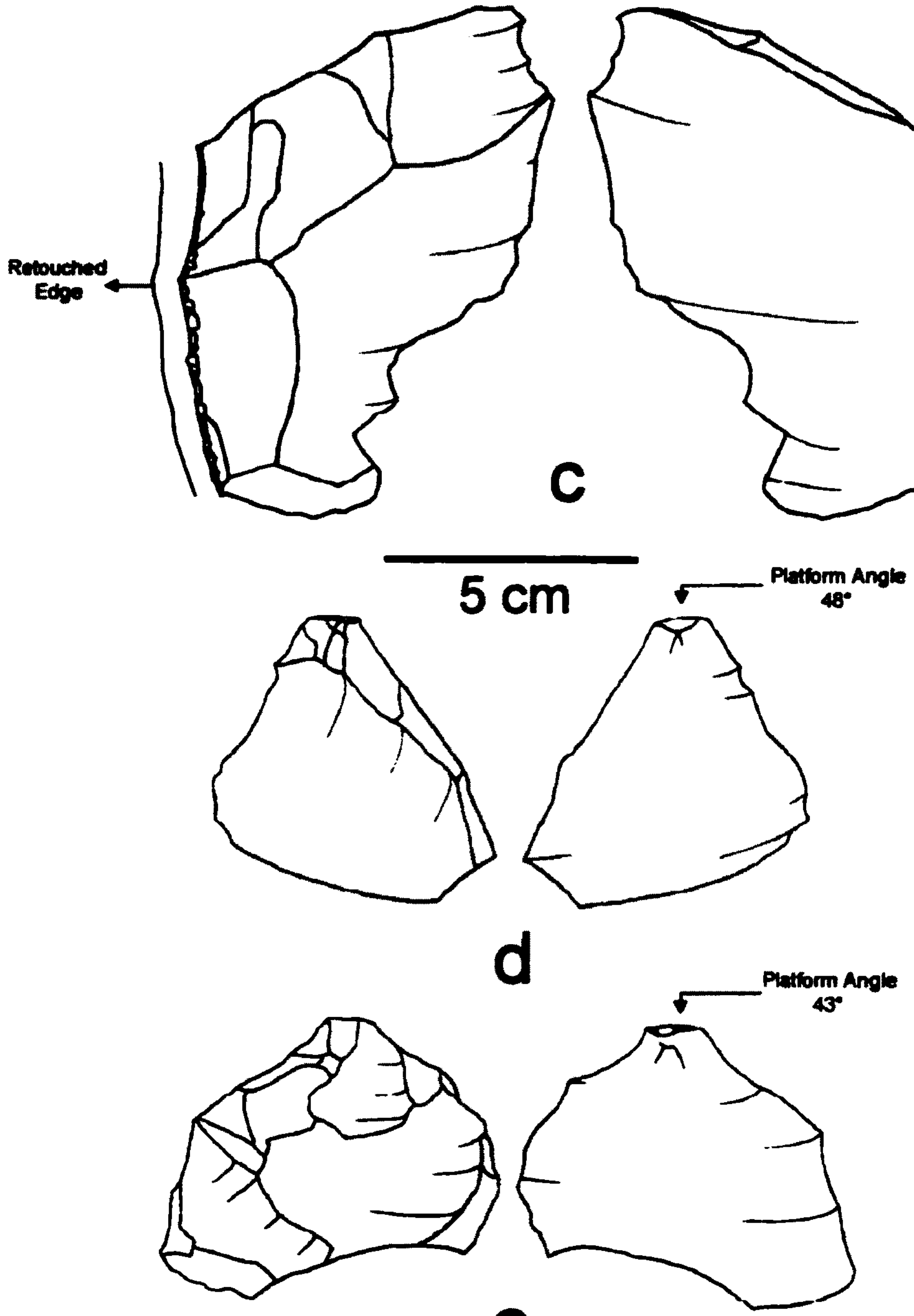


Figure 20. Lake Alajuela, Westend site, large bifacial thinning flakes.



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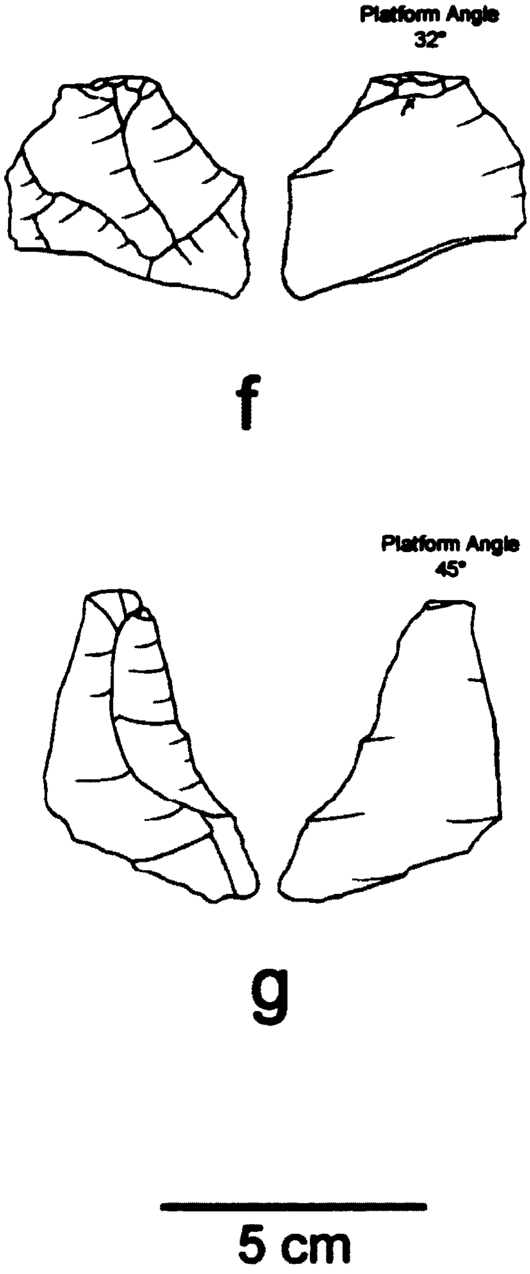

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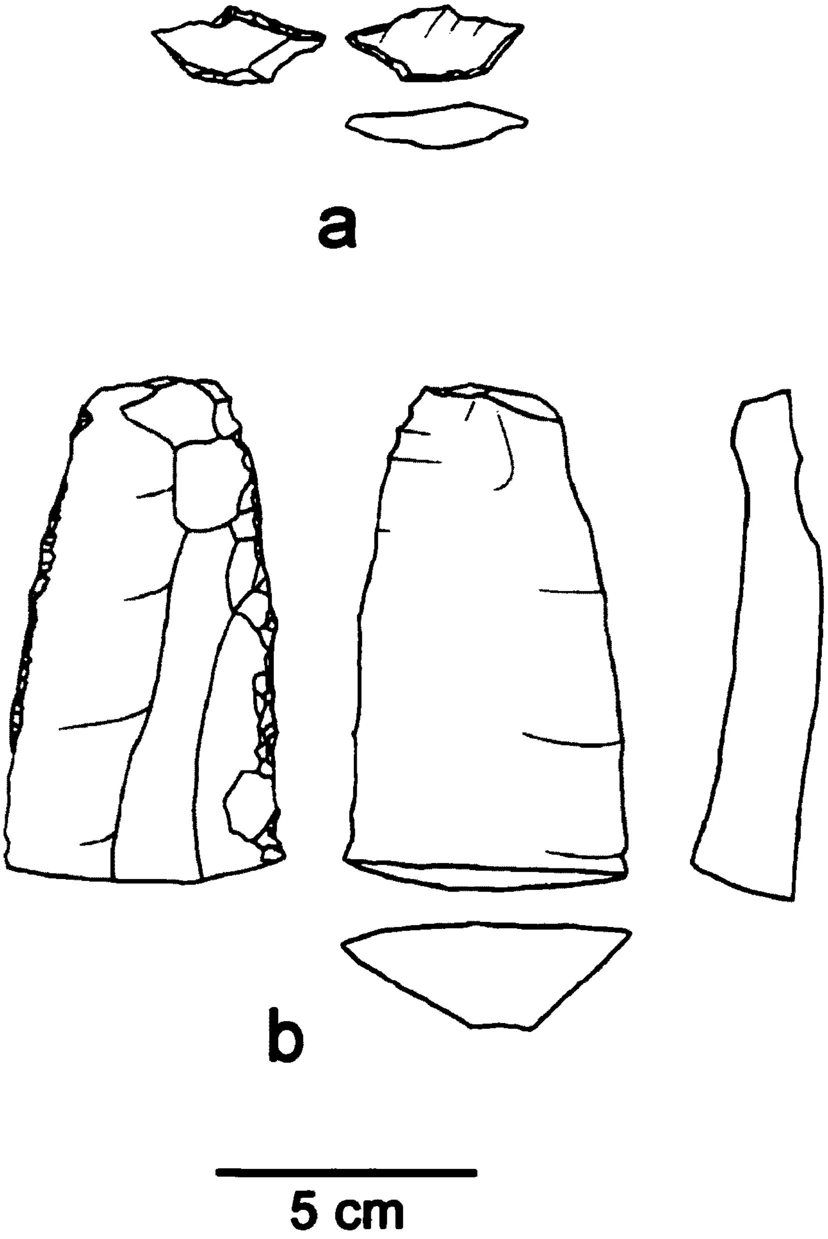


Figure 21. Lake Alajuela, graver and large retouched blade.

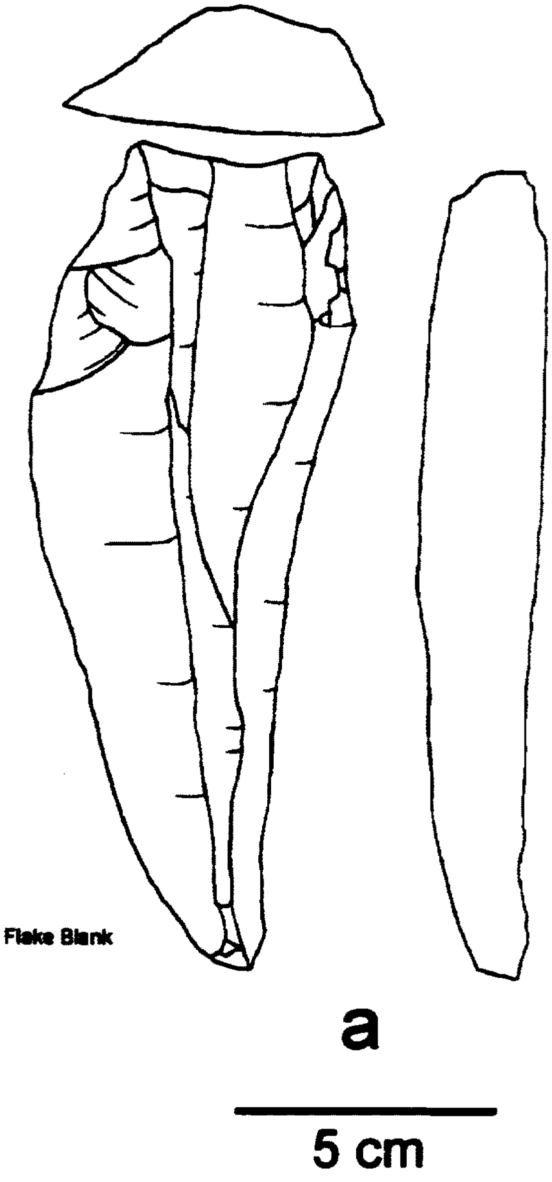


Figure 22. Lake Alajuela, large keeled/scraper planes.

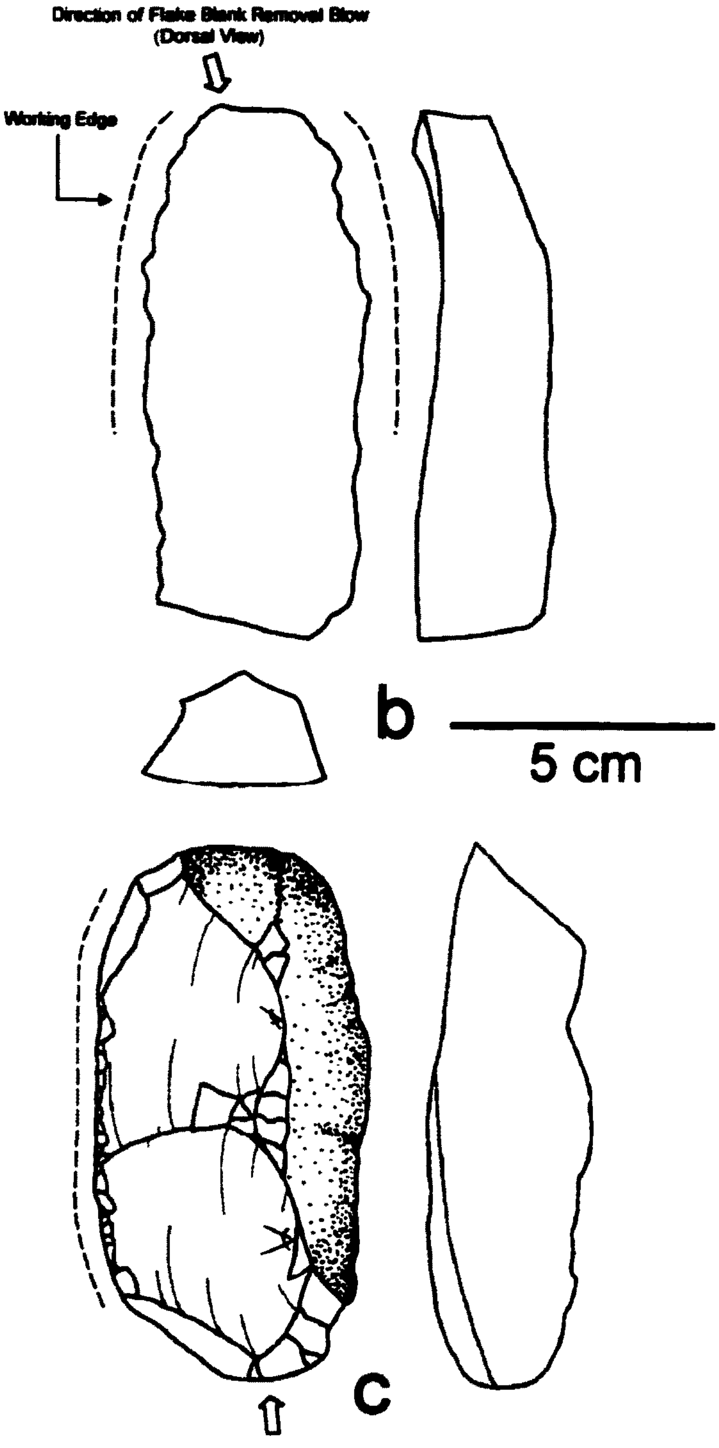
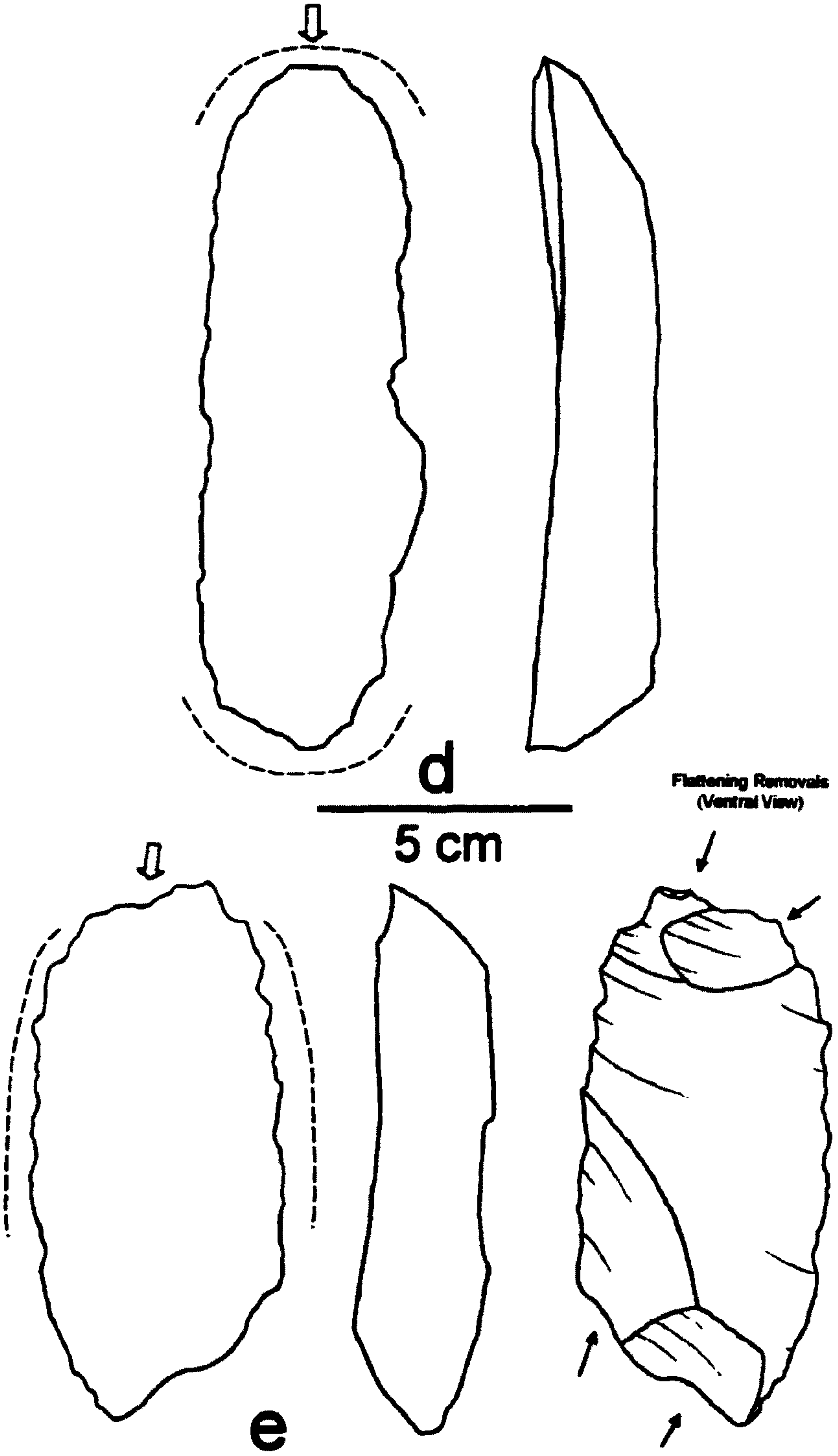


Figure 22. Continued.



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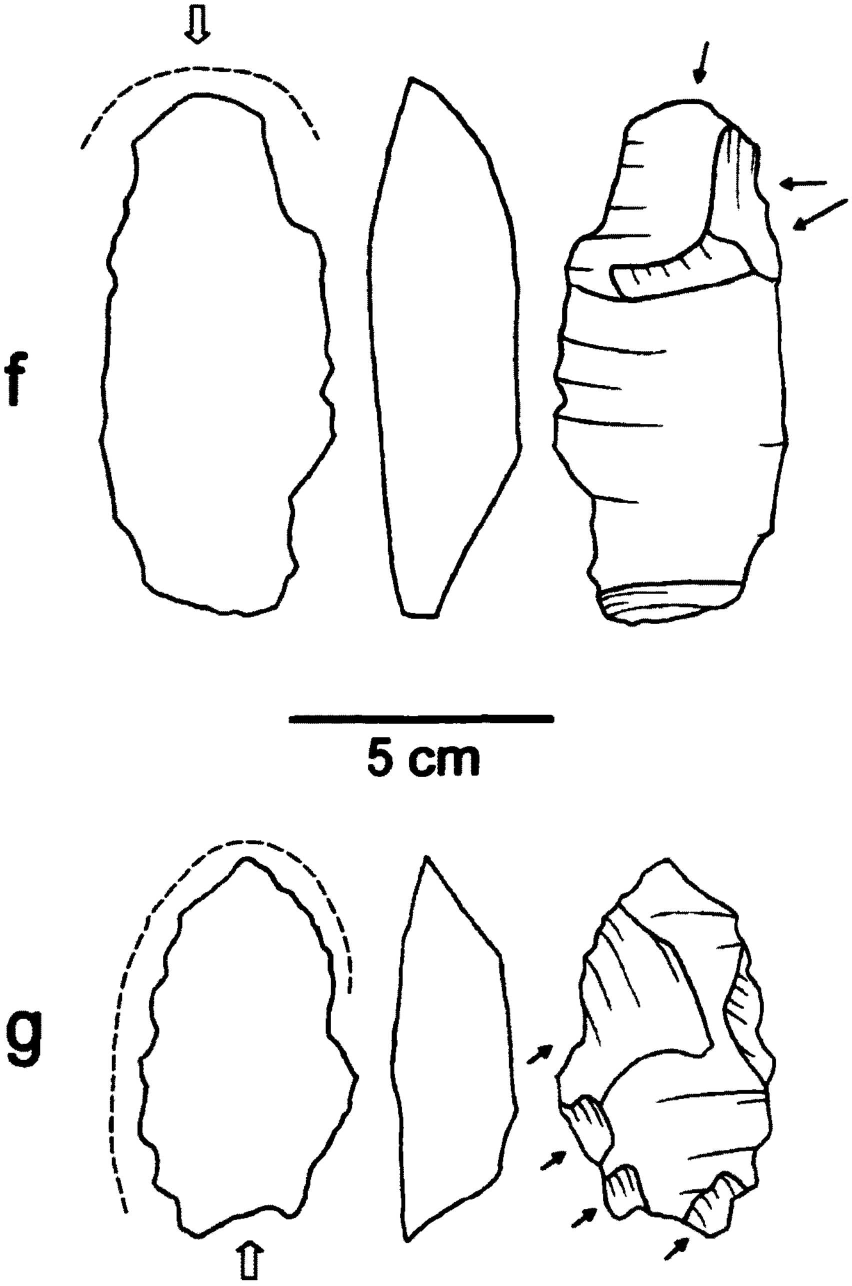

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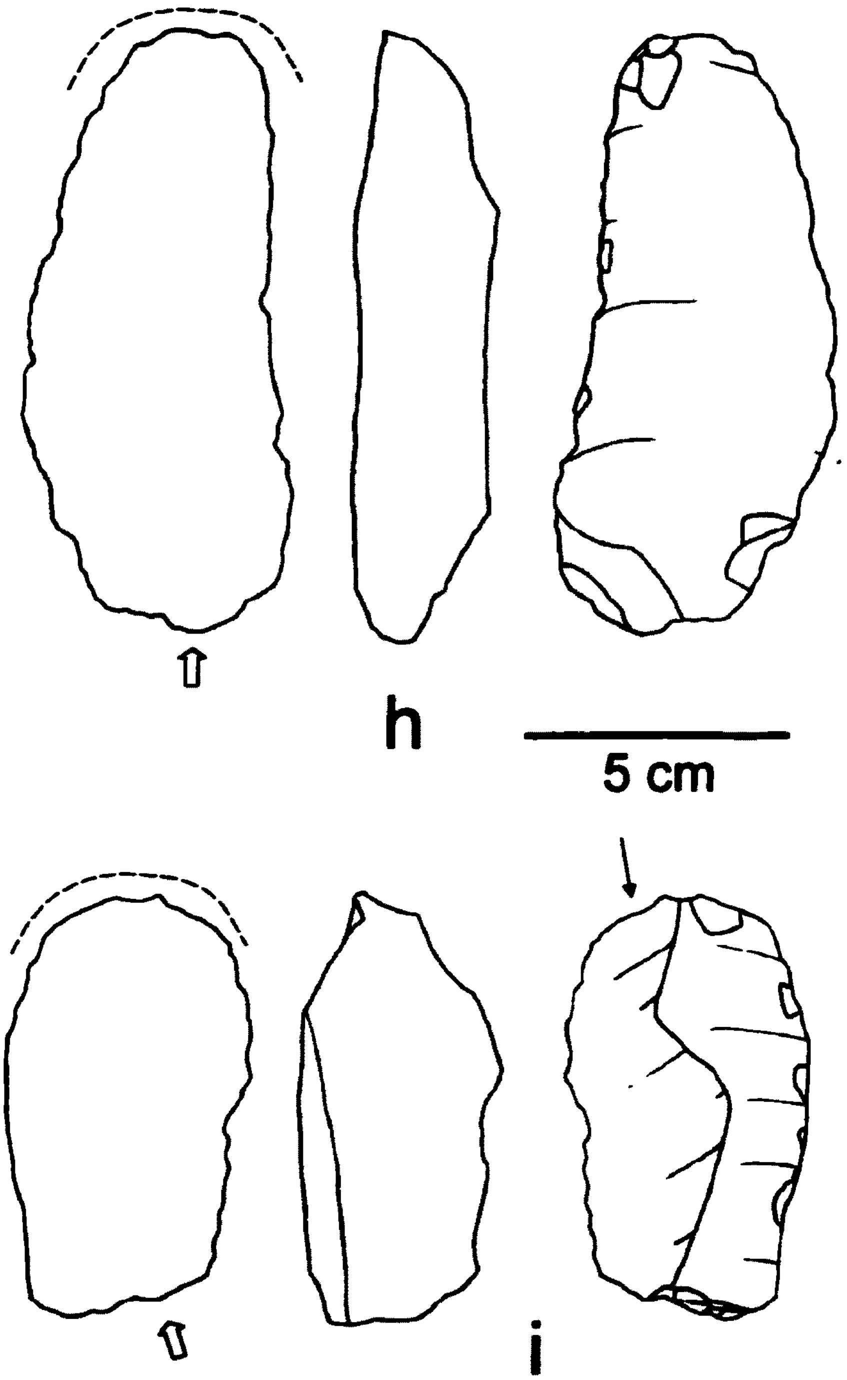

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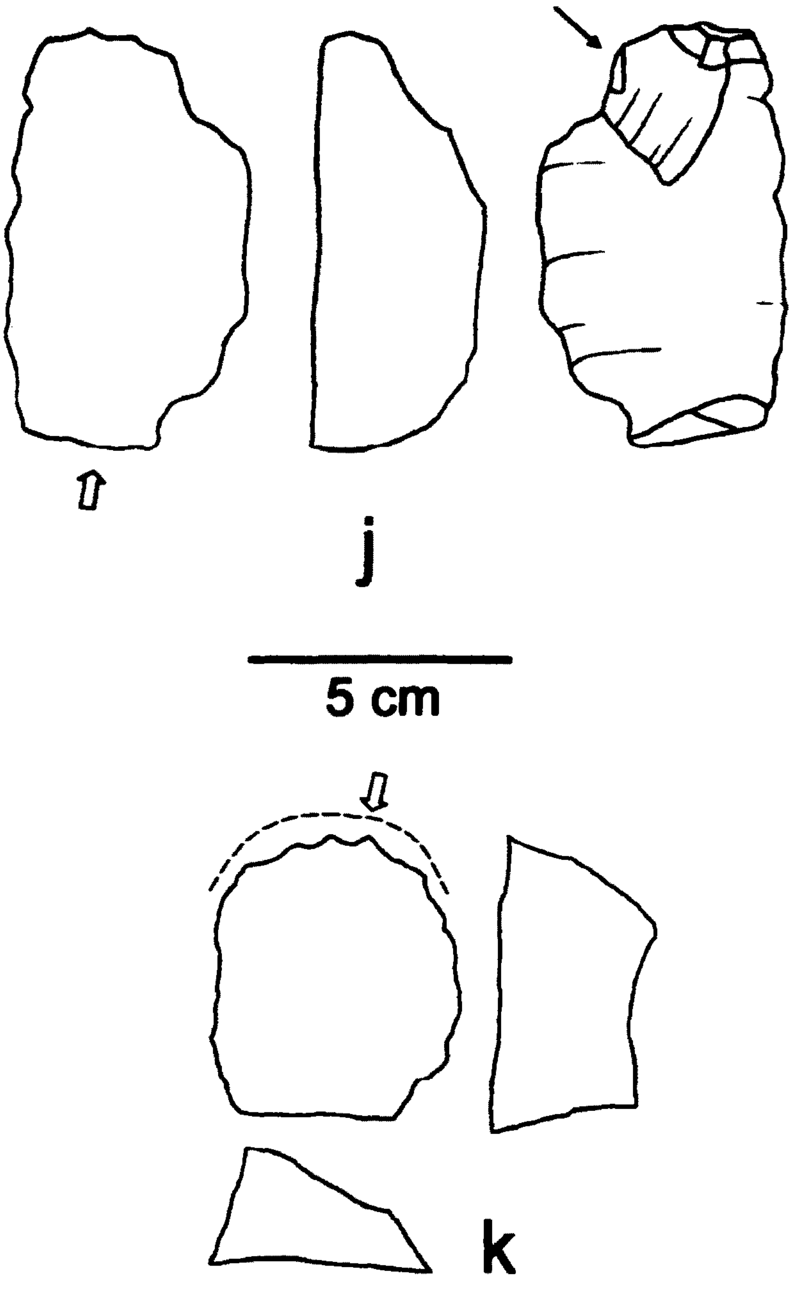

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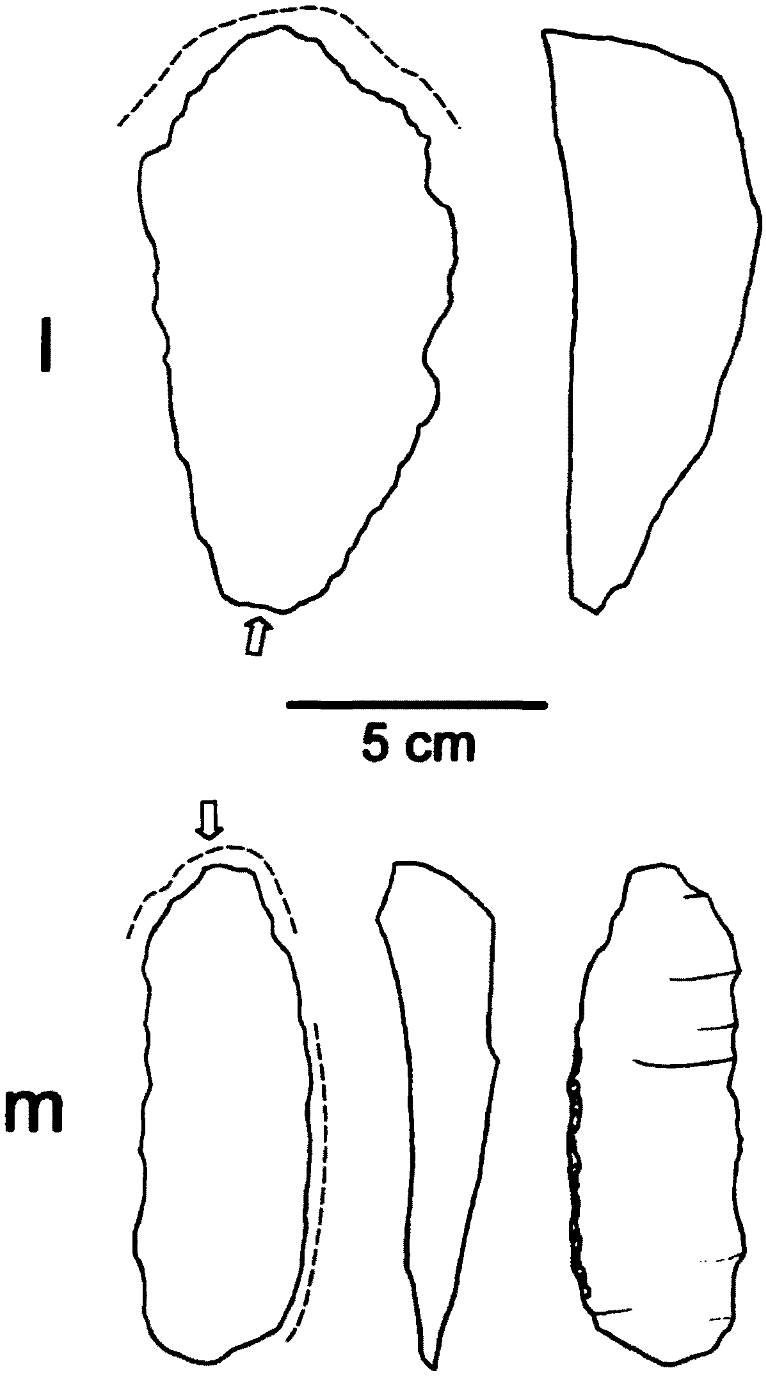

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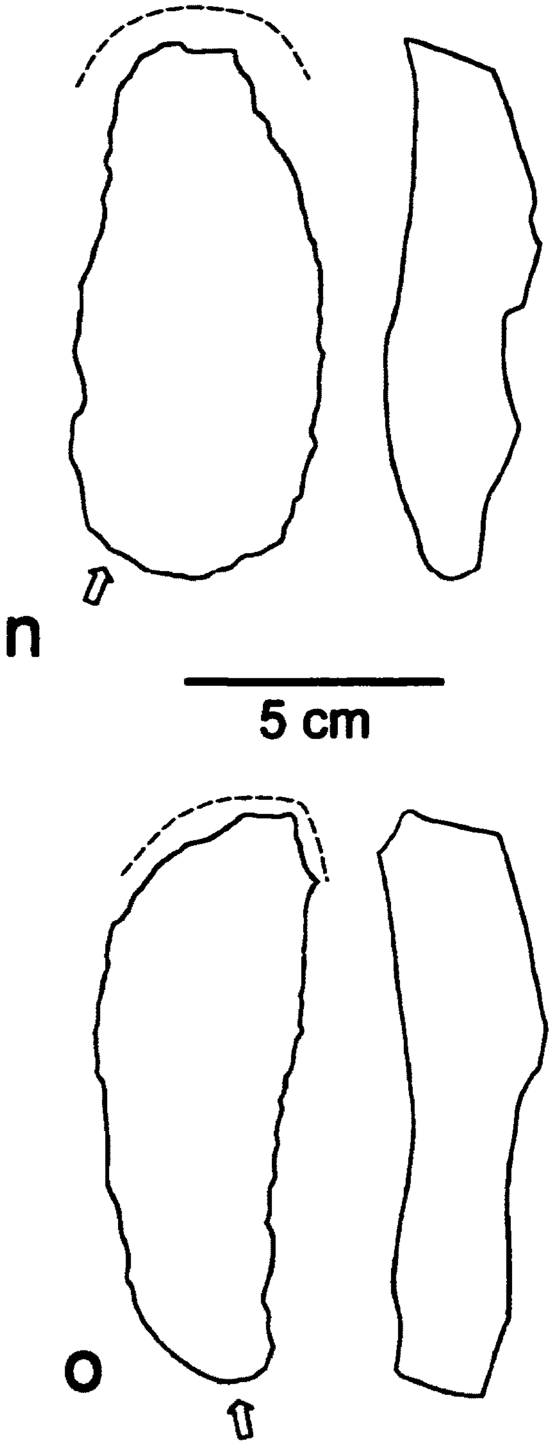

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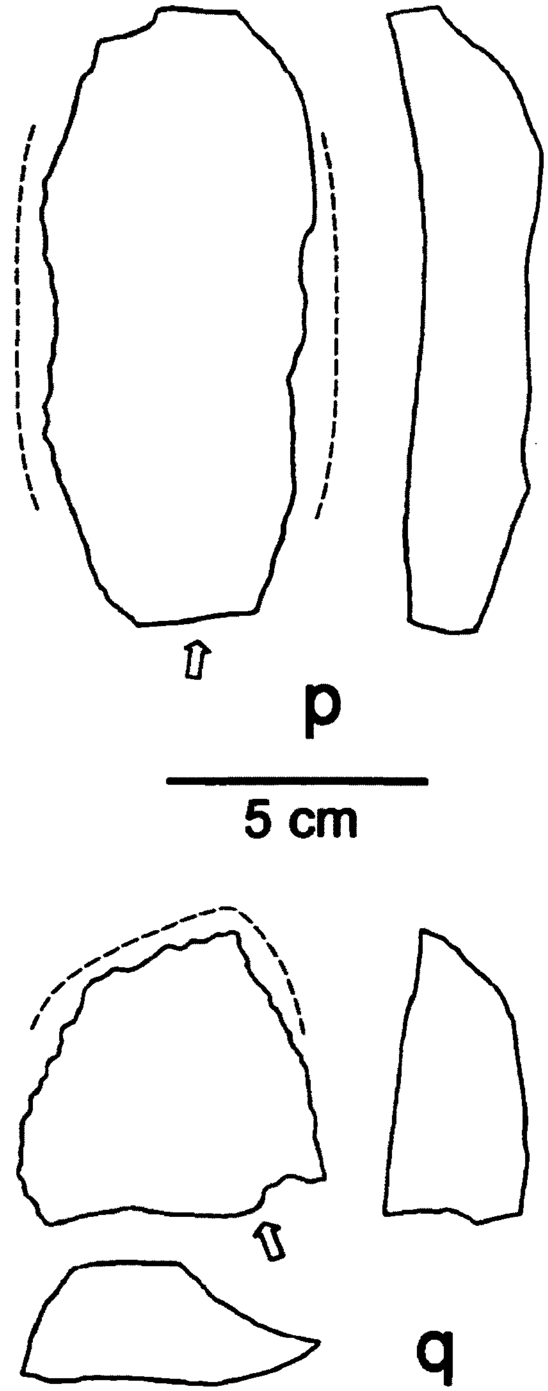

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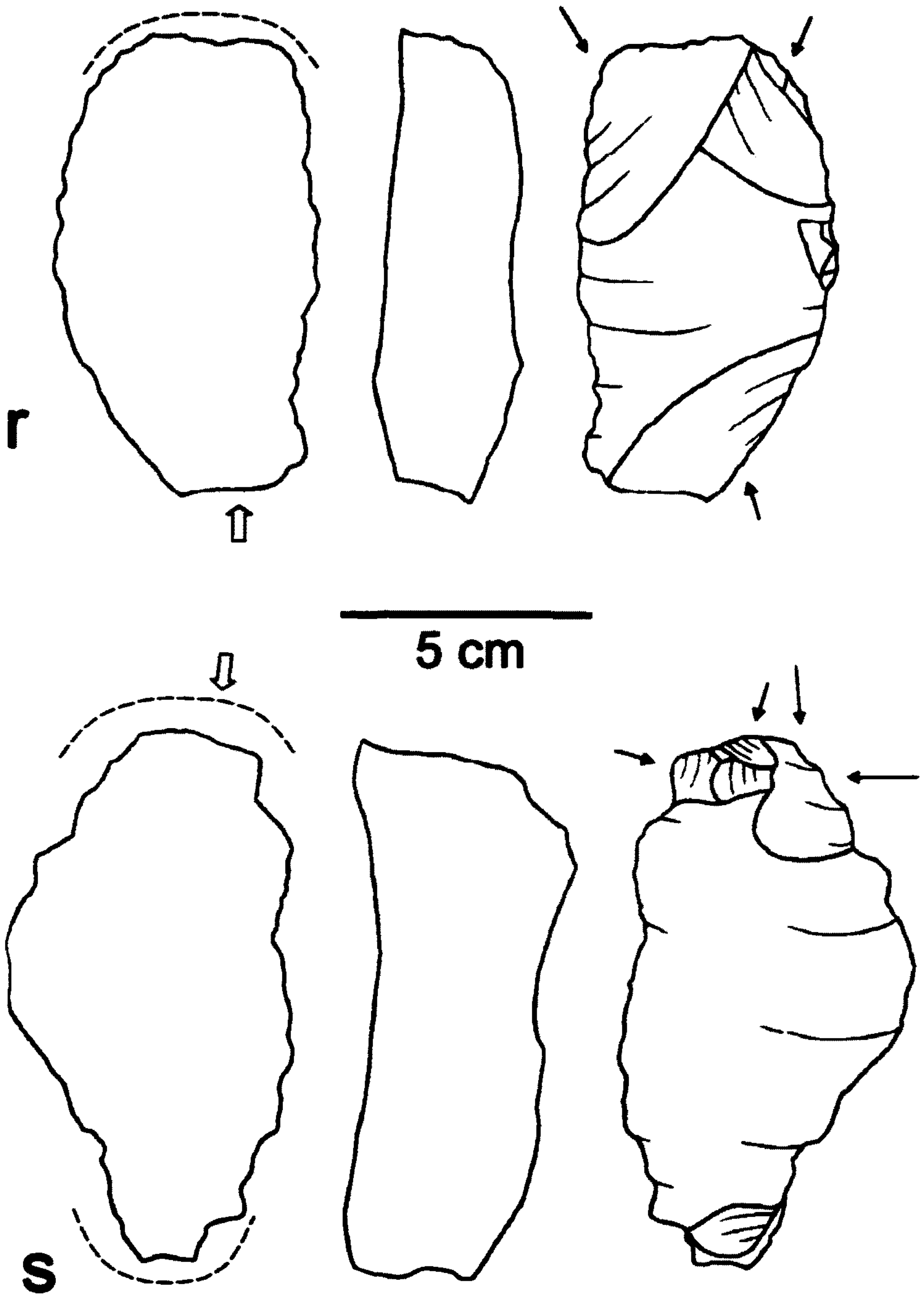

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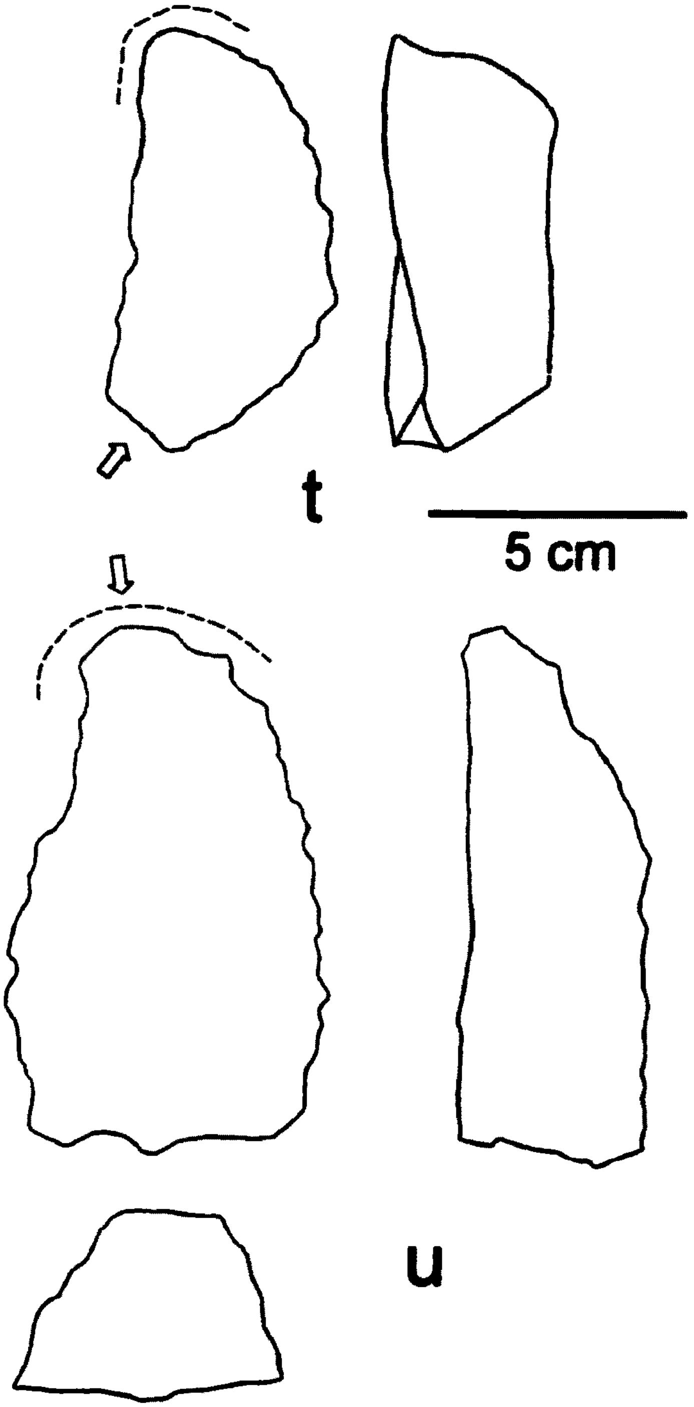

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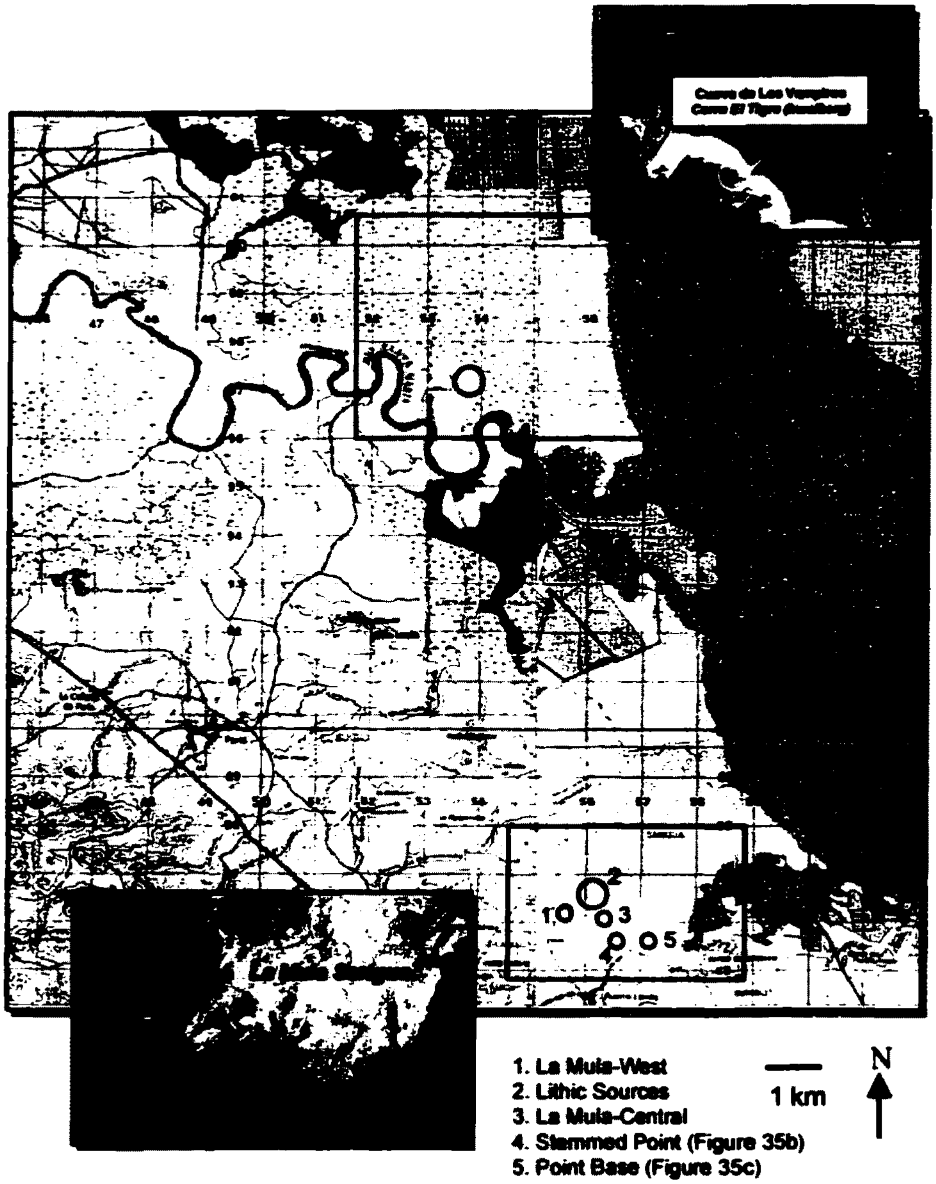


Figure 23. Aerial view of Parita Bay showing the locations of La Mula-West and Cueva de Los Vampiros.

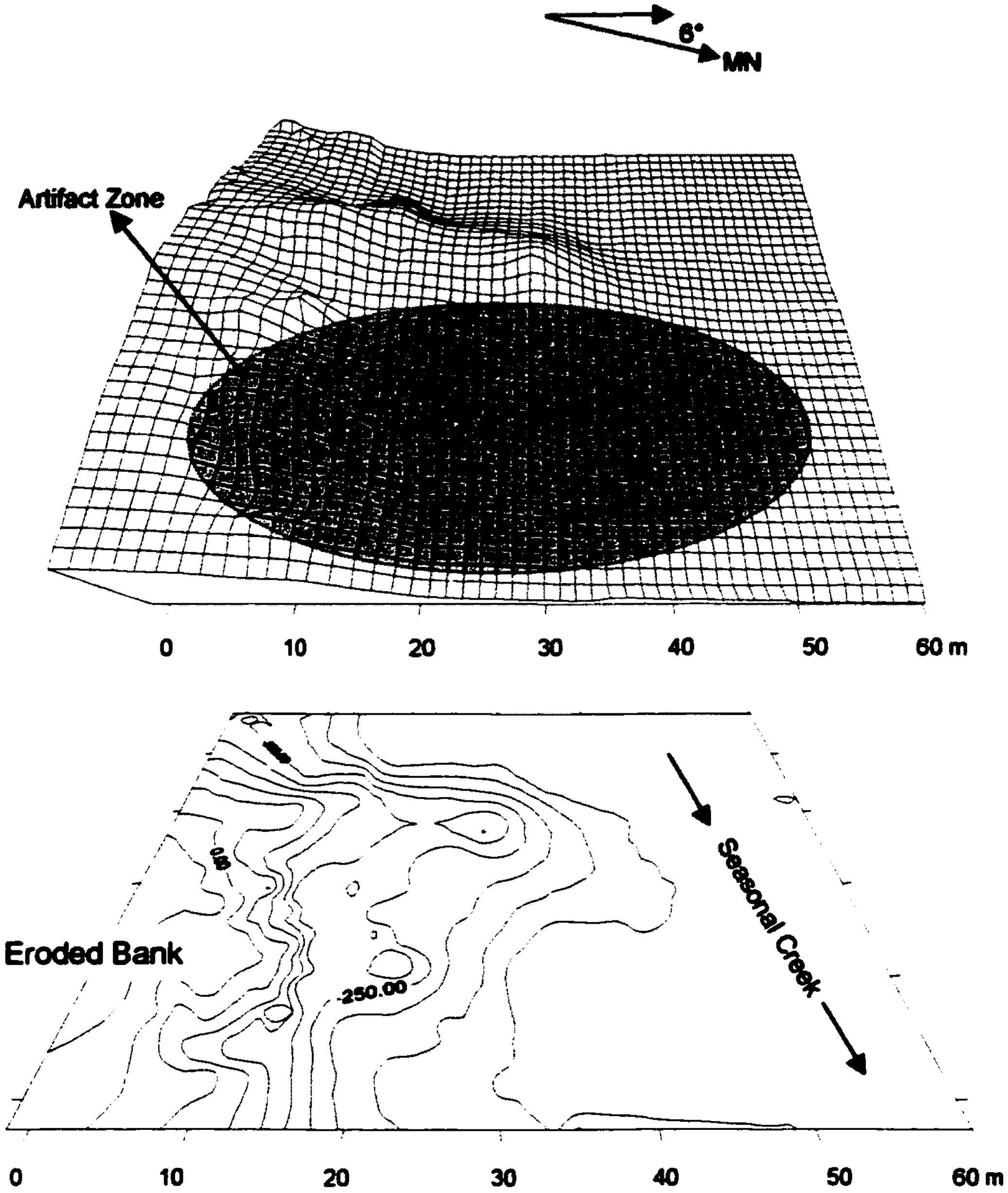


Figure 24. Map of the La Mula-West site.

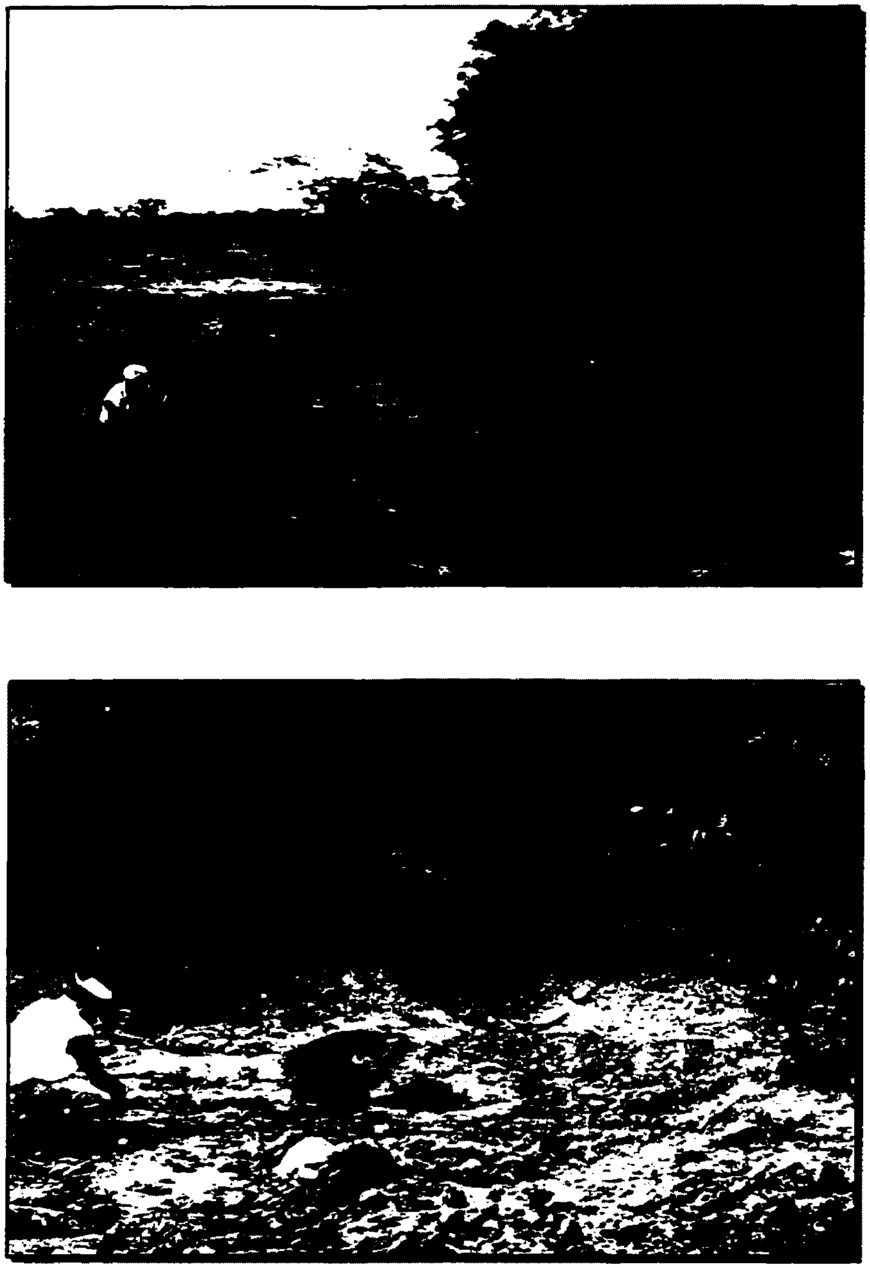
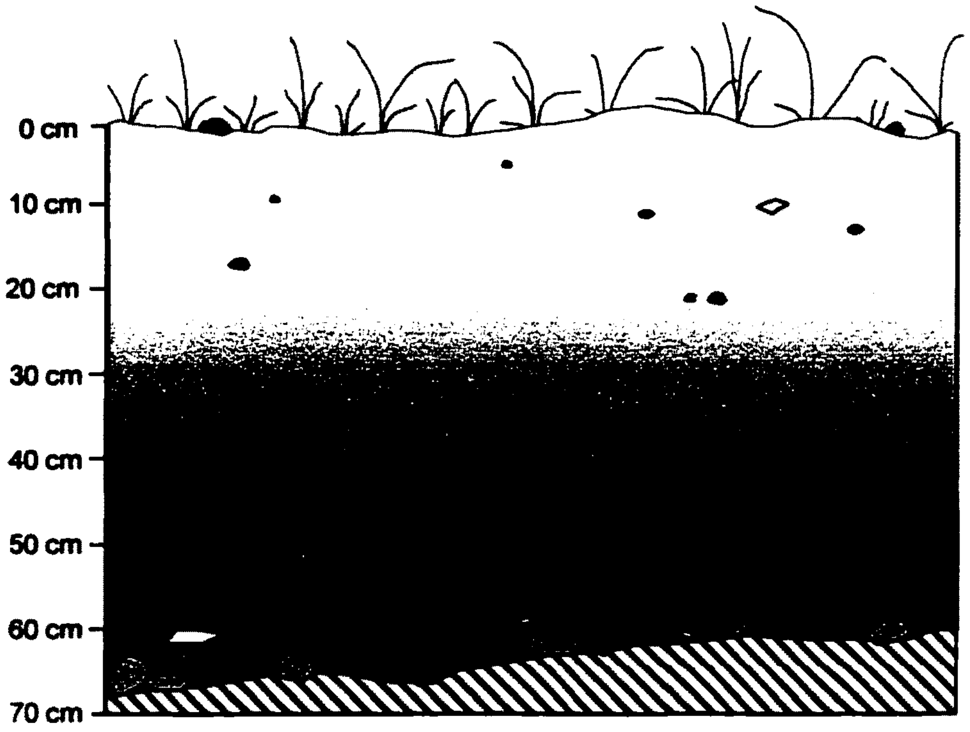


Figure 25. La Mula-West, eroding section containing Paleoindian artifacts.



Redeposited clayey loam (eolian?) containing chronologically-mixed artifacts.
(Munsell 7.5 YR 5/3 Brown grading into 7.5 YR 5/4 Brown)

■ **Red Clay Zone (large peds) containing Paleoindian material and pebbles resting on top of bedrock.**
(Munsell 5 YR 4/4 Reddish Brown)

▨ **Degraded bedrock (regolith)**
(Munsell 7.5 YR 4/2 Brown and 7.5 YR 6/2 Pinkish Gray)

Figure 26. La Mula-West, stratigraphic profile of eroding bank.

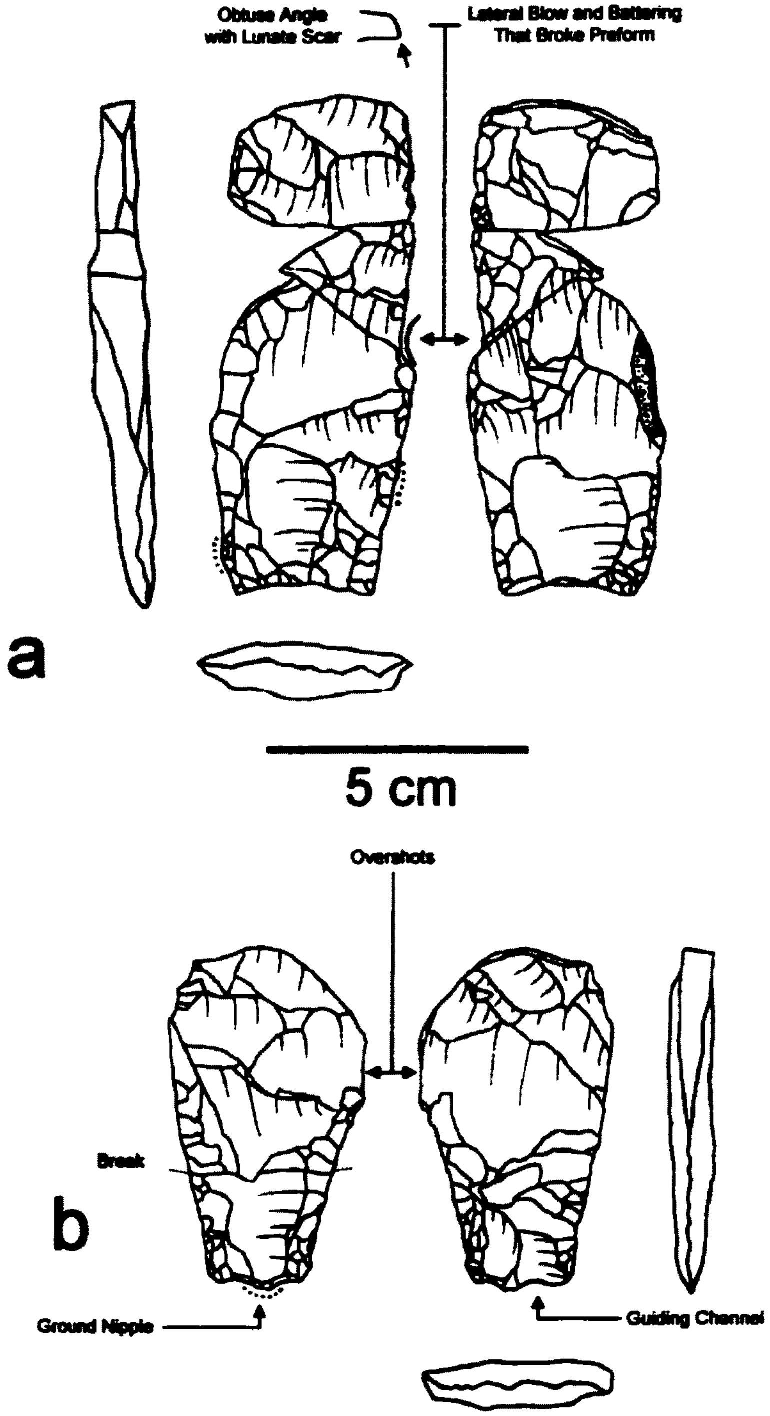
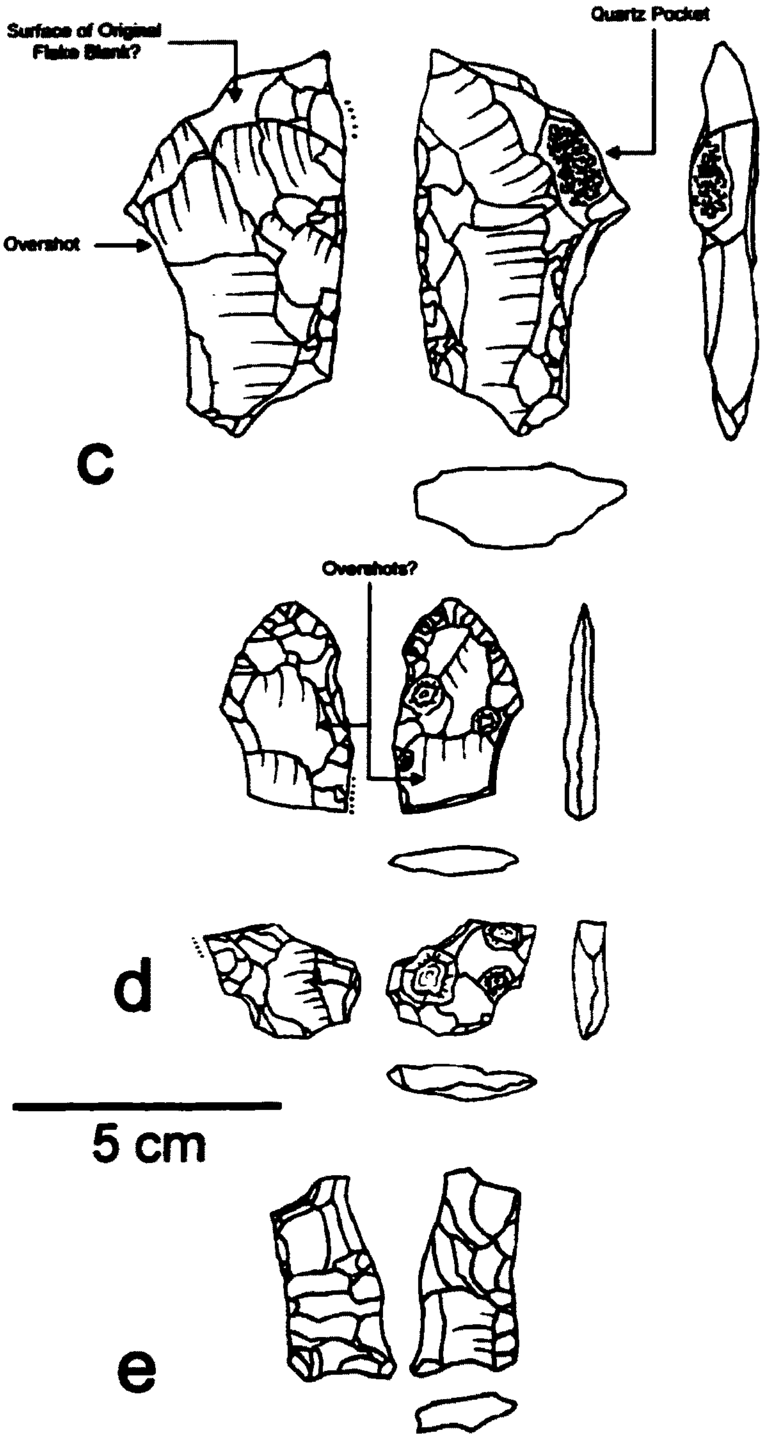
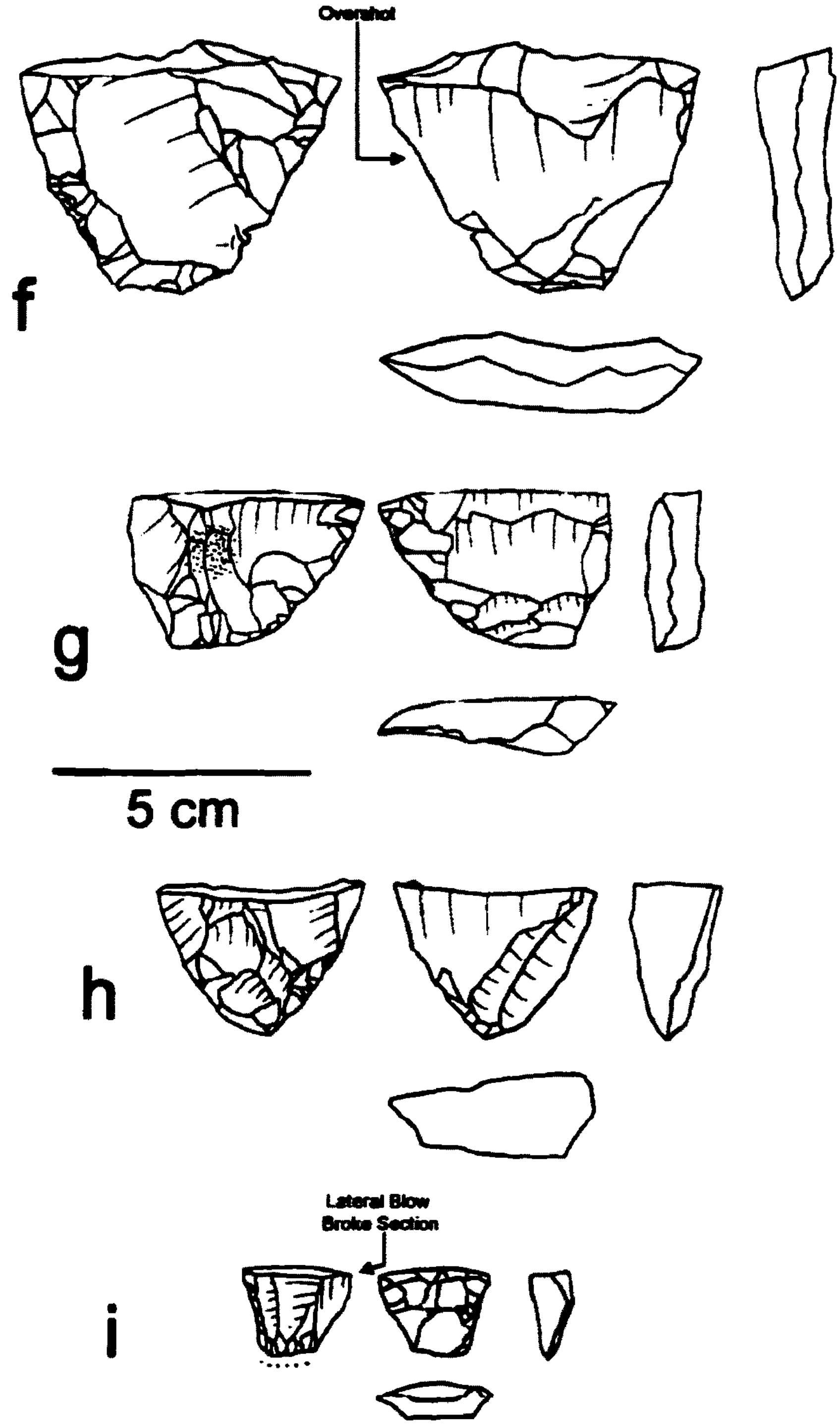


Figure 27. La Mula-West, projectile point fragments and preforms.



(Redrawn from Ranere and Cooke 1995)

Figure 27. Continued.



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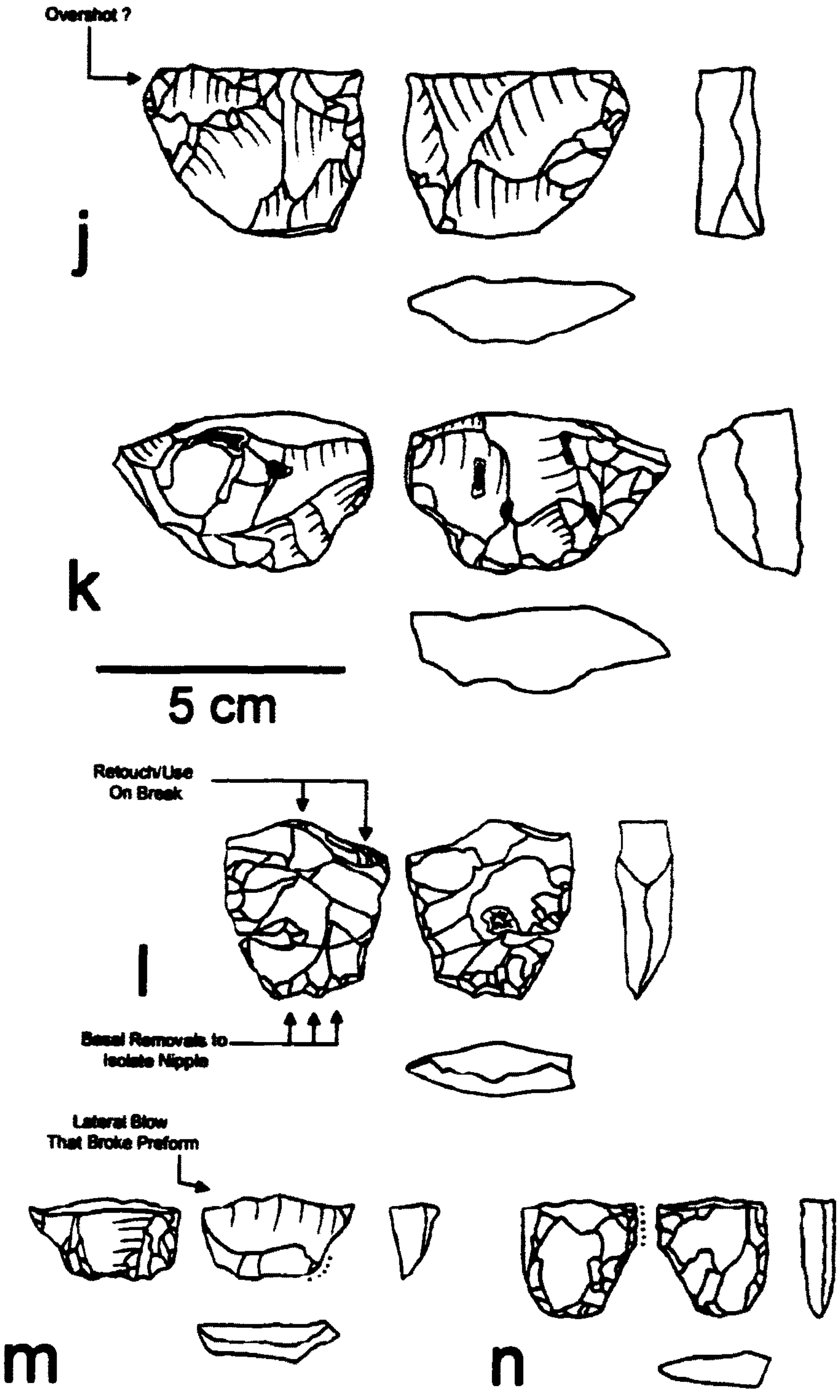
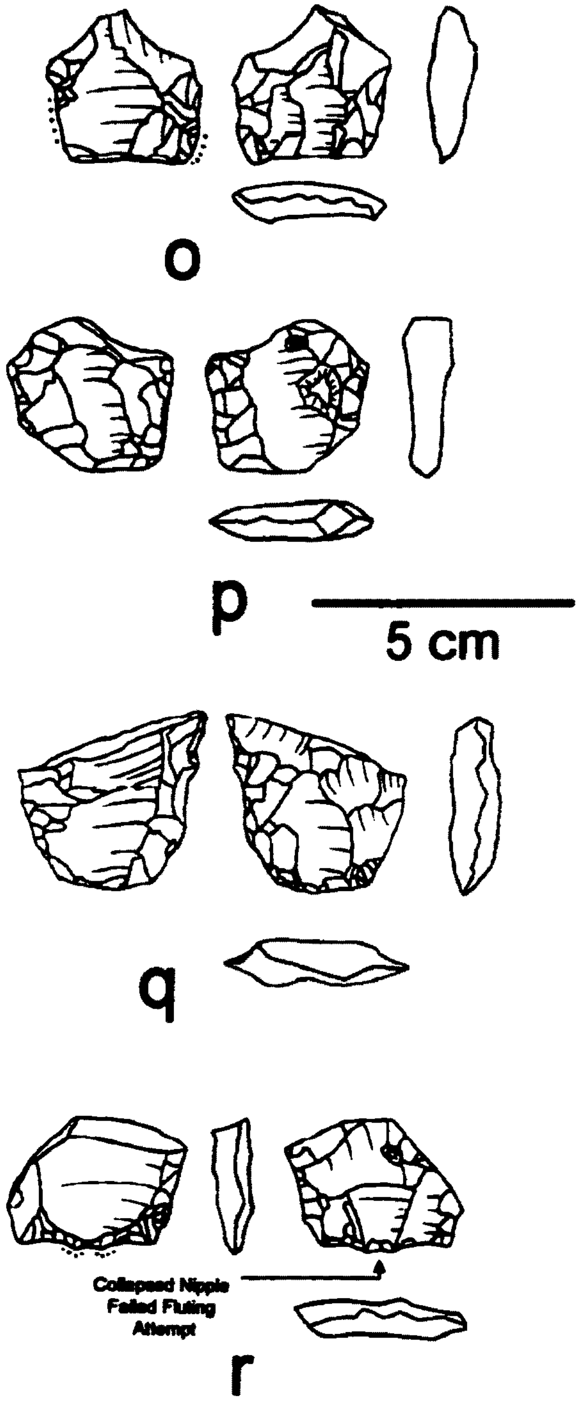


Figure 27. Continued.



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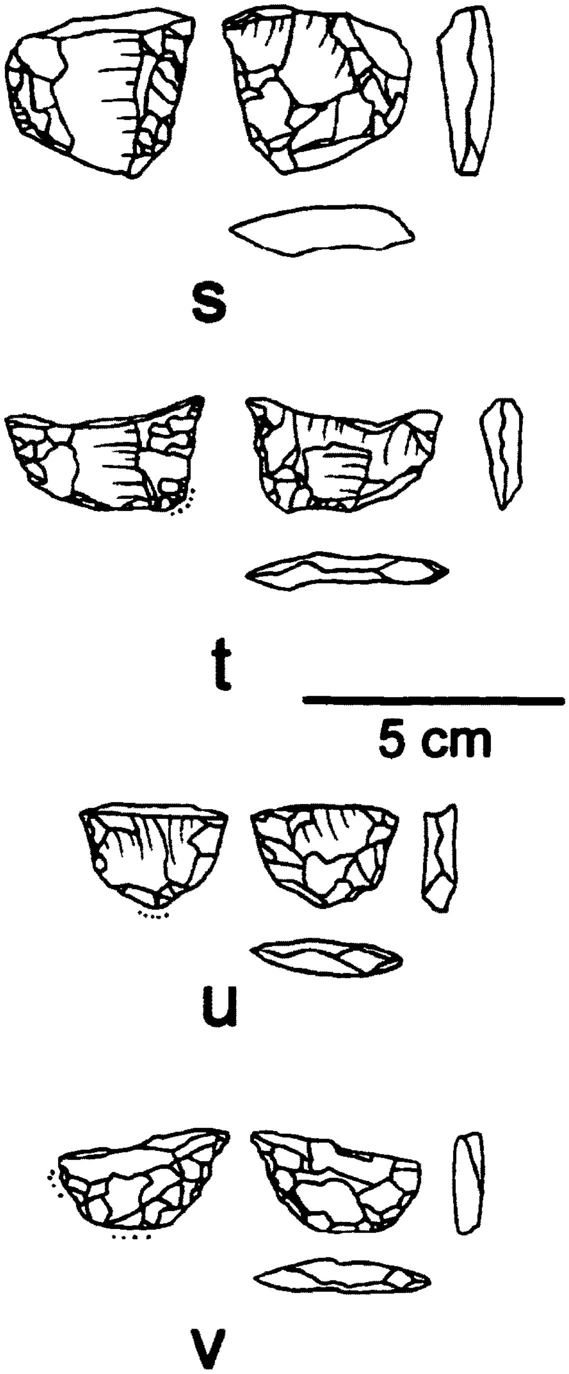

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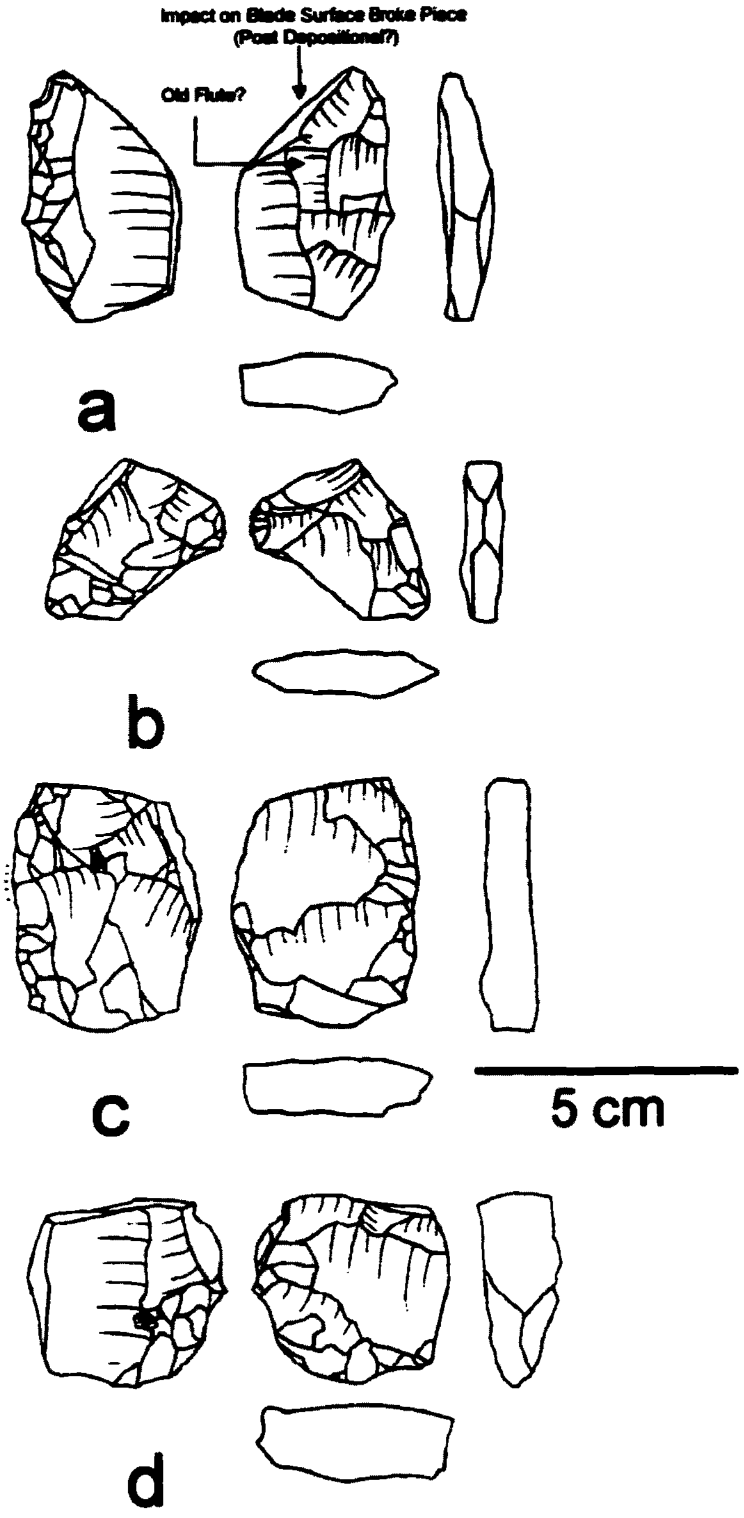


Figure 28. La Mula-West, projectile point and bifacial mid-sections.

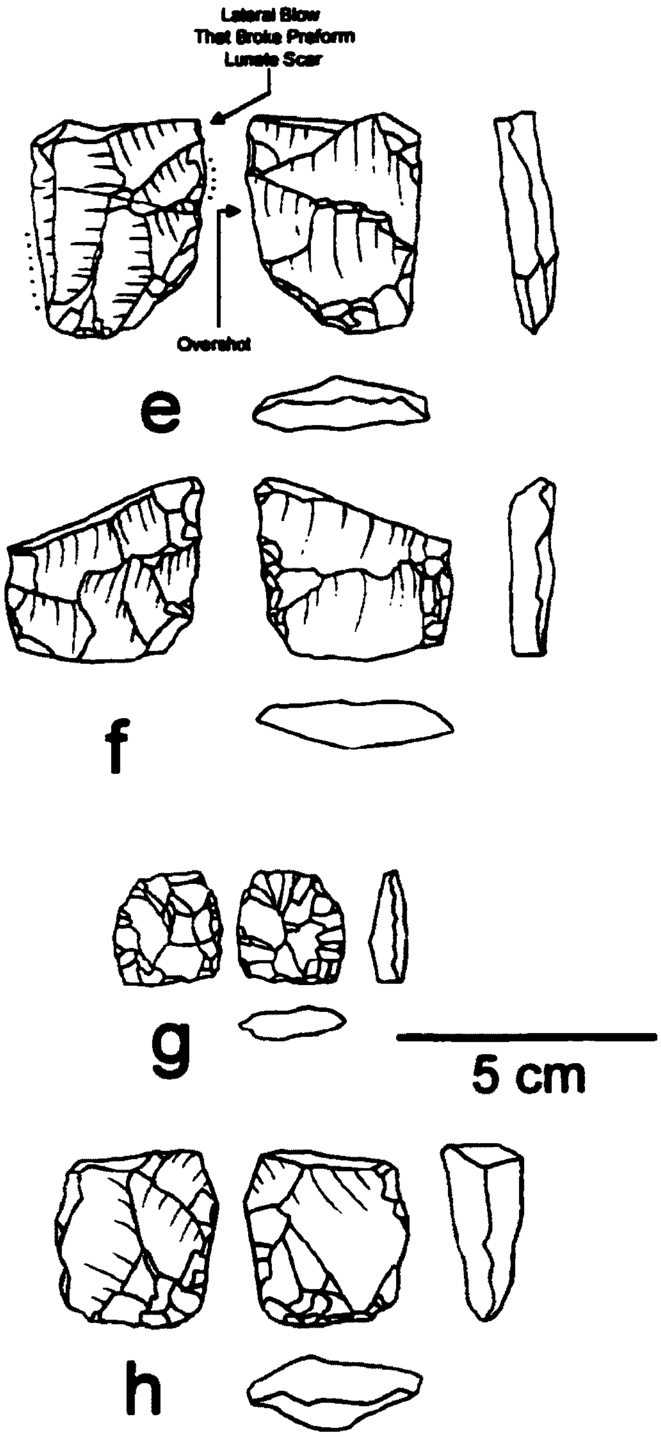


Figure 28. Continued.

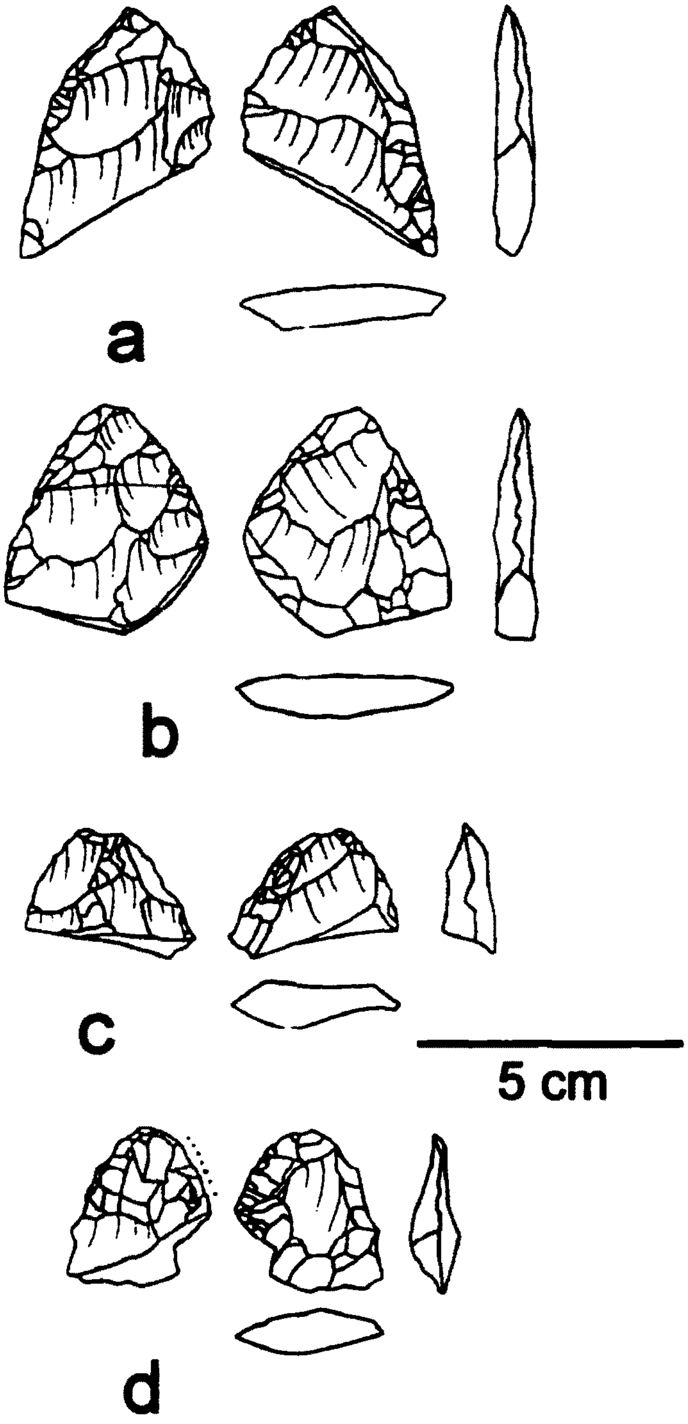


Figure 29. La Mula-West, projectile point and bifacial preform tips.

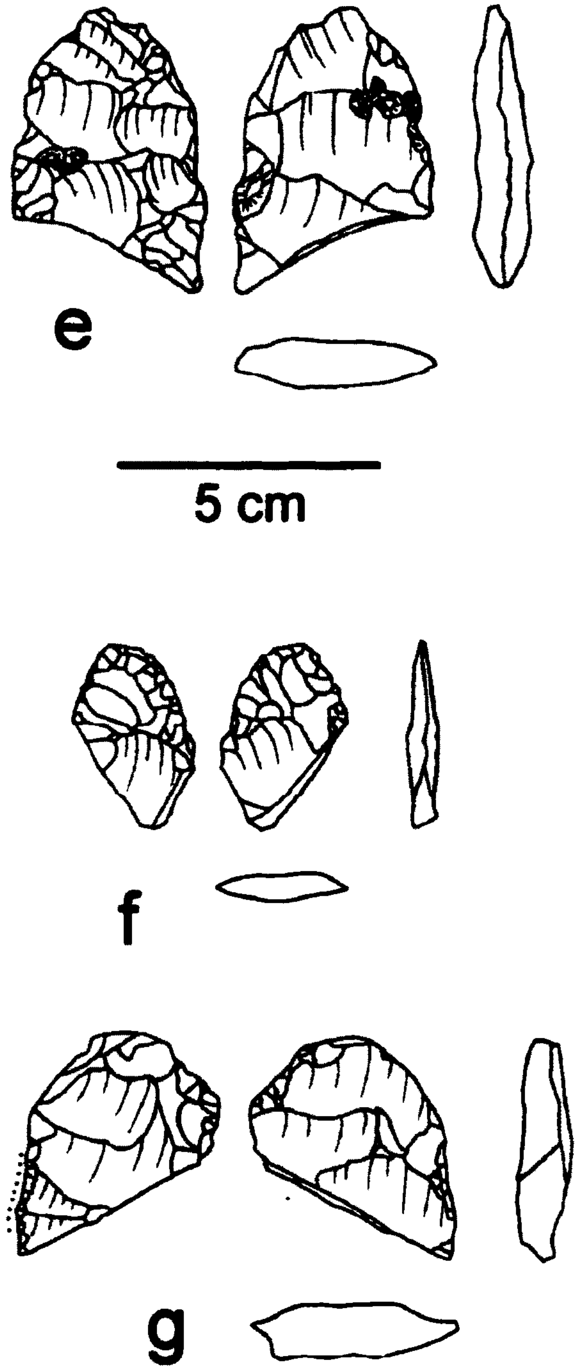


Figure 29. Continued.

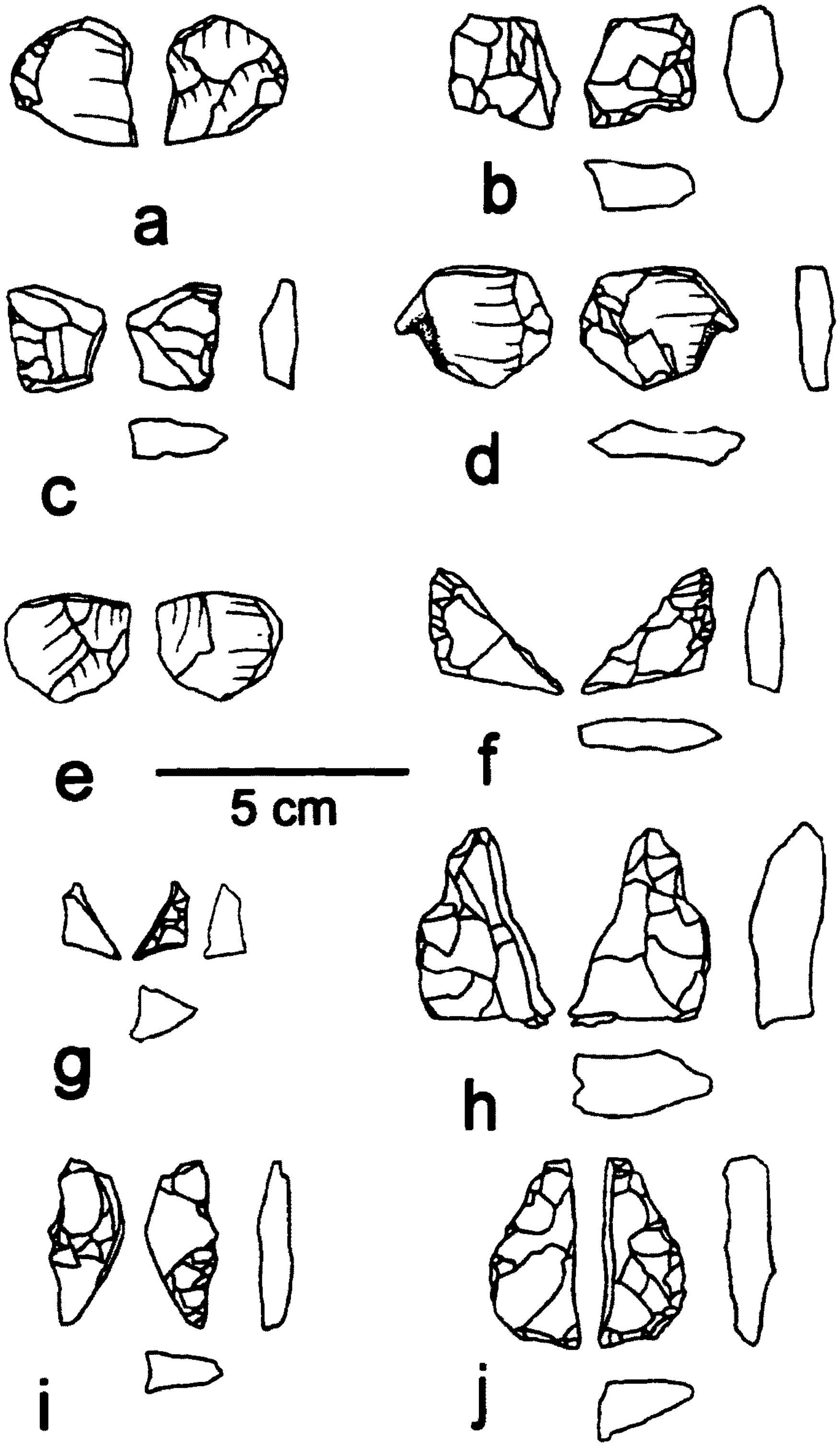


Figure 30. La Mula-West, bifacial fragments.

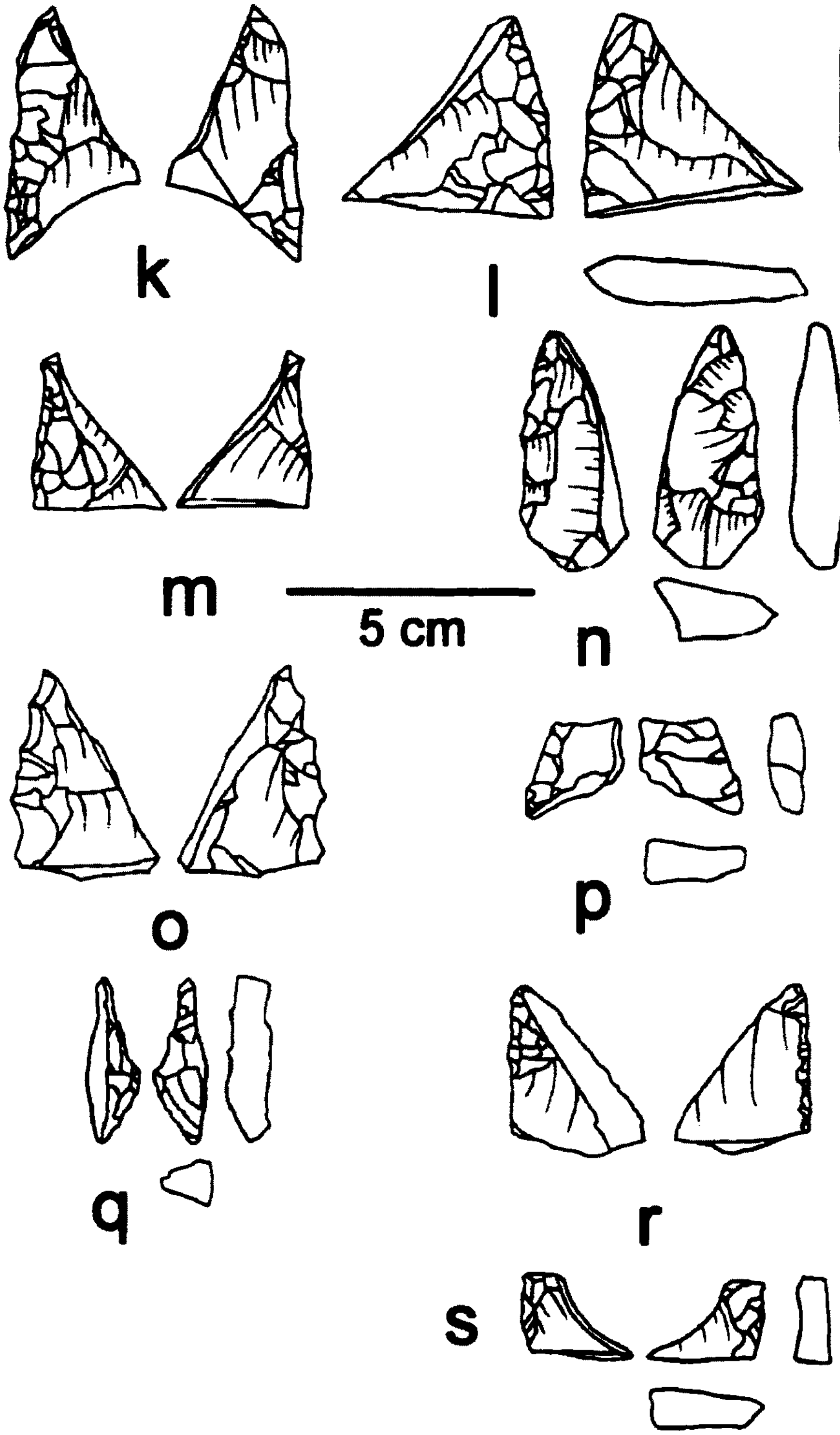


Figure 30. Continued.

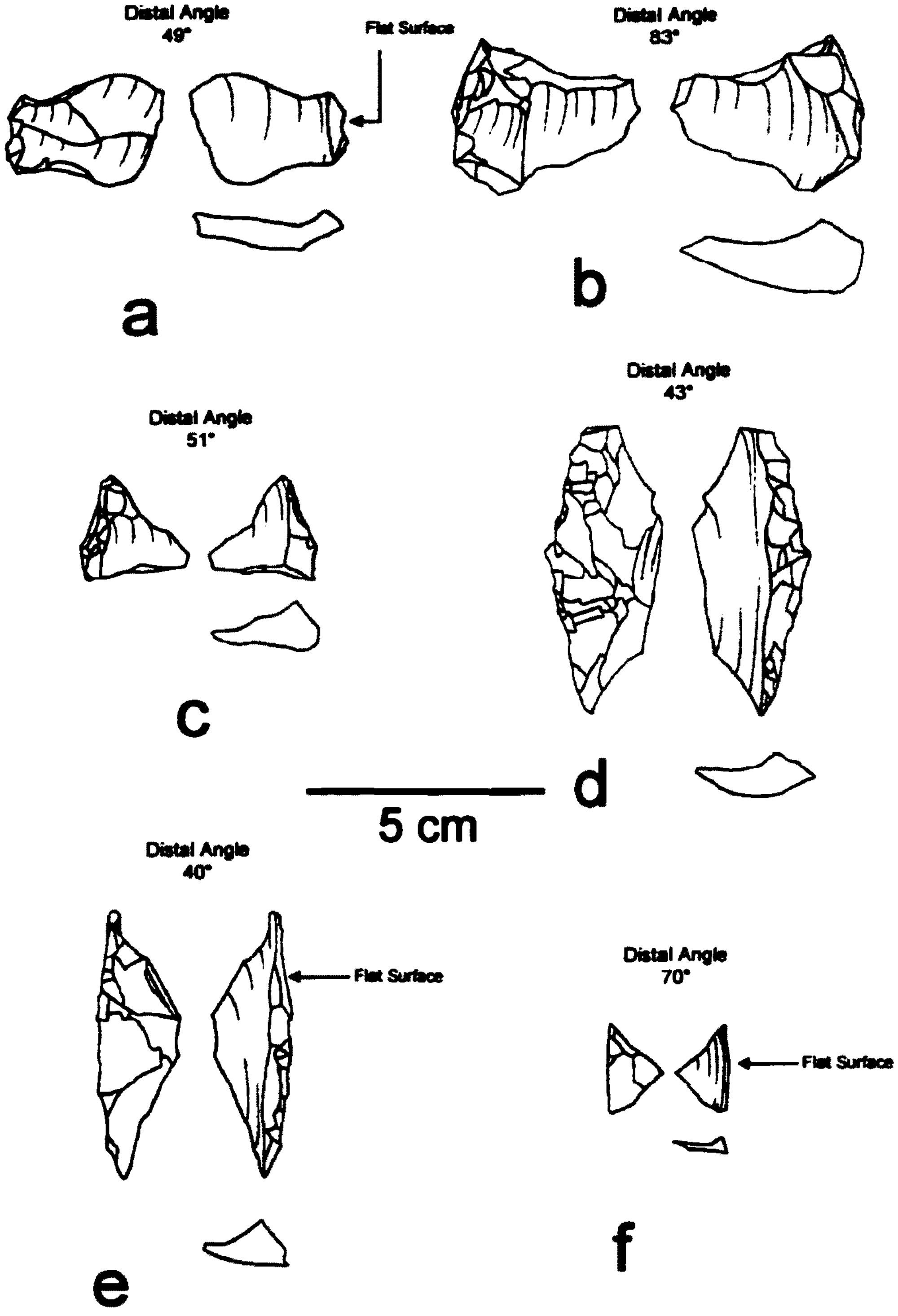


Figure 31. La Mula-West, bifacial thinning overshot flakes.

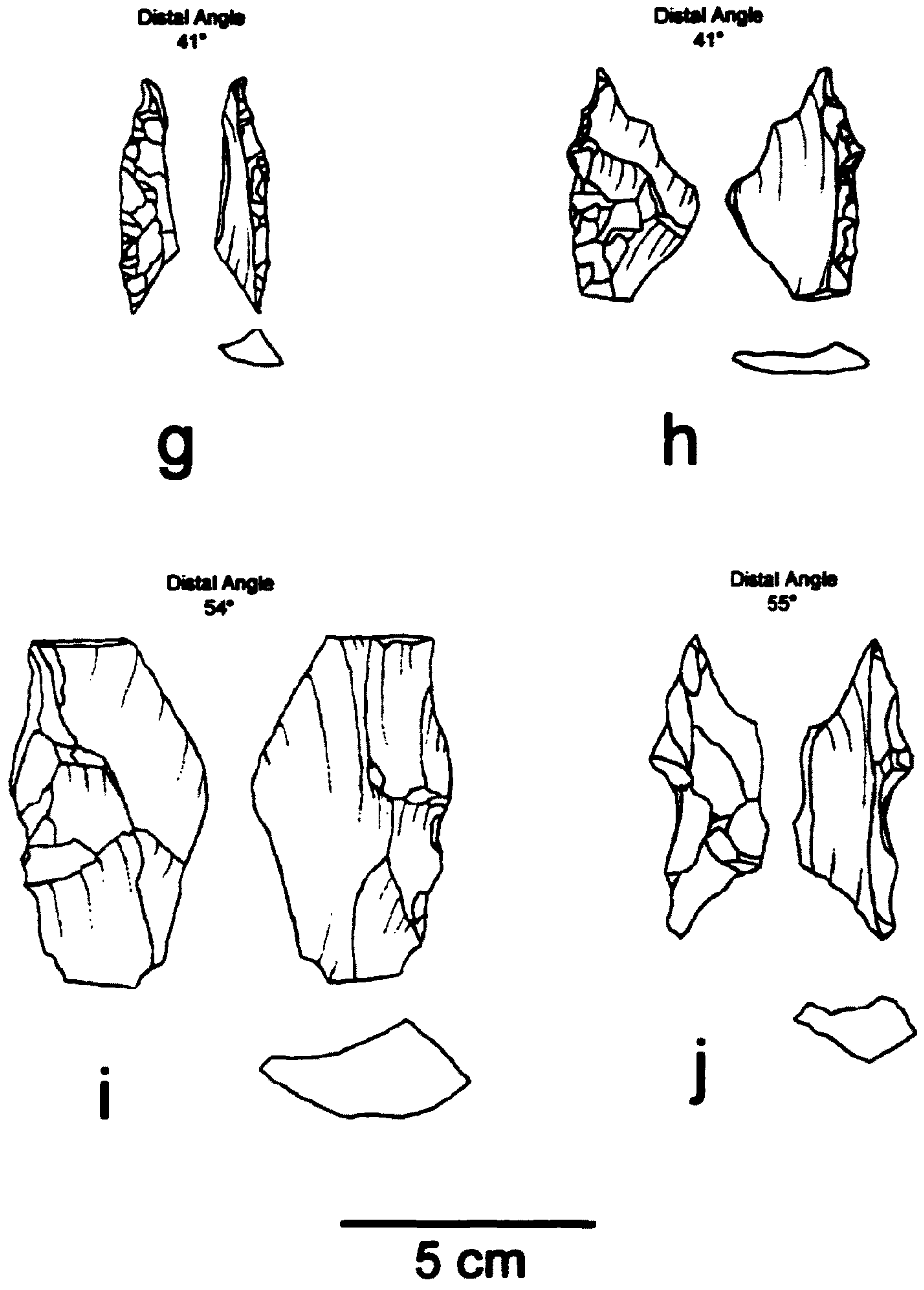


Figure 31. Continued.

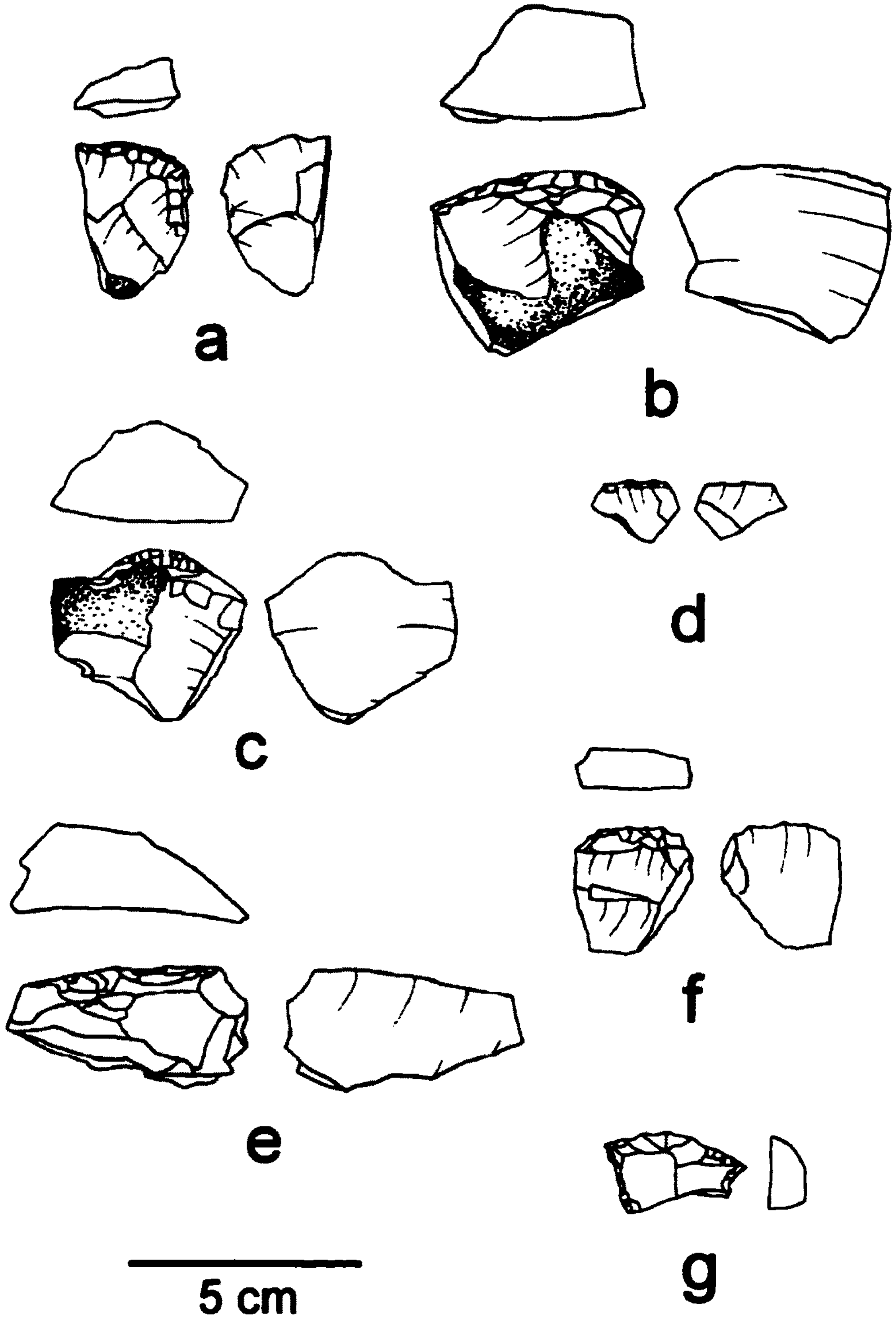


Figure 32. La Mula-West, scrapers.

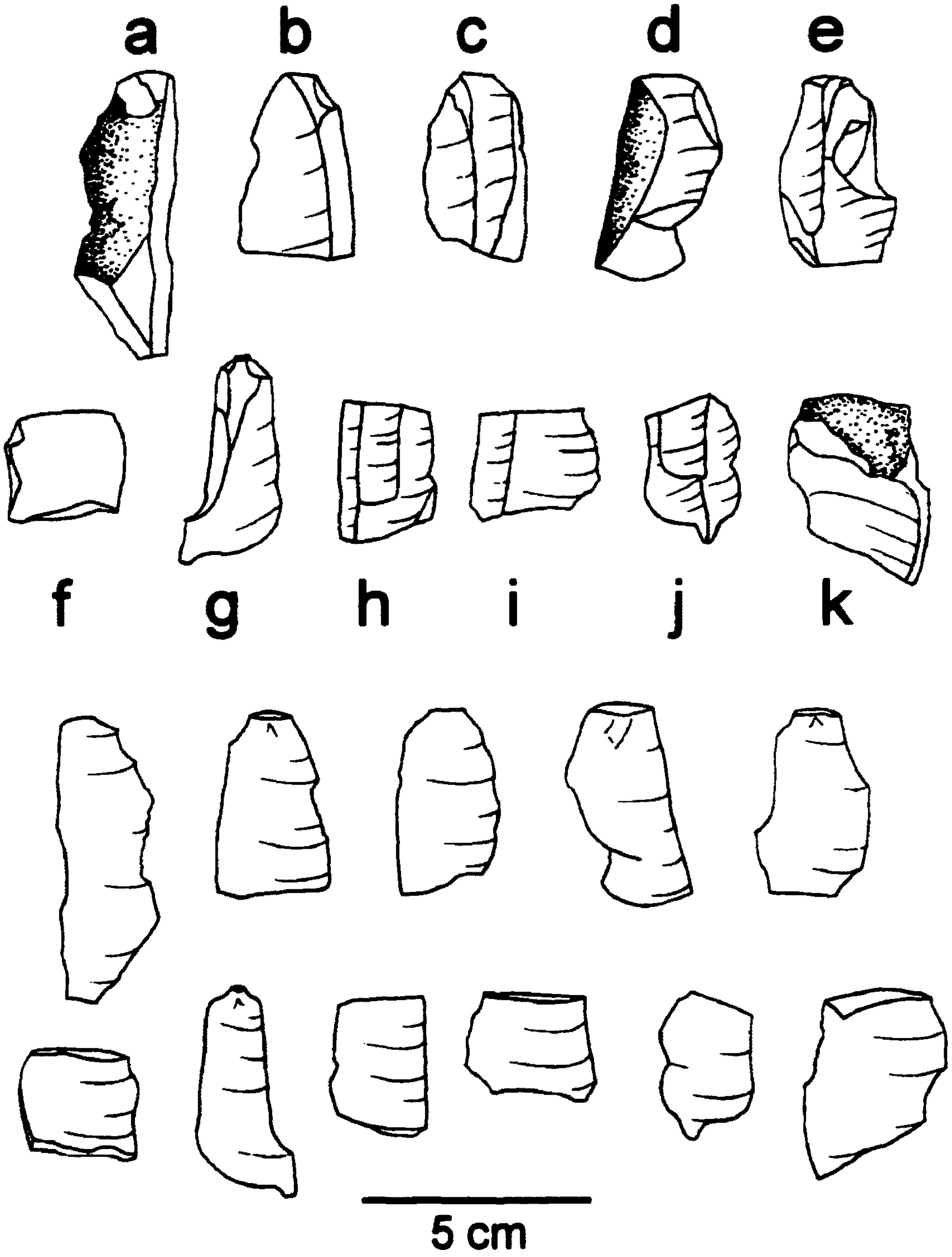
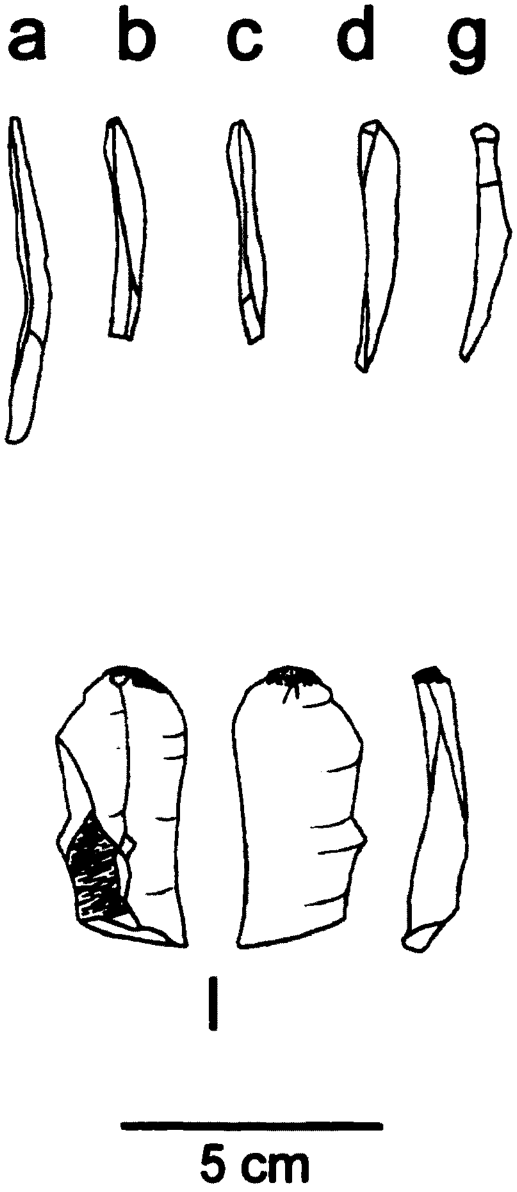


Figure 33. La Mula-West, blades.



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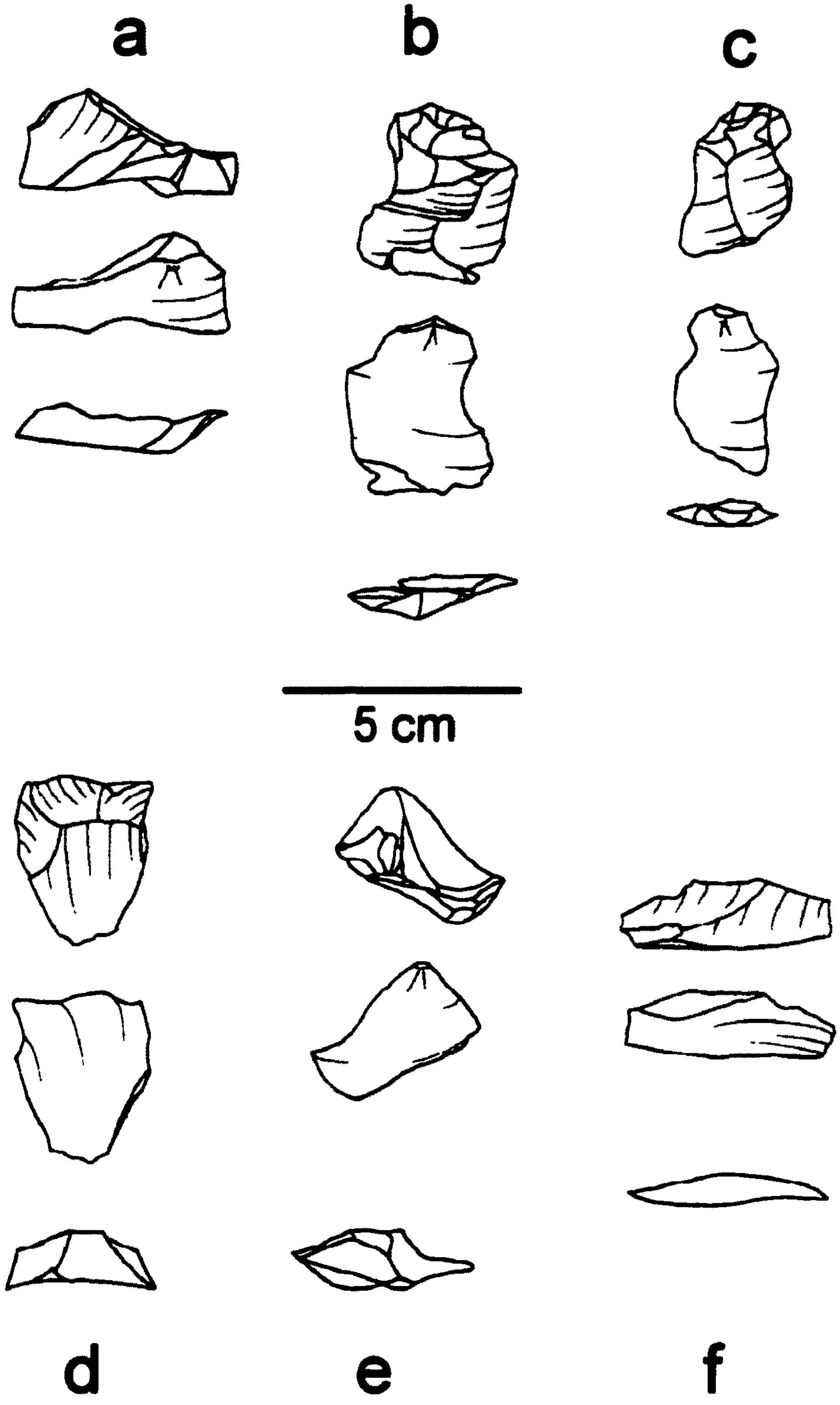
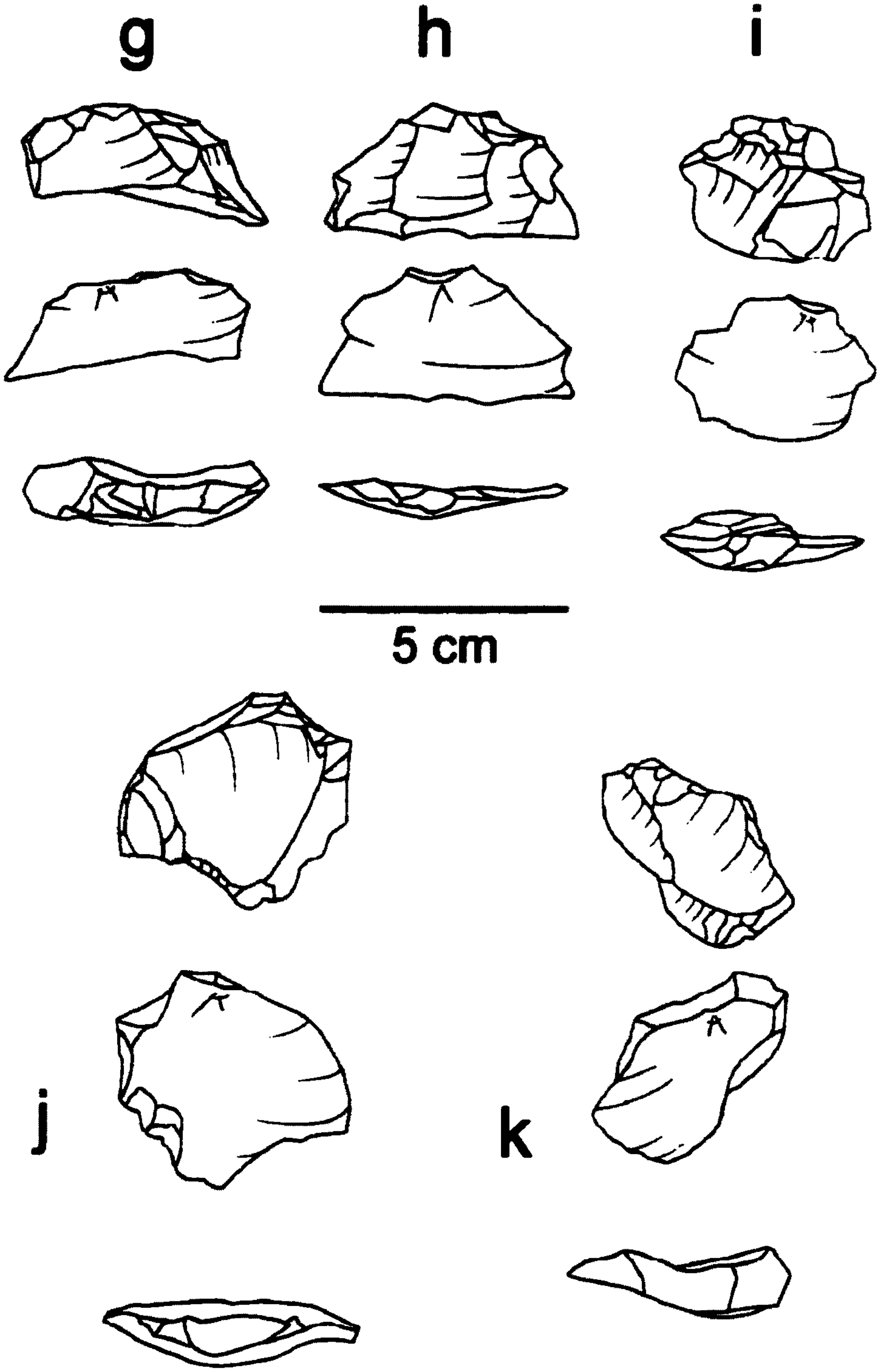


Figure 34. La Mula-West, blade core platform rejuvenation tablets.



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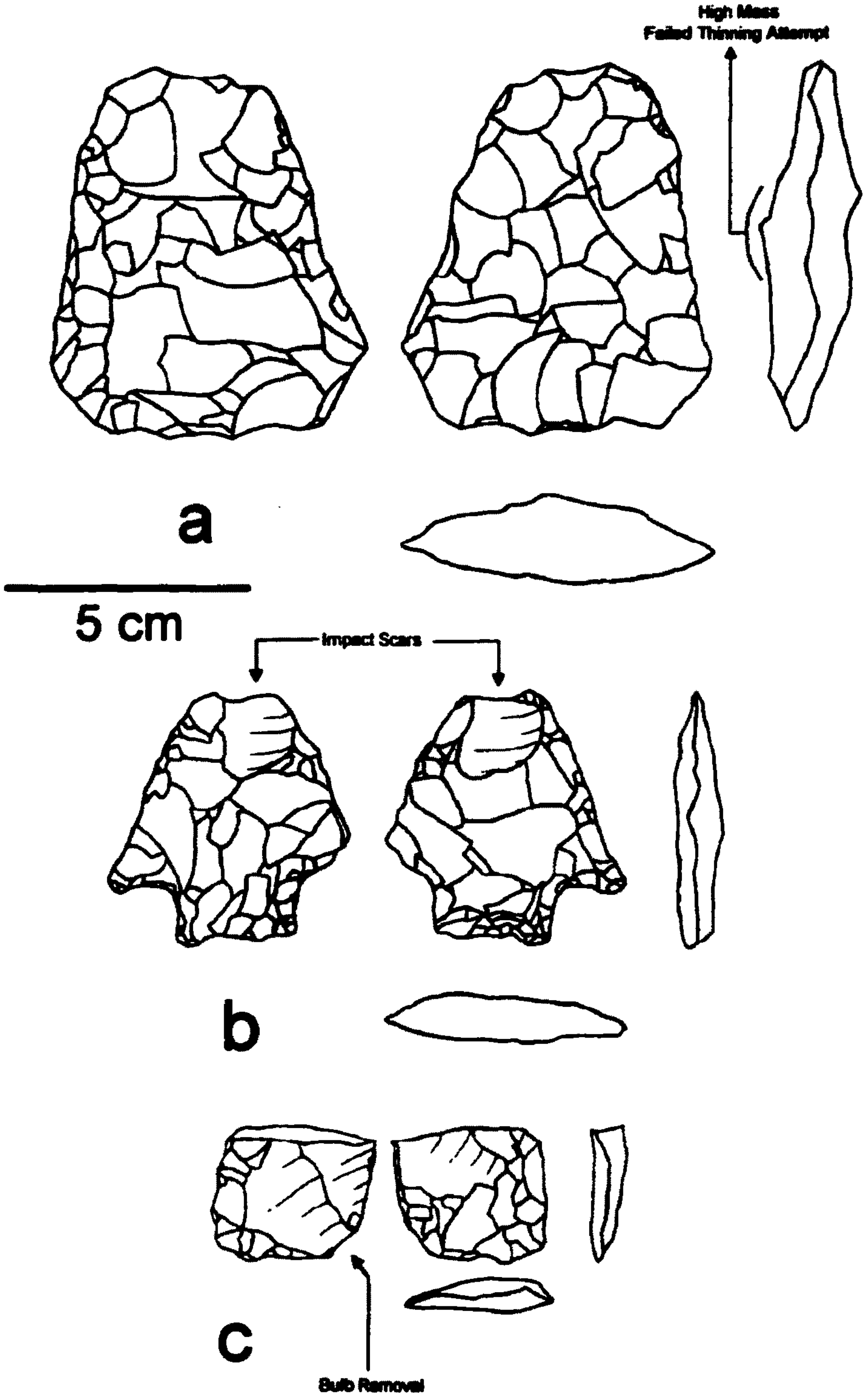


Figure 35. La Mula Sarigua, bifacial artifacts recovered during 2000 survey.

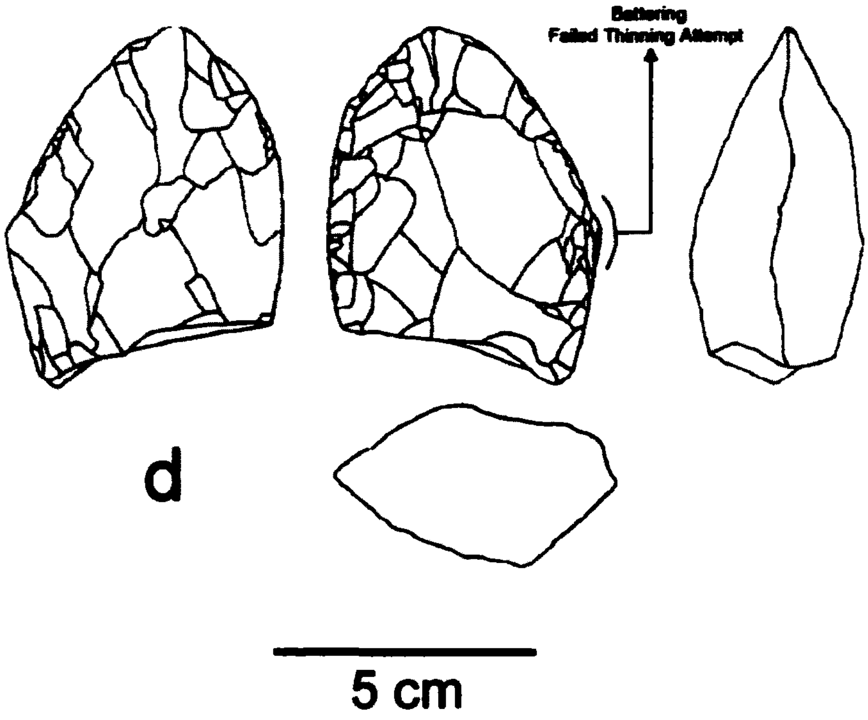


Figure 35. Continued

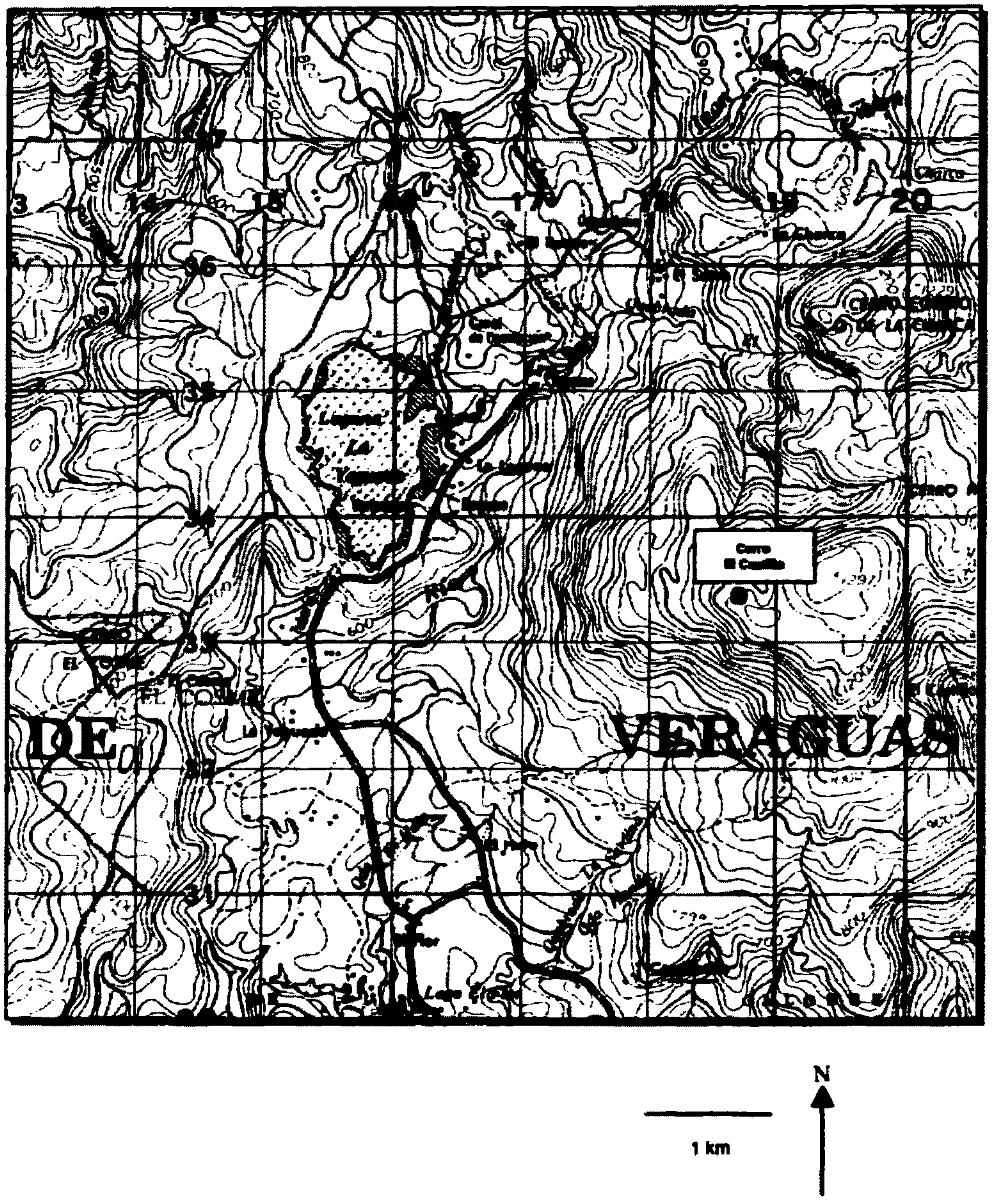


Figure 36. Map of Lake La Yeguada and Cerro El Castillo.

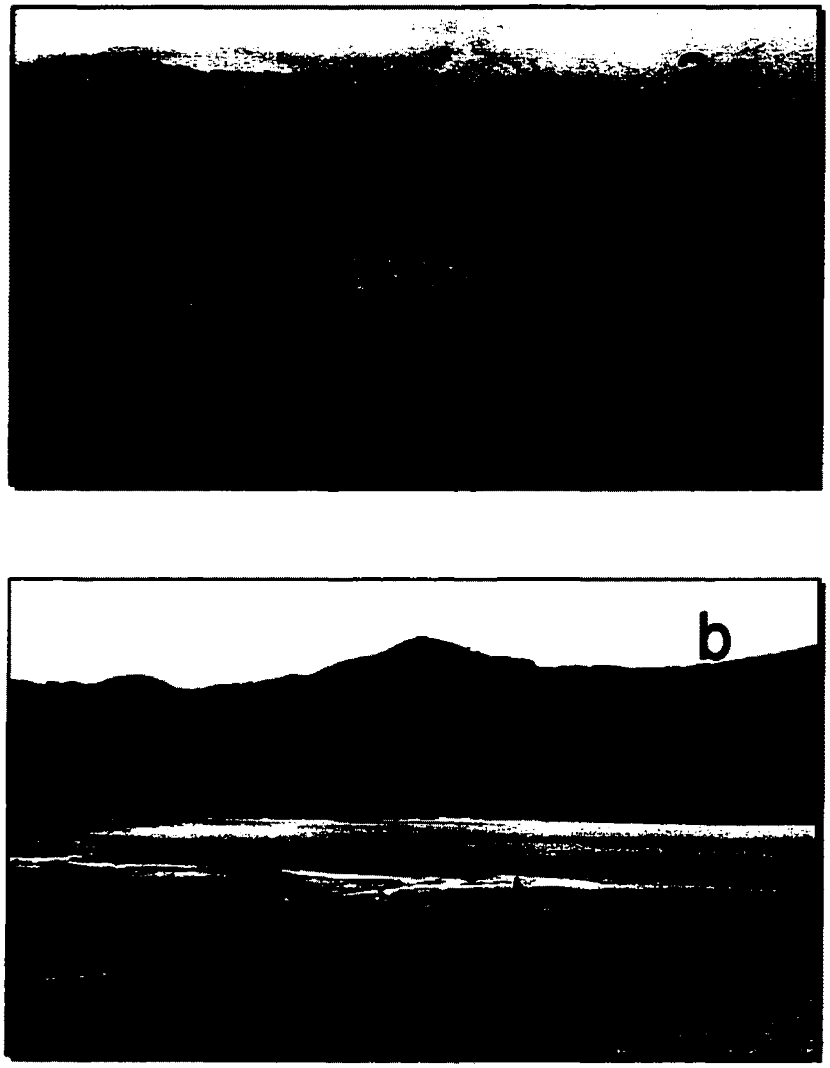


Figure 37. Lake La Yeguada in a) December, at the end of the rainy season, and b) May, at the end of the dry season.

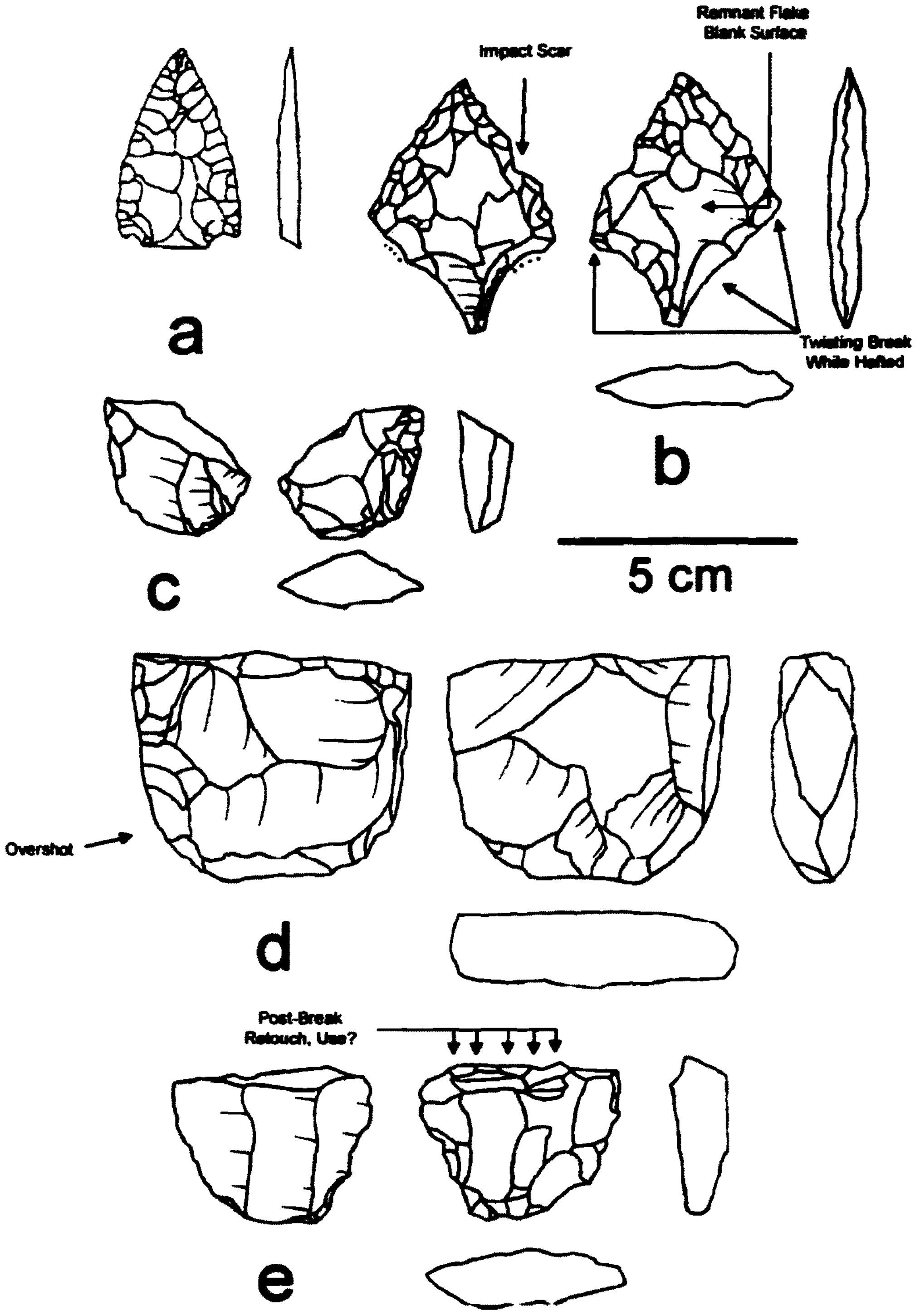


Figure 38. Lake La Yeguada, projectile points and bifacial preforms.
a) Point discovered during 1985 survey (redrawn from Ranere and Cooke 1996);
b) El Inga-like point; c) El Jobo-like base; d-f) Preforms; g-h) Bifacial thinning flakes and overshots.

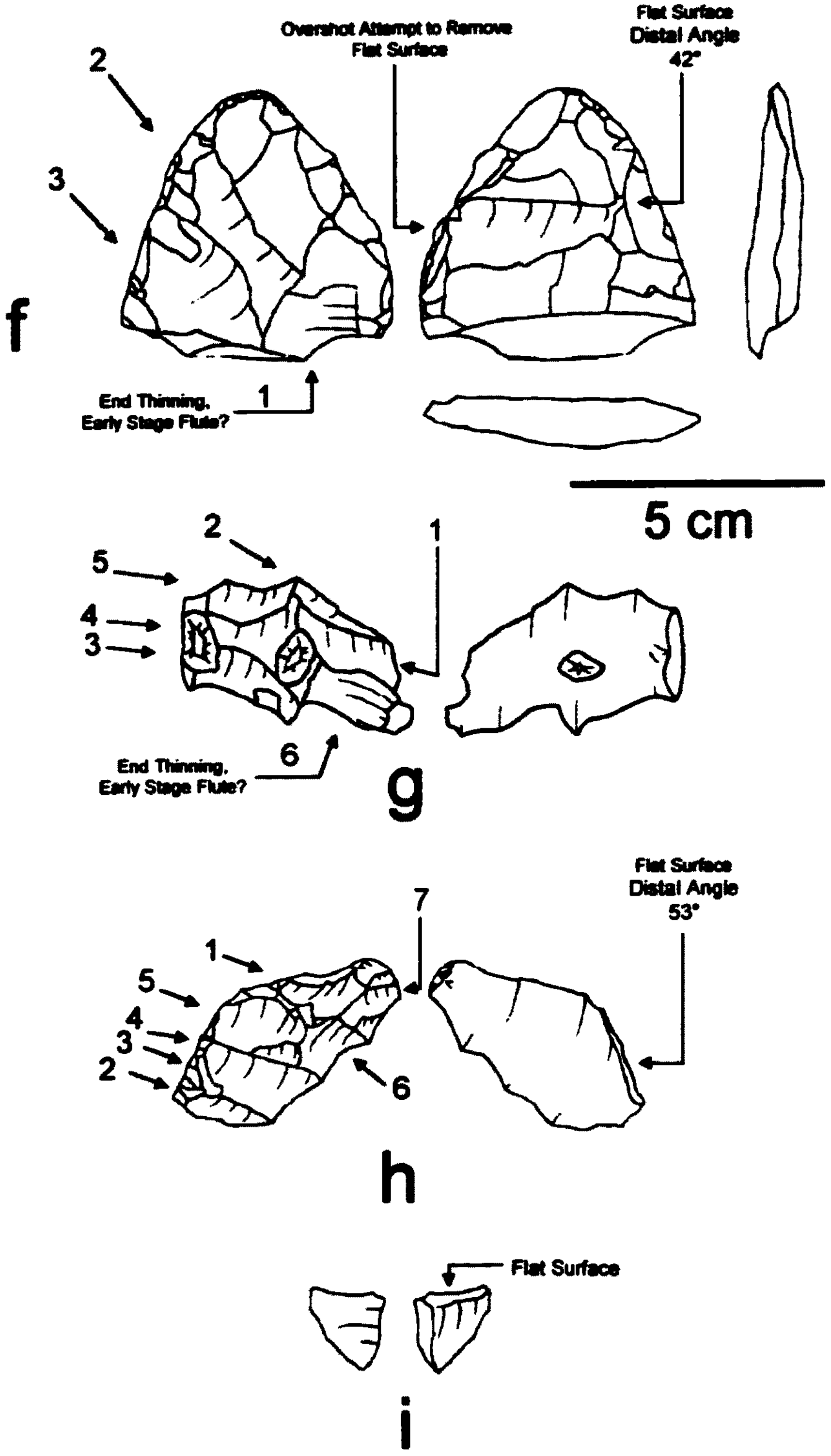


Figure 38. Continued.

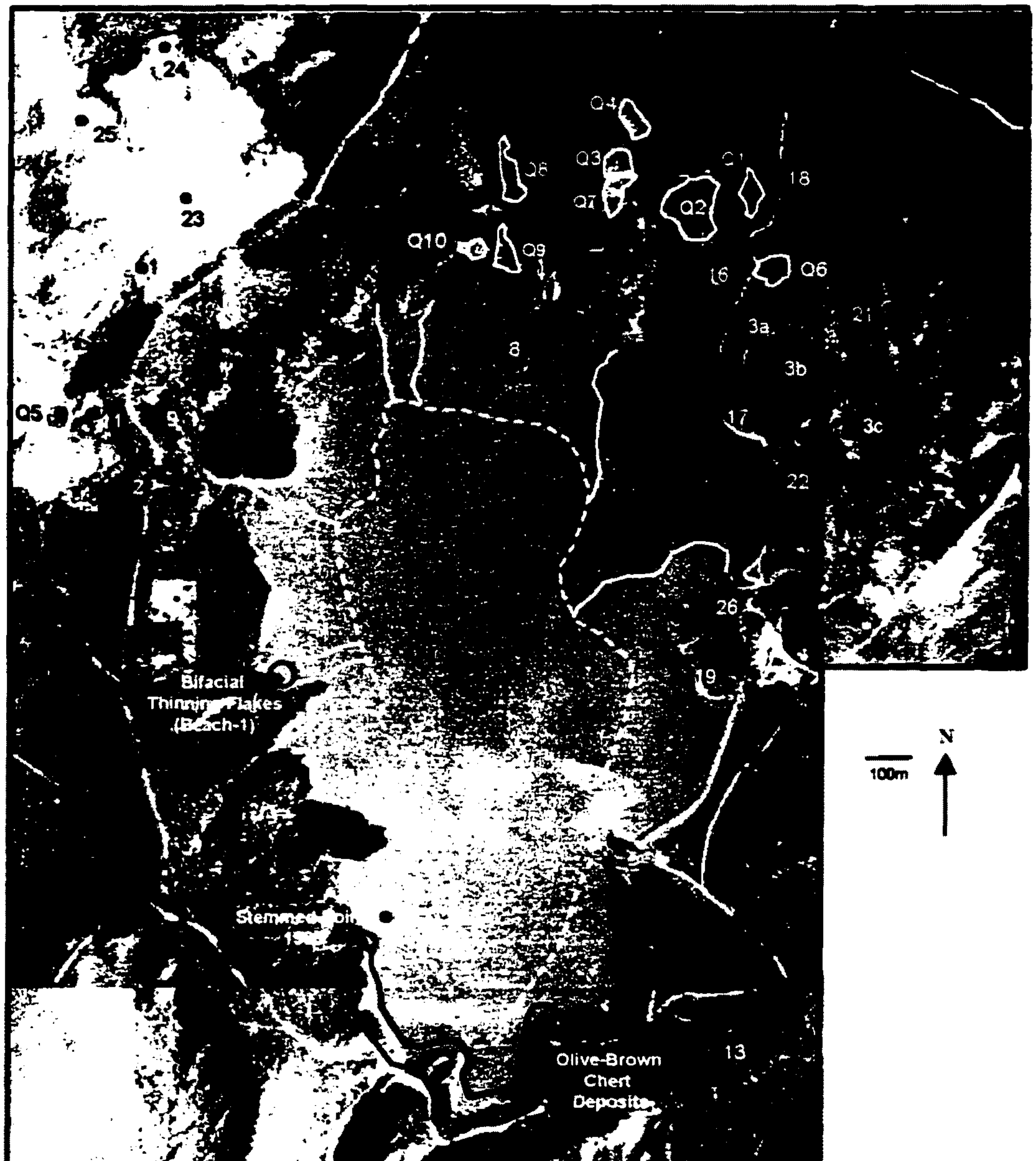


Figure 39. Lake La Yeguada, aerial view and locations of sites discovered during the 1999 survey.

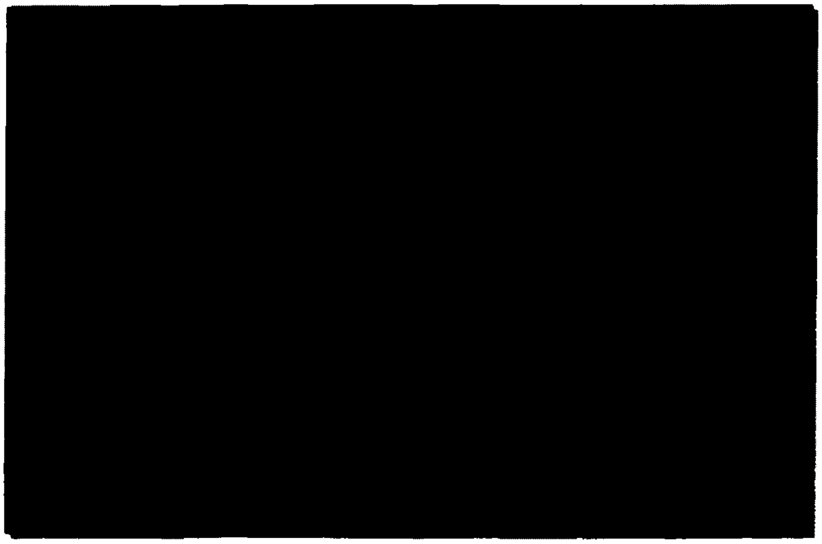


Figure 40. Lake La Yeguada, quarry/workshop No.2 (Q2).

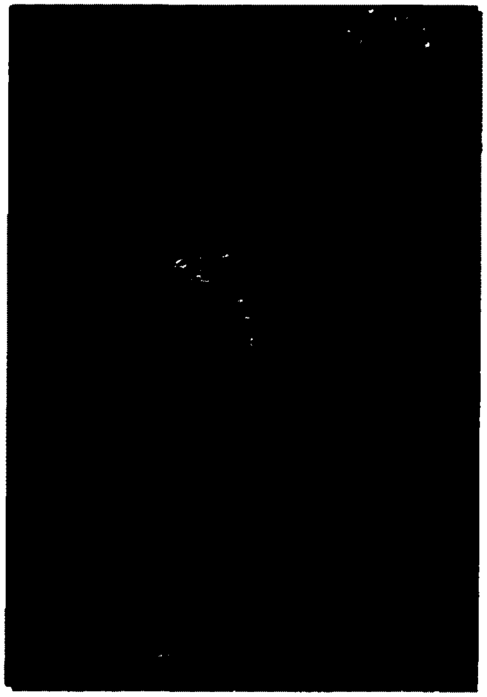


Figure 41. Lake La Yeguada rockshelter, Test Pit No. 1.

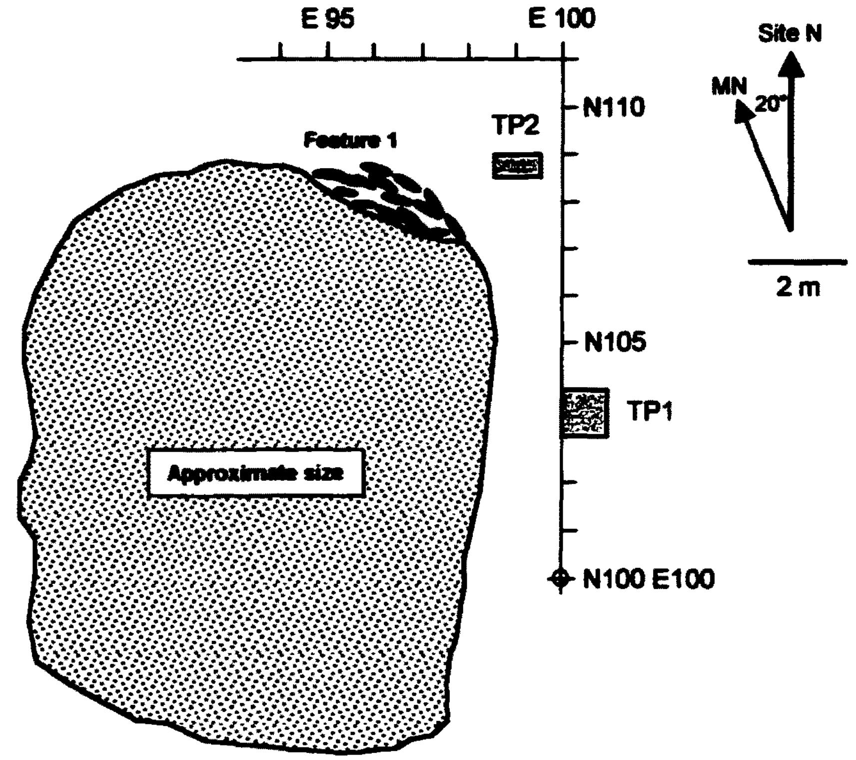


Figure 42. Lake La Yeguada rockshelter, location of test pits.

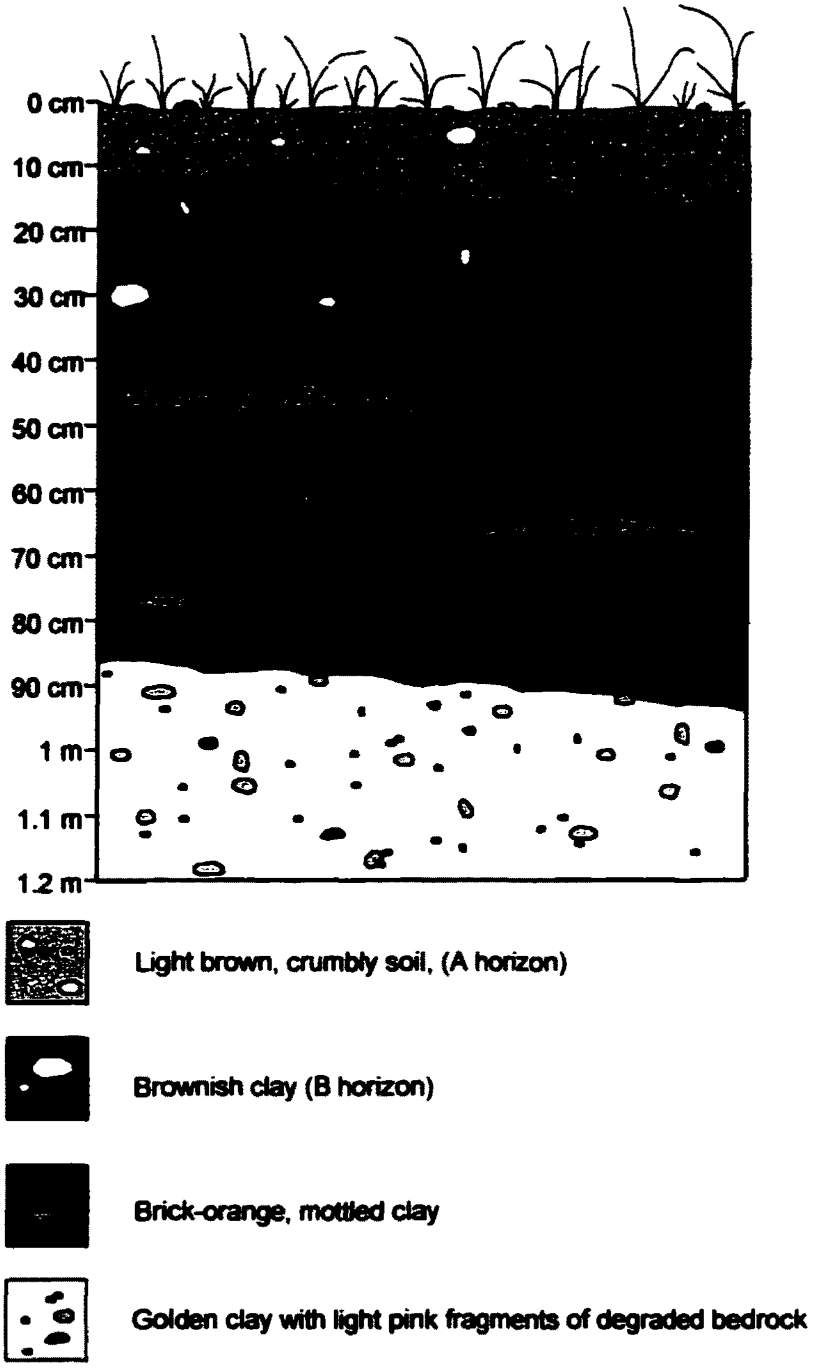


Figure 43. Lake La Yeguada rockshelter, stratigraphic profile of south wall, Test Pit No.1.

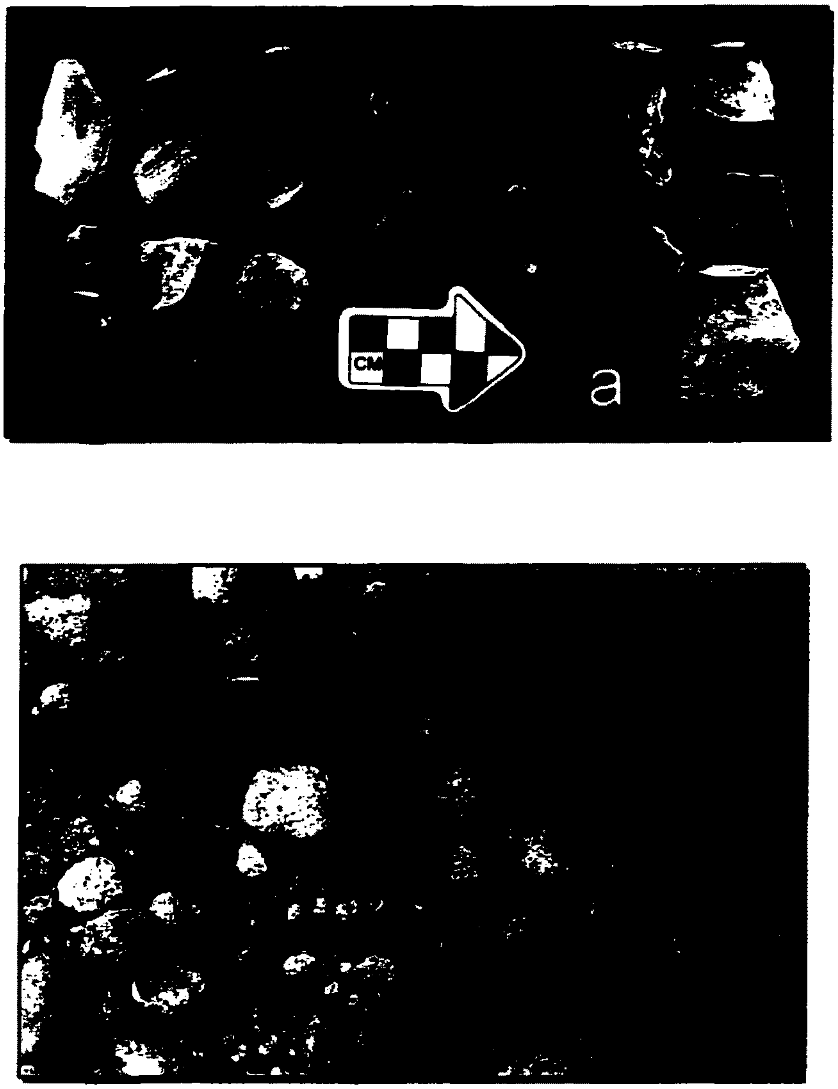


Figure 44. Lake La Yeguada, a) Beach-1, bifacial thinning flakes and, b) Beach-2, point preform fragment.

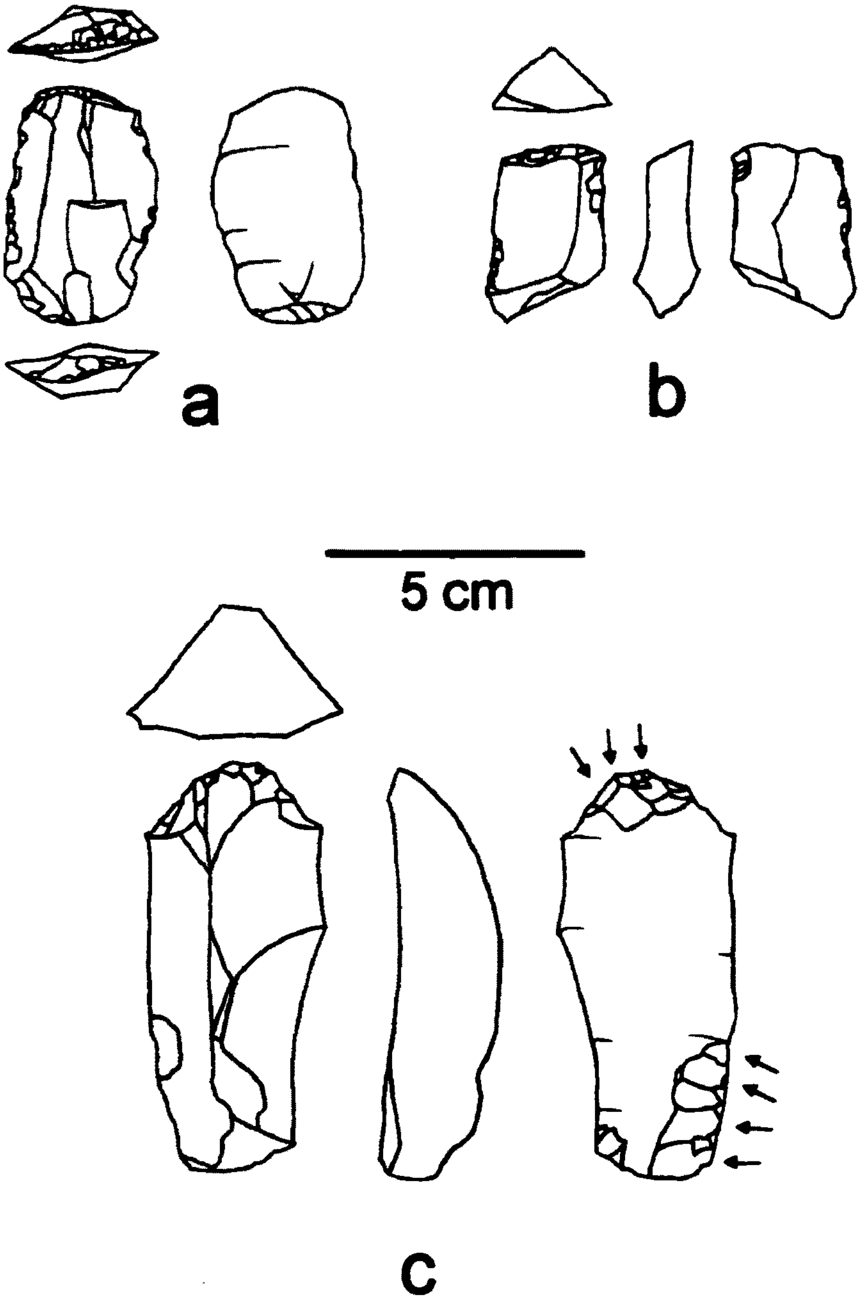
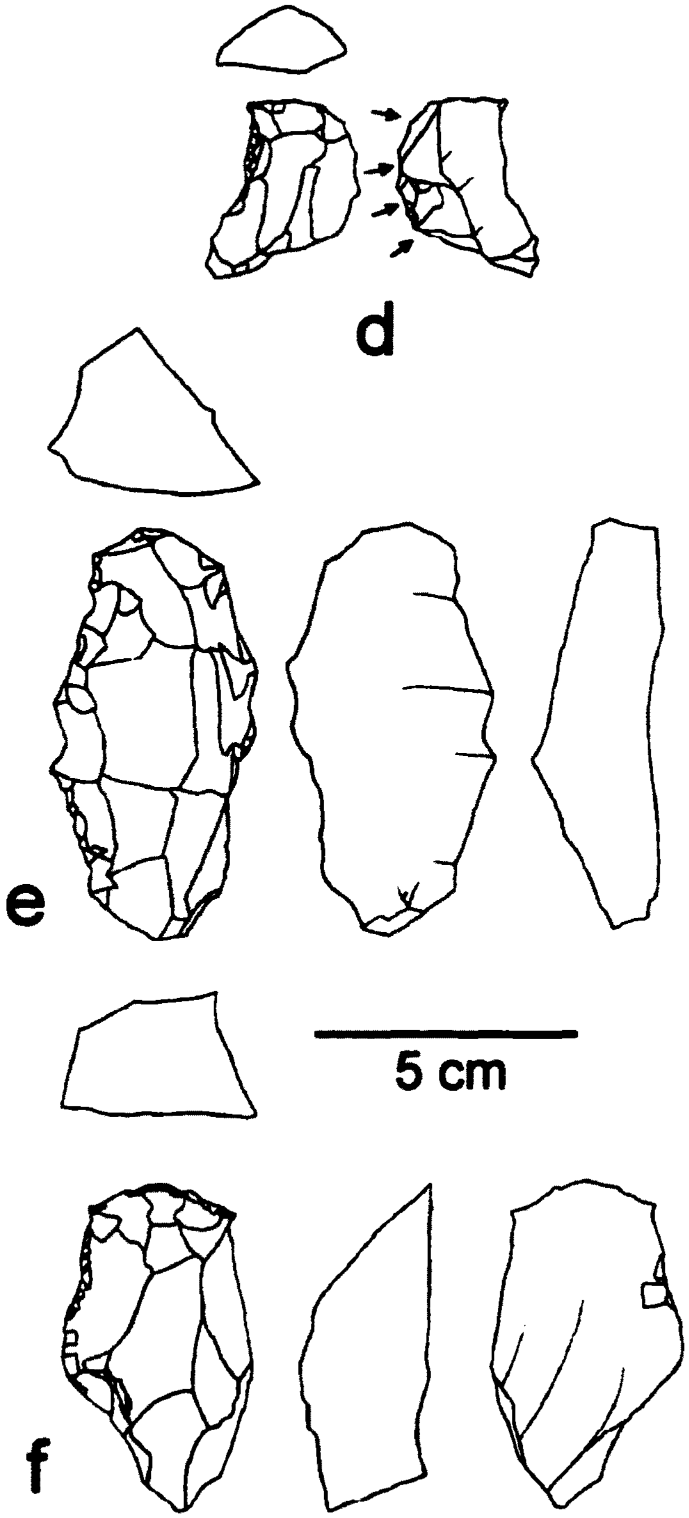


Figure 45. Lake La Yeguada, a, b) end scrapers, c, d, f, g, j) spurred scrapers, and e, h, i, k) large scrapers and planes.



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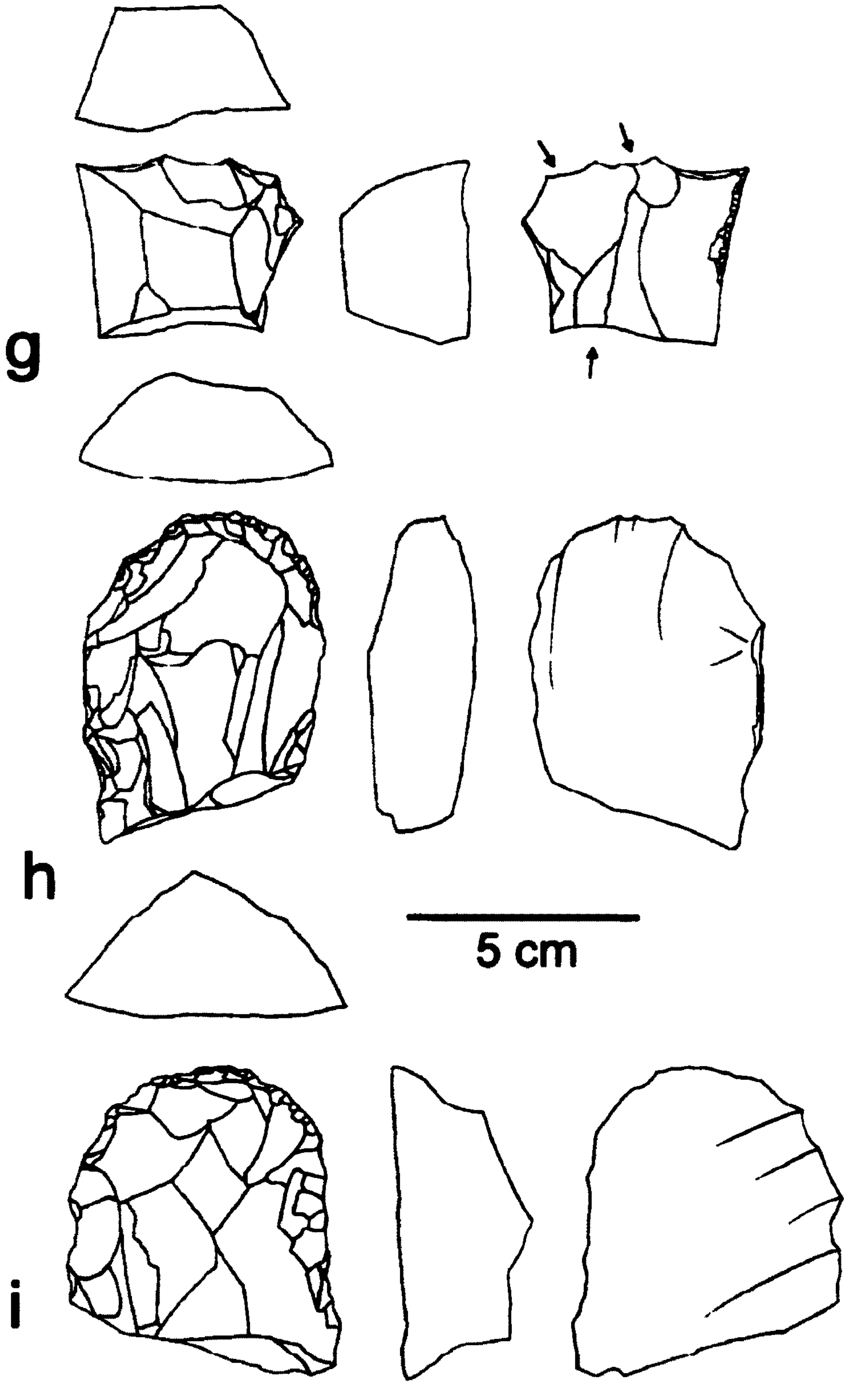

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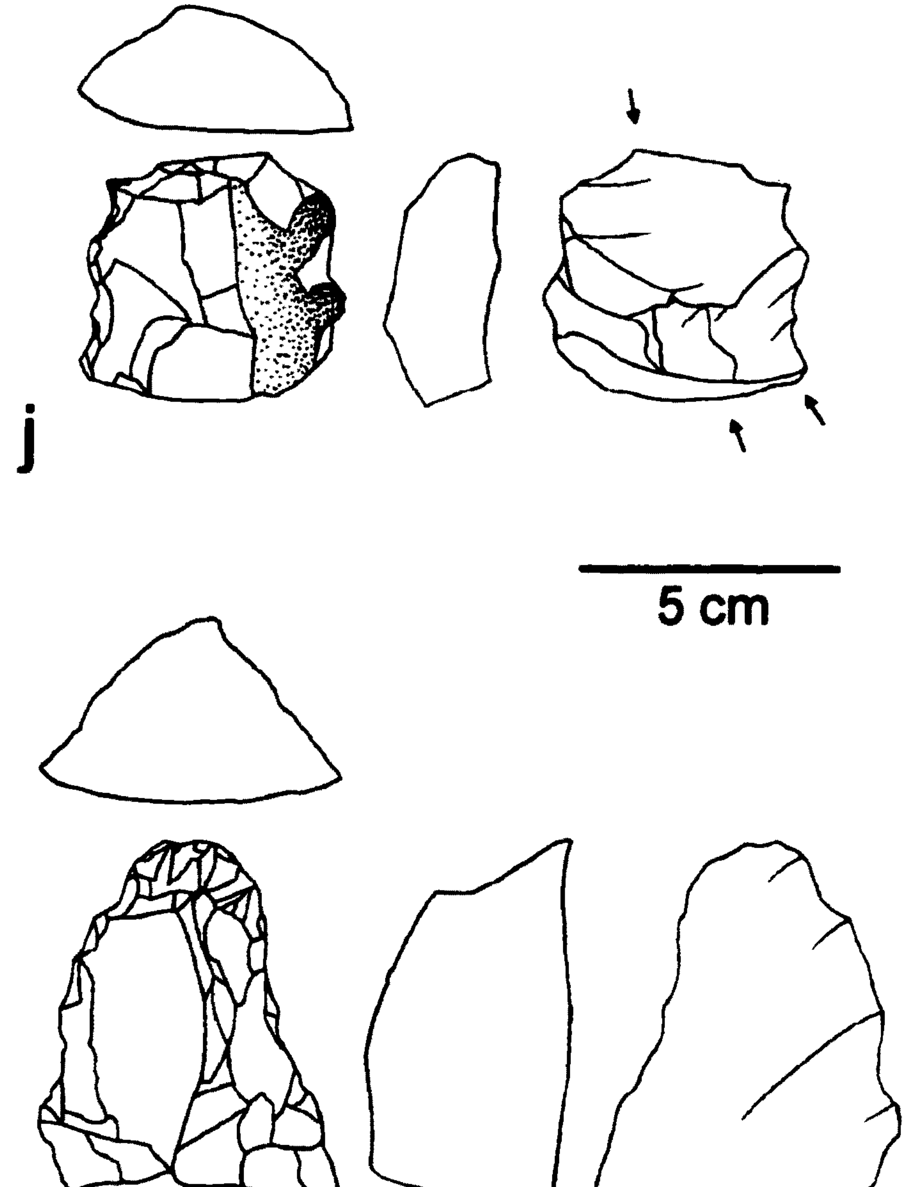

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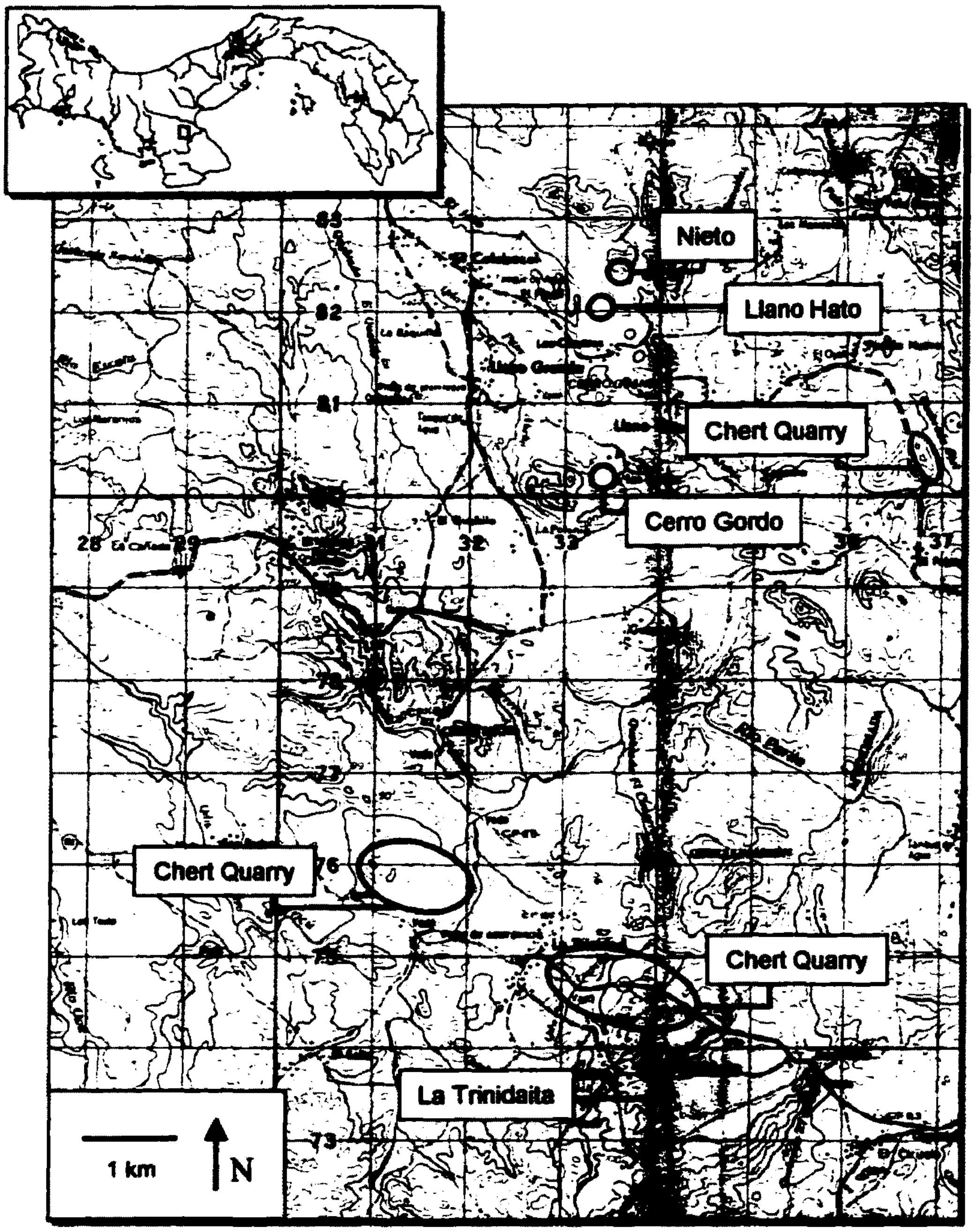


Figure 46. Map showing locations of the Nieto quarry/workshop, nearby lithic sources, and megafaunal deposits.

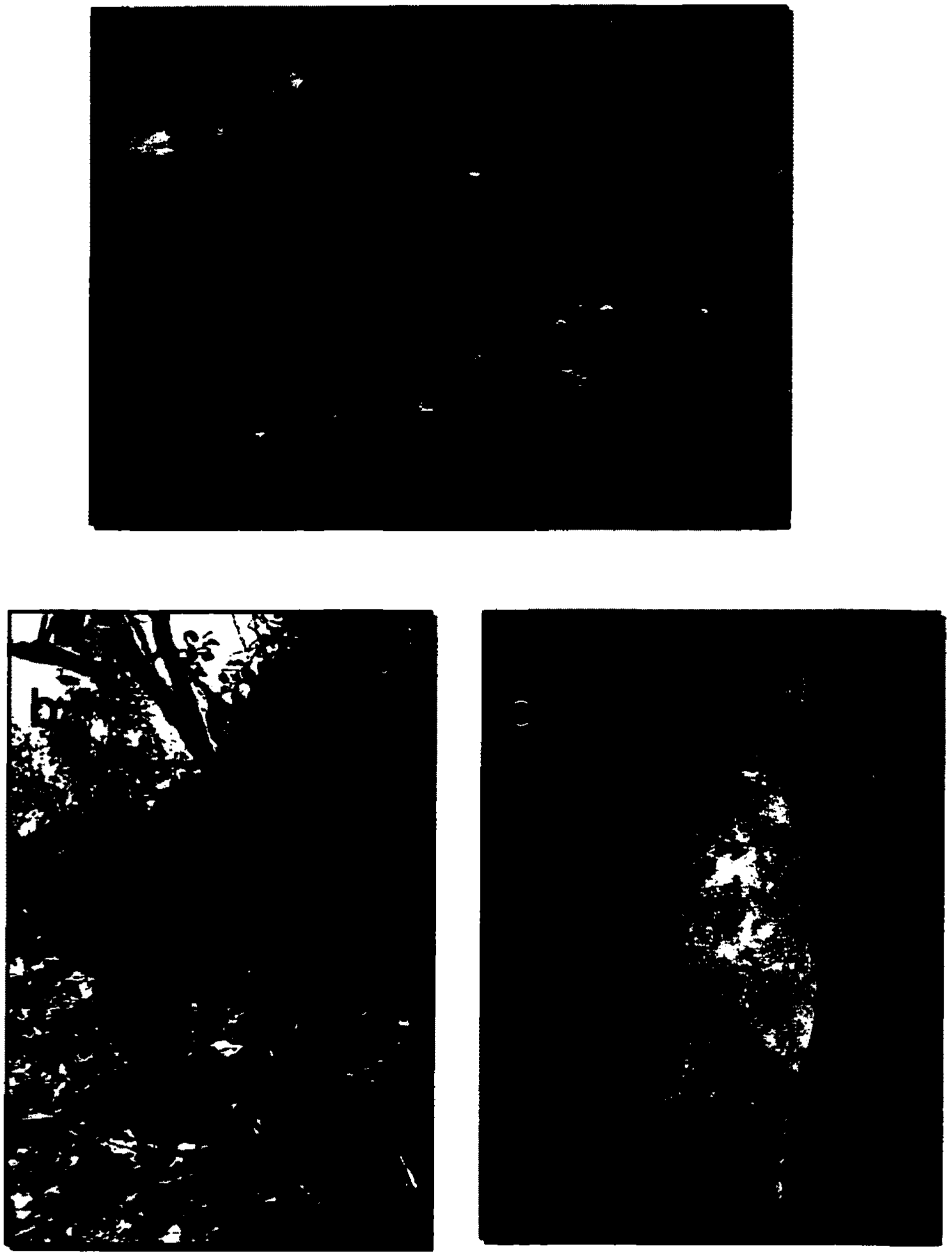


Figure 47. Nieto quarry/workshop, a-b) quartz vein on hilltop (south side), c) Clovis-like point preform.

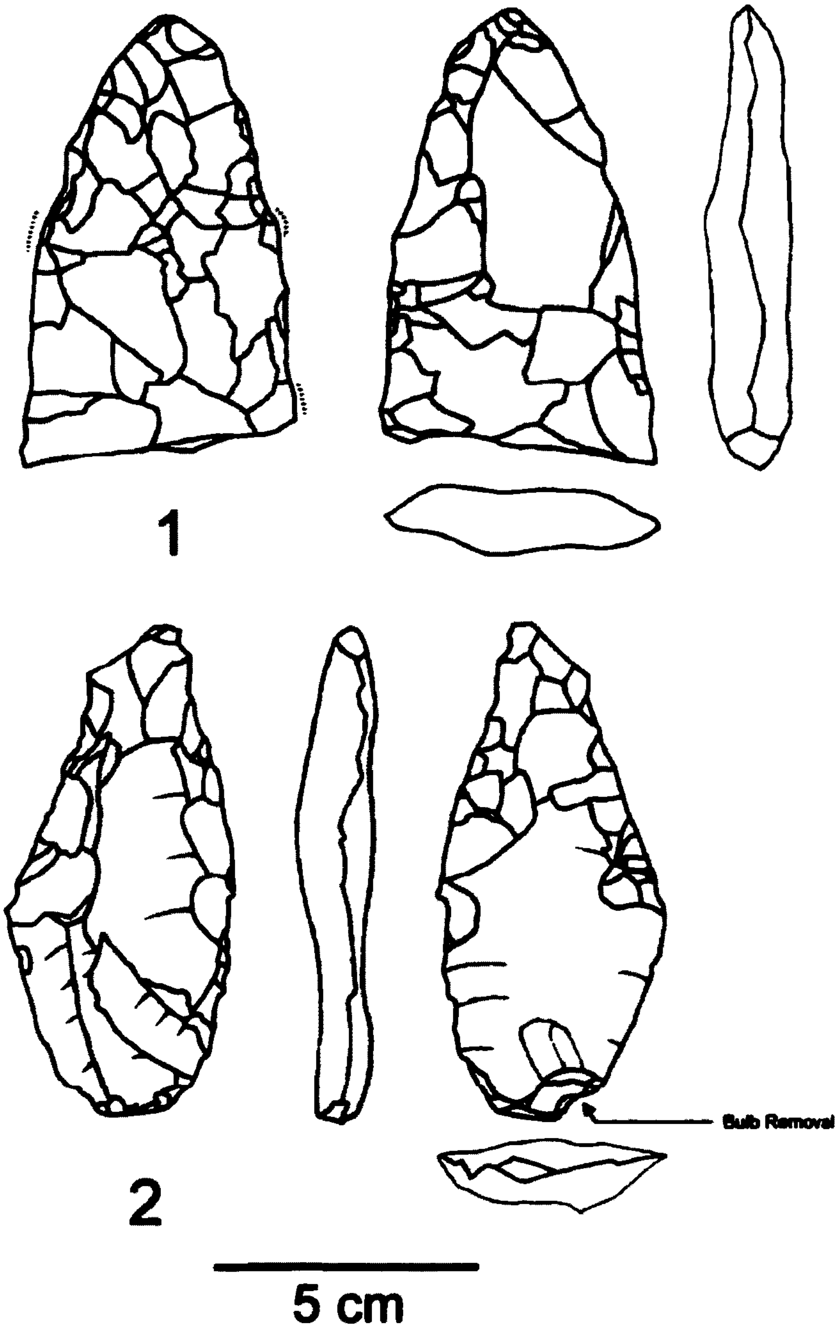
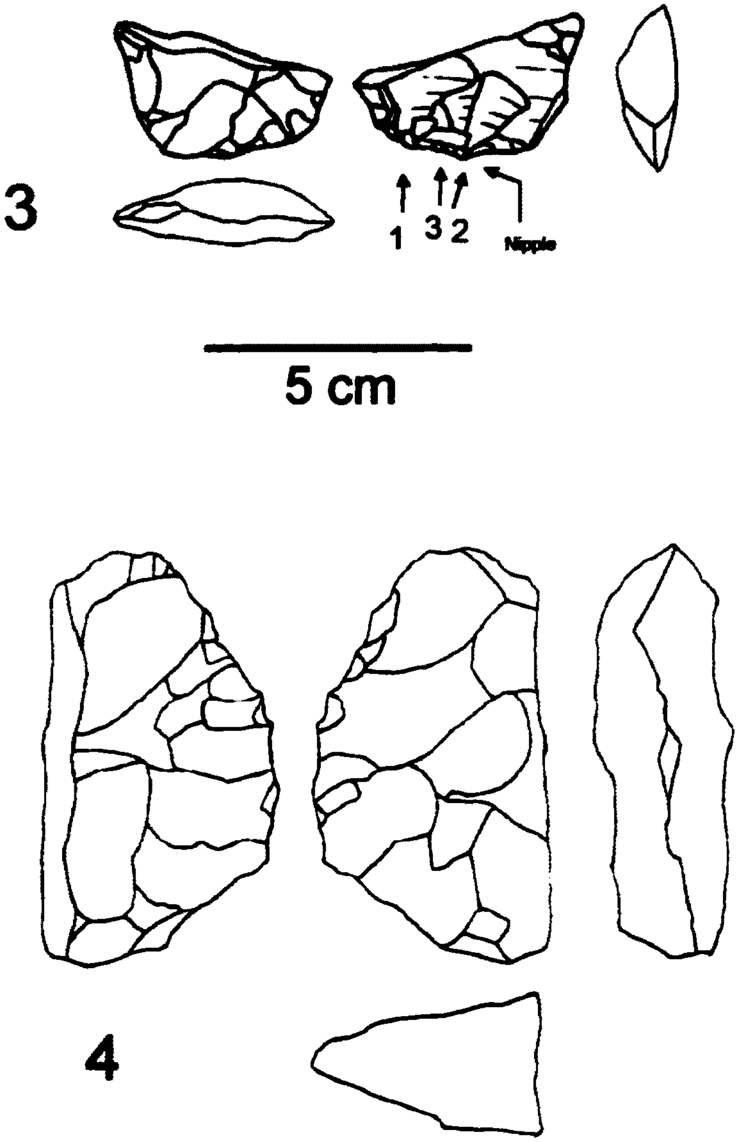


Figure 48. Nieto, projectile point and biface preforms.



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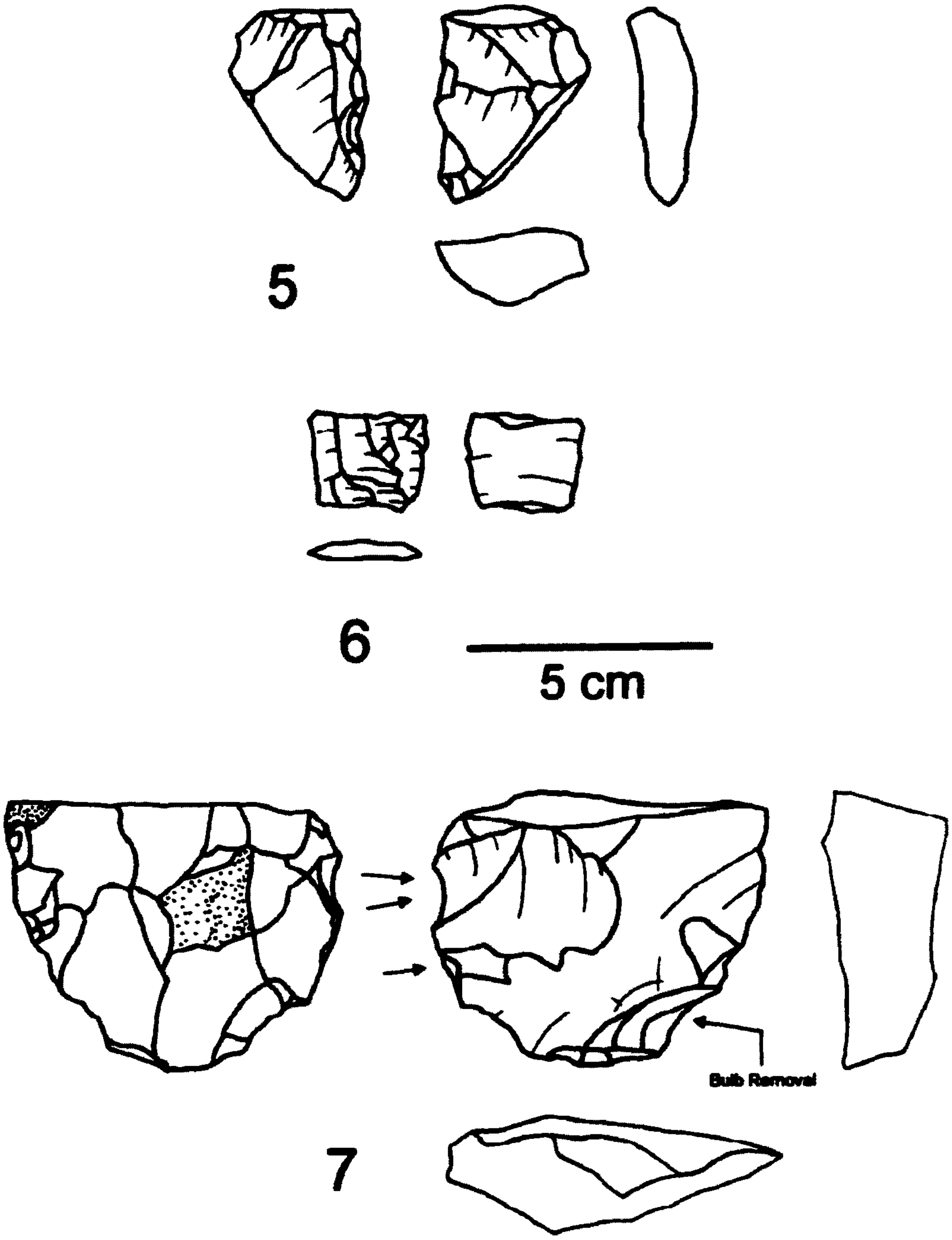

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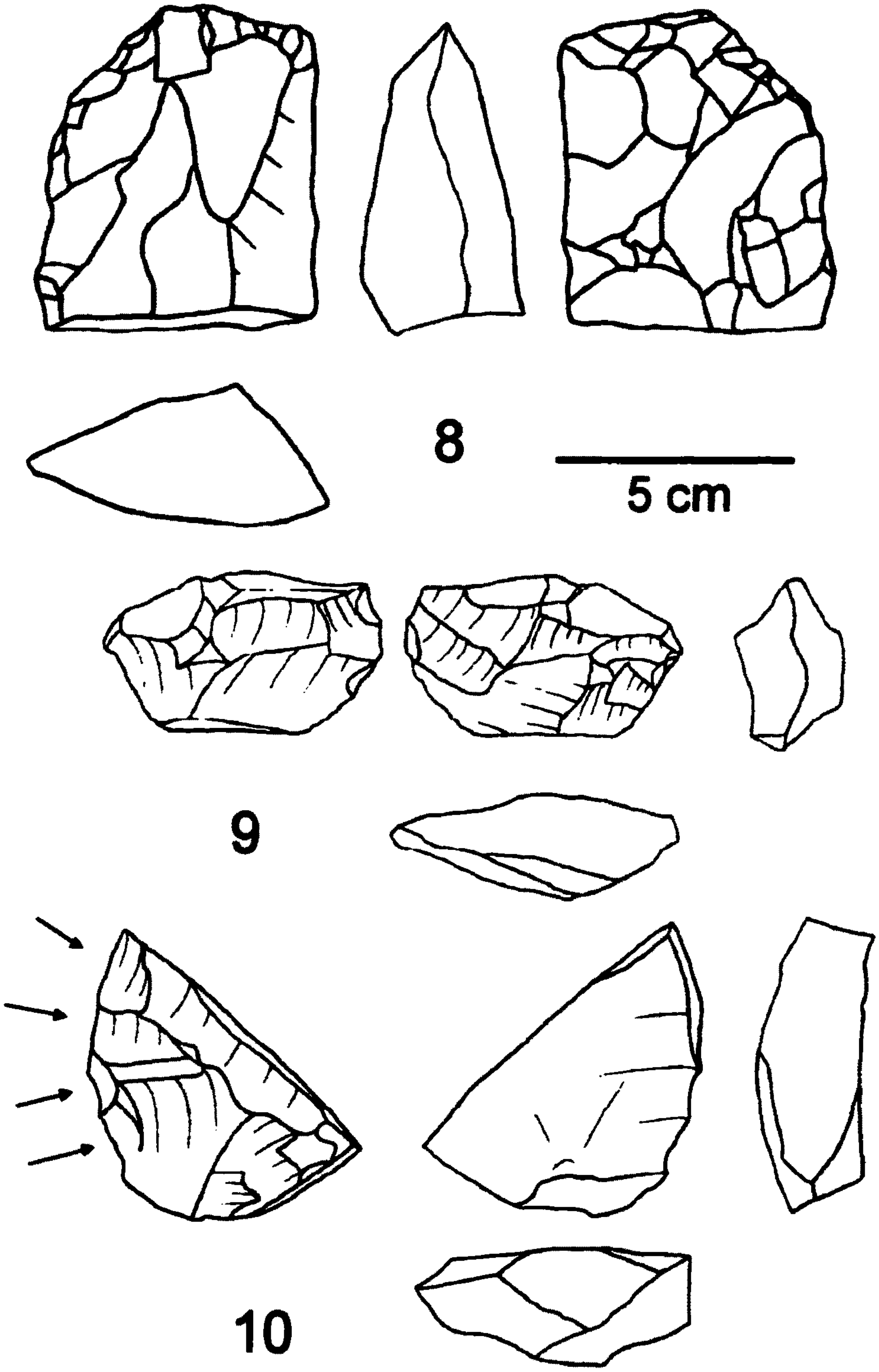

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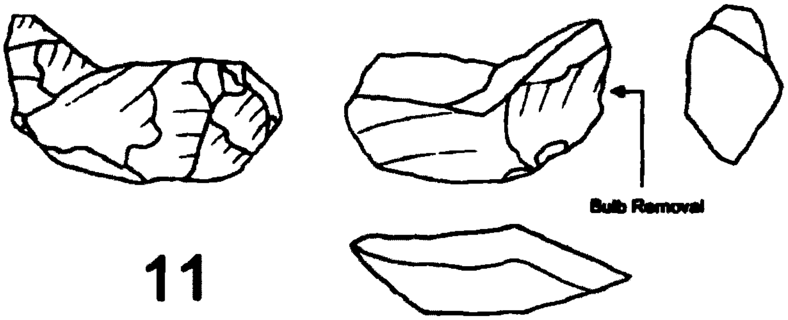

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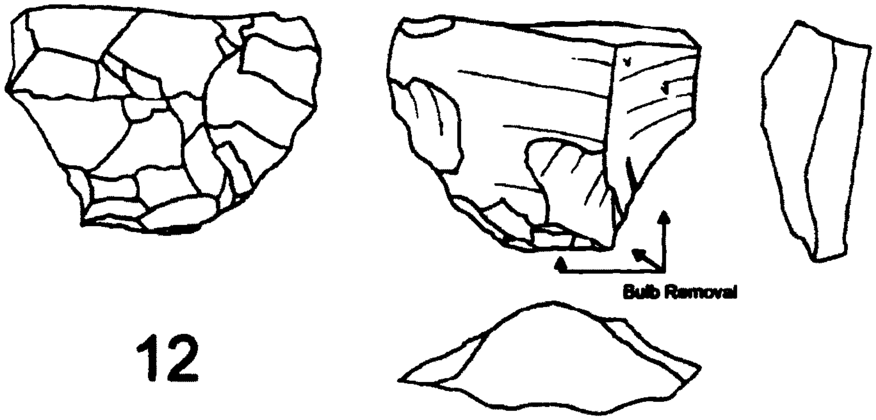

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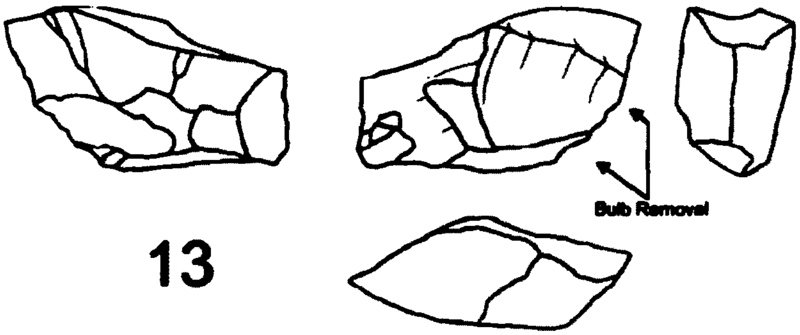

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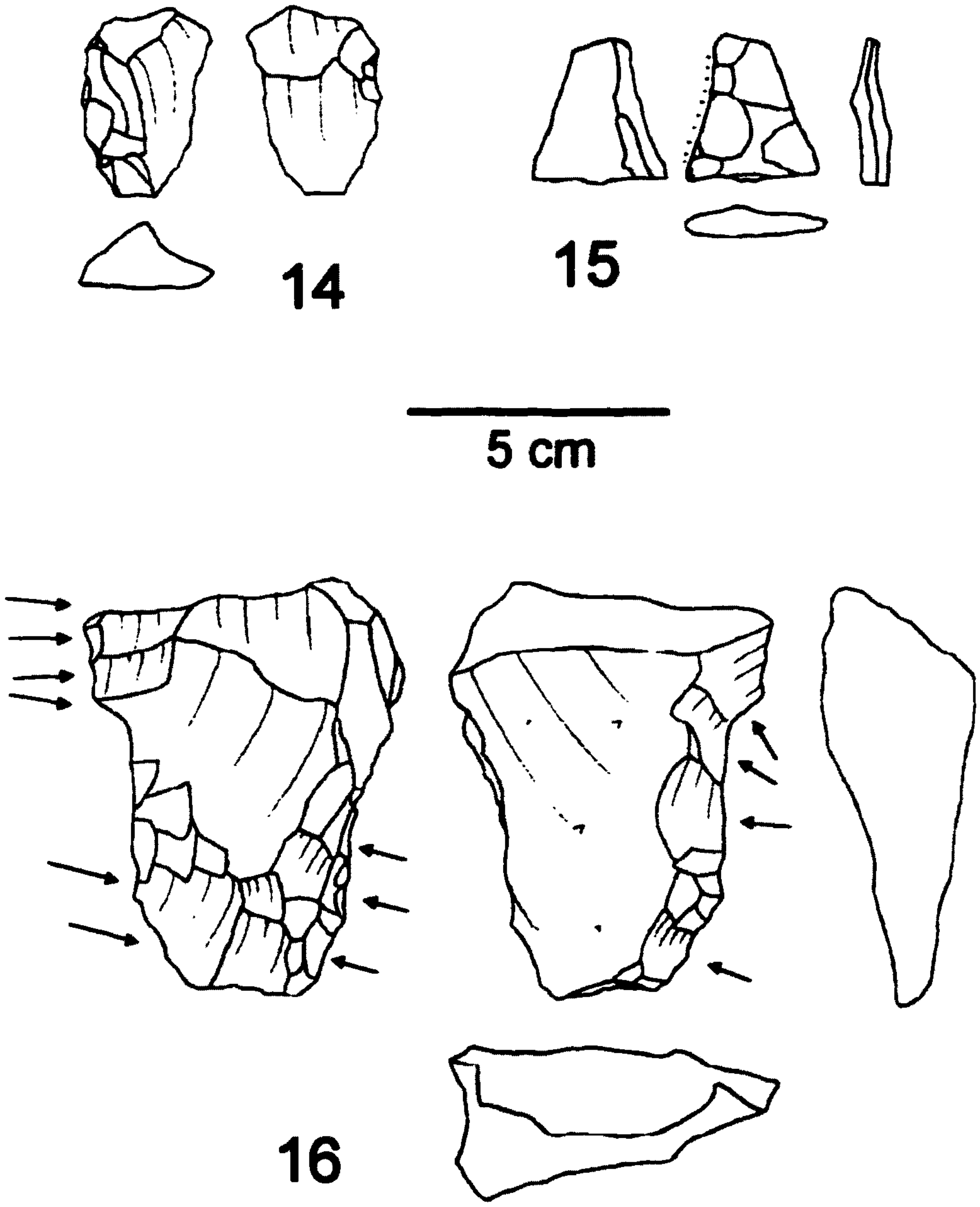
Figure 48. Continued.



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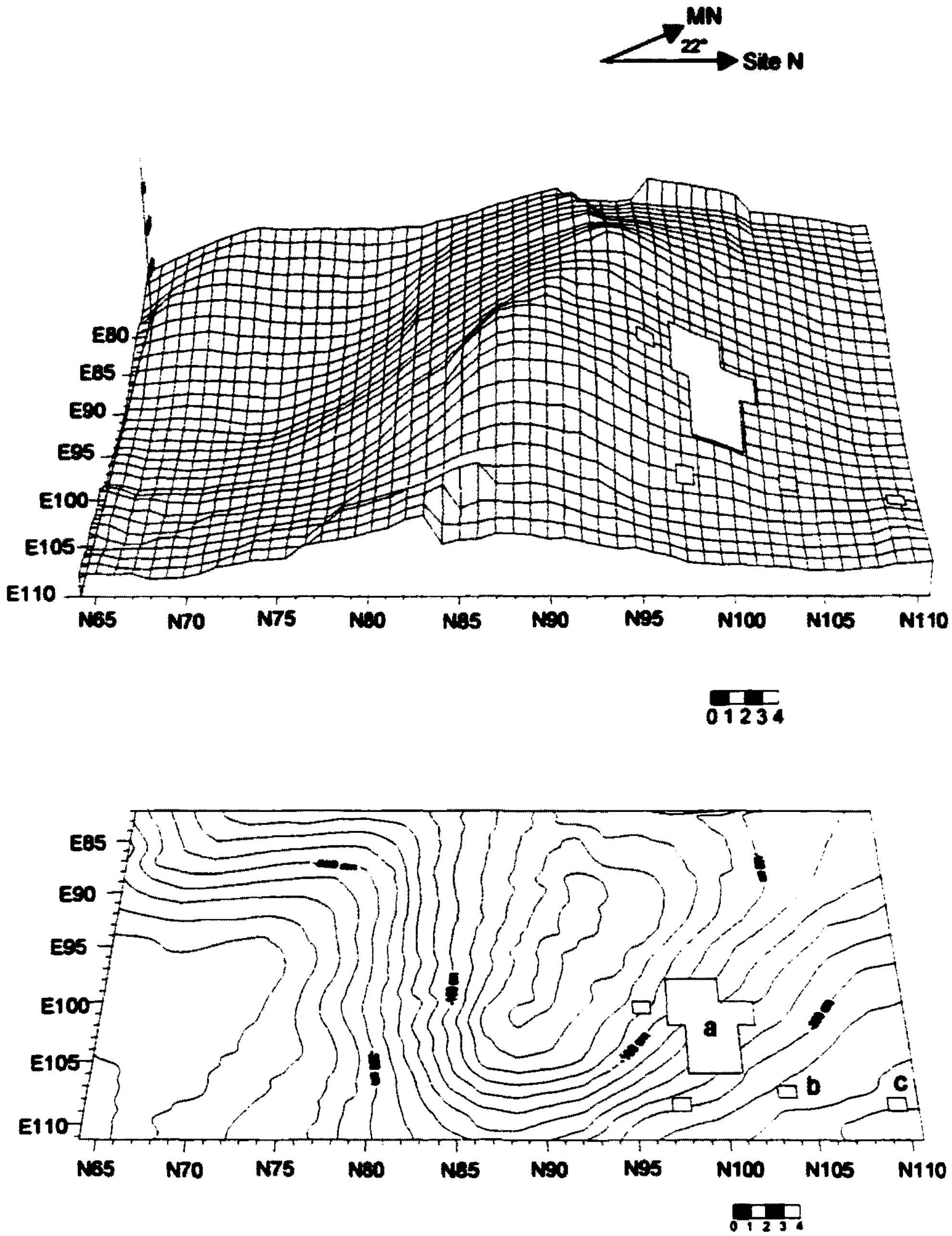


Figure 49. Site map of Nieto quarry/workshop.

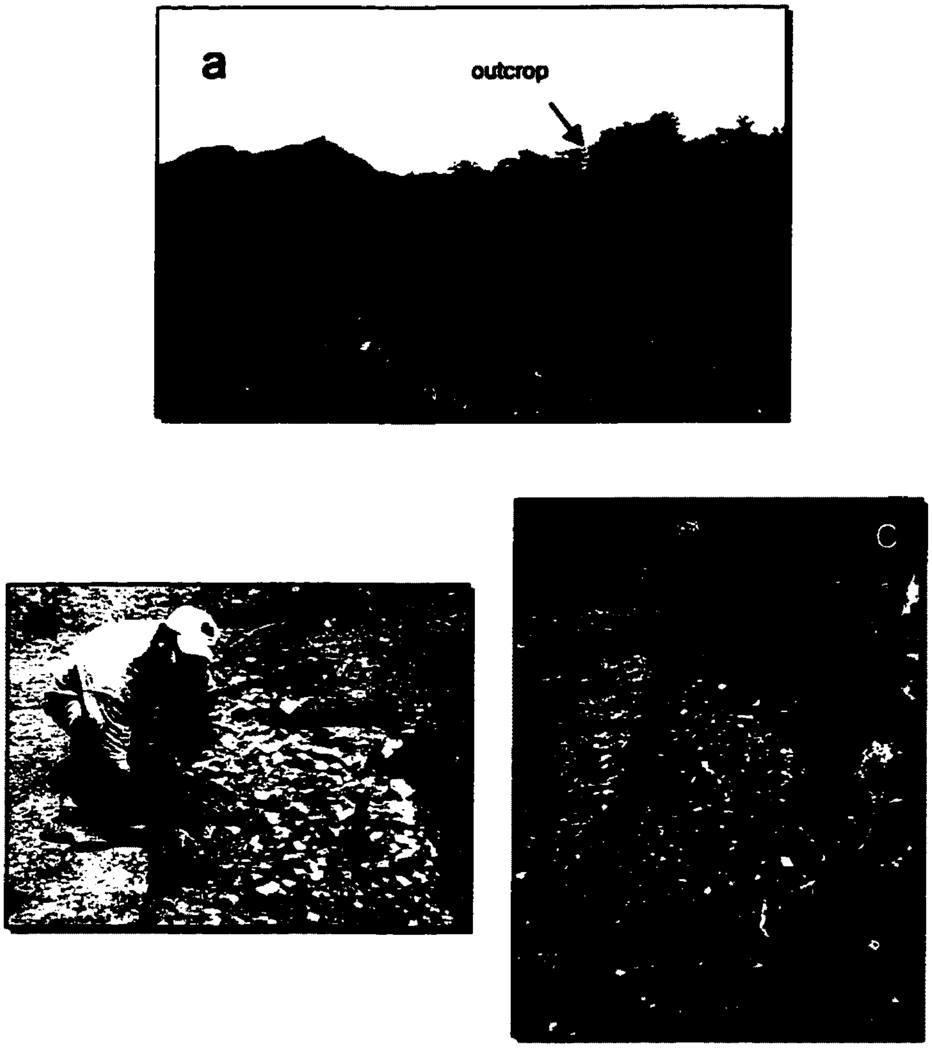


Figure 50. Nieto, a) north side of quarry/workshop, b-c) main excavation block.

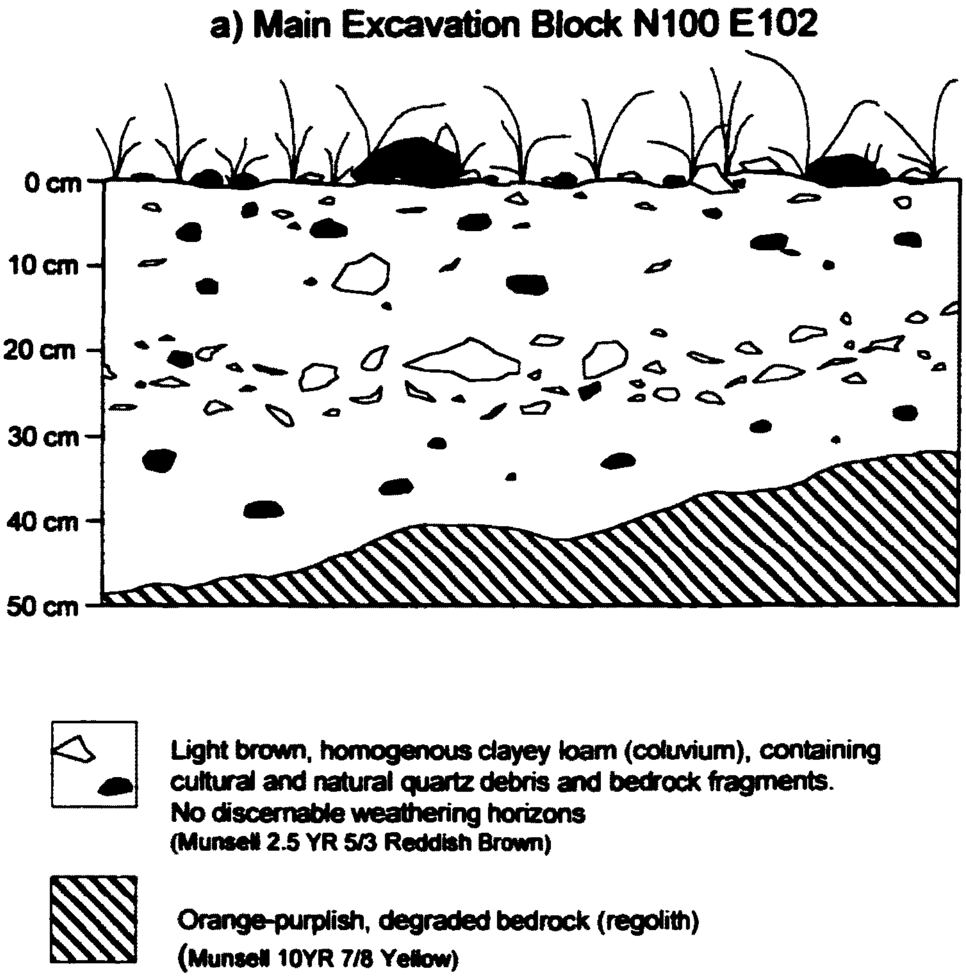


Figure 51. Nieto, stratigraphic profiles, a) north wall main excavation block N100 E102, b) north wall test pit N103 E107, c) north wall test pit N109 E108. (See Figure 49 for location of test pits).

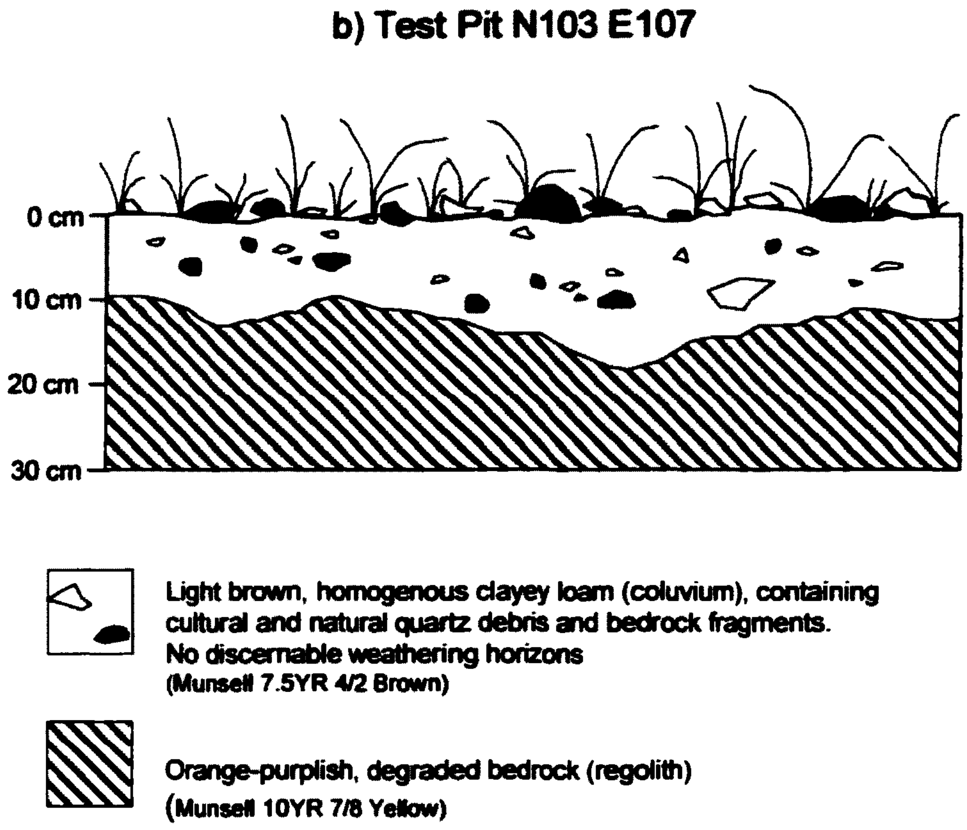
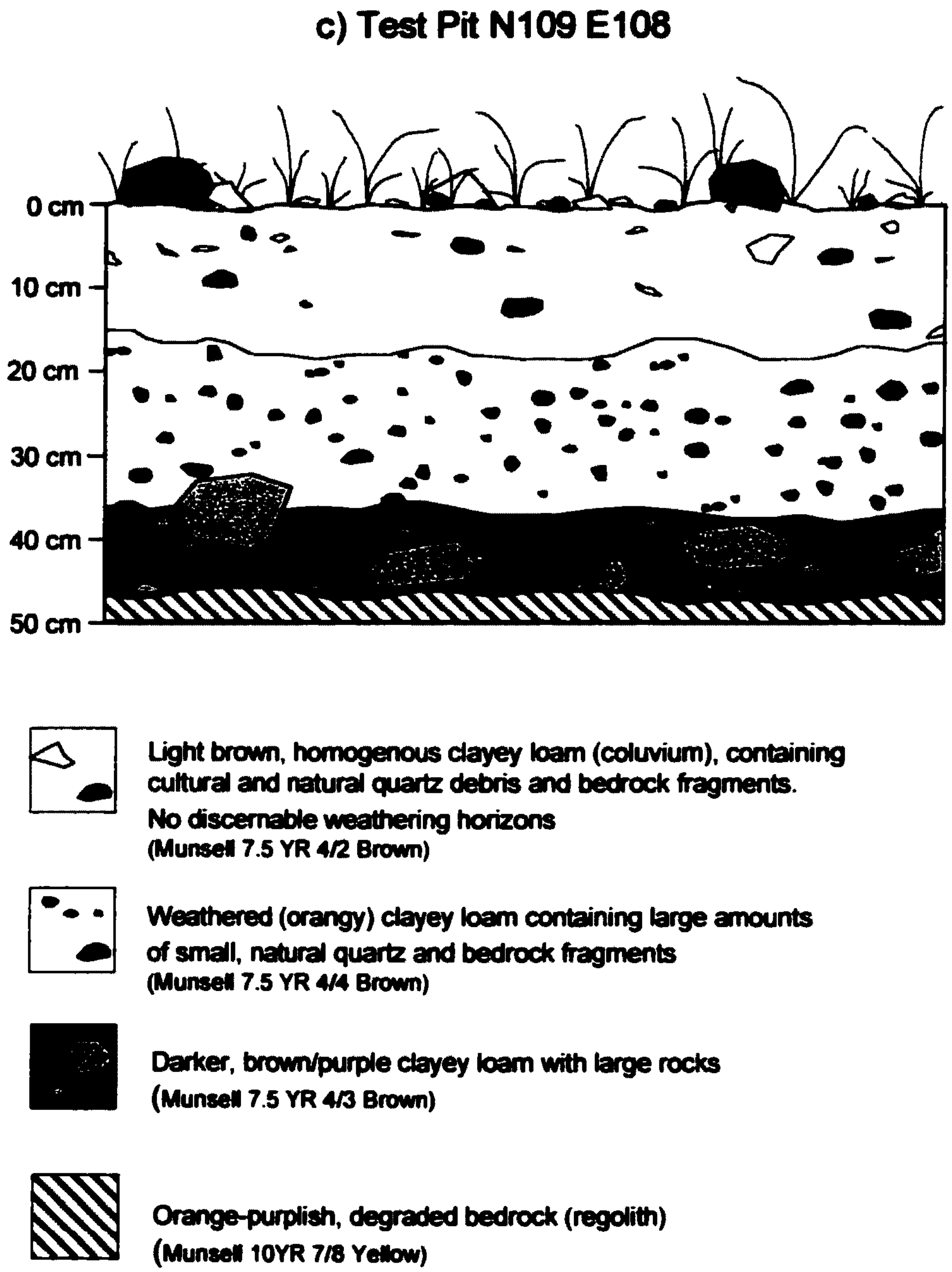

b) Test Pit N103 E107

Figure 51. Continued.


c) Test Pit N109 E108

Light brown, homogenous clayey loam (coluvium), containing cultural and natural quartz debris and bedrock fragments. No discernable weathering horizons
(Munsell 7.5 YR 4/2 Brown)

Weathered (orangy) clayey loam containing large amounts of small, natural quartz and bedrock fragments
(Munsell 7.5 YR 4/4 Brown)

Darker, brown/purple clayey loam with large rocks
(Munsell 7.5 YR 4/3 Brown)

Orange-purplish, degraded bedrock (regolith)
(Munsell 10YR 7/8 Yellow)

Figure 51. Continued.

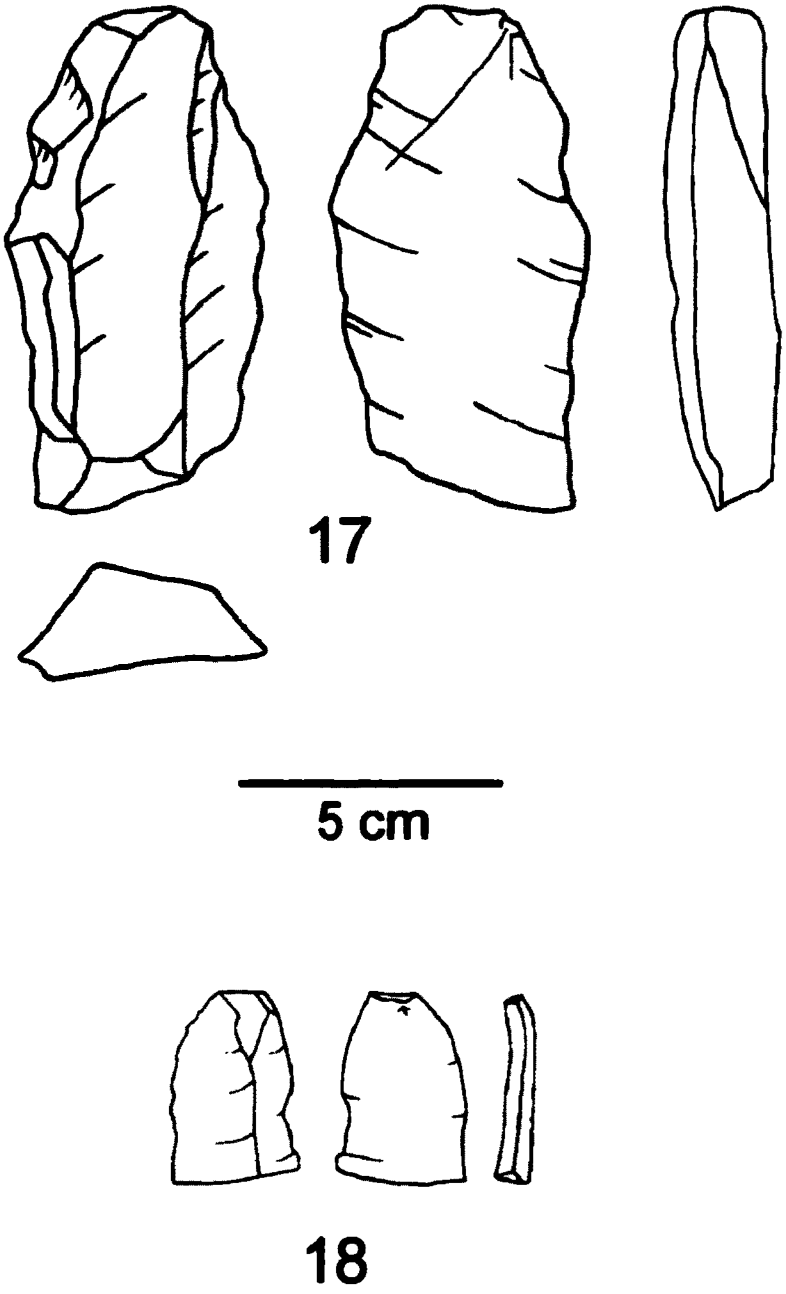
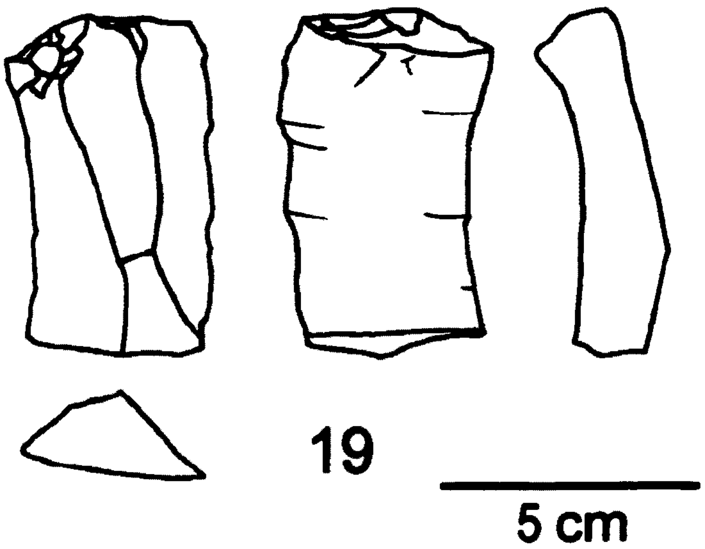


Figure 52. Nieto, blade-like flakes and possible blades.



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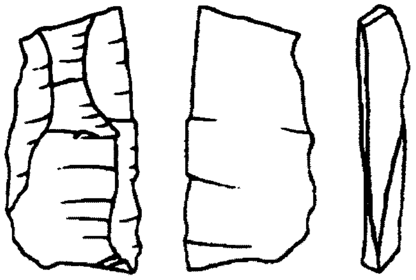

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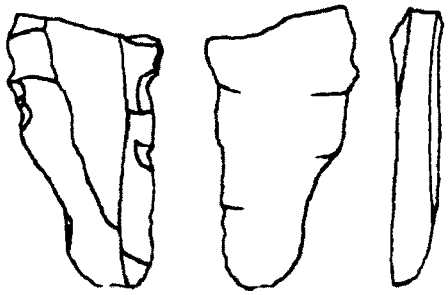

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Figure 52. Continued.

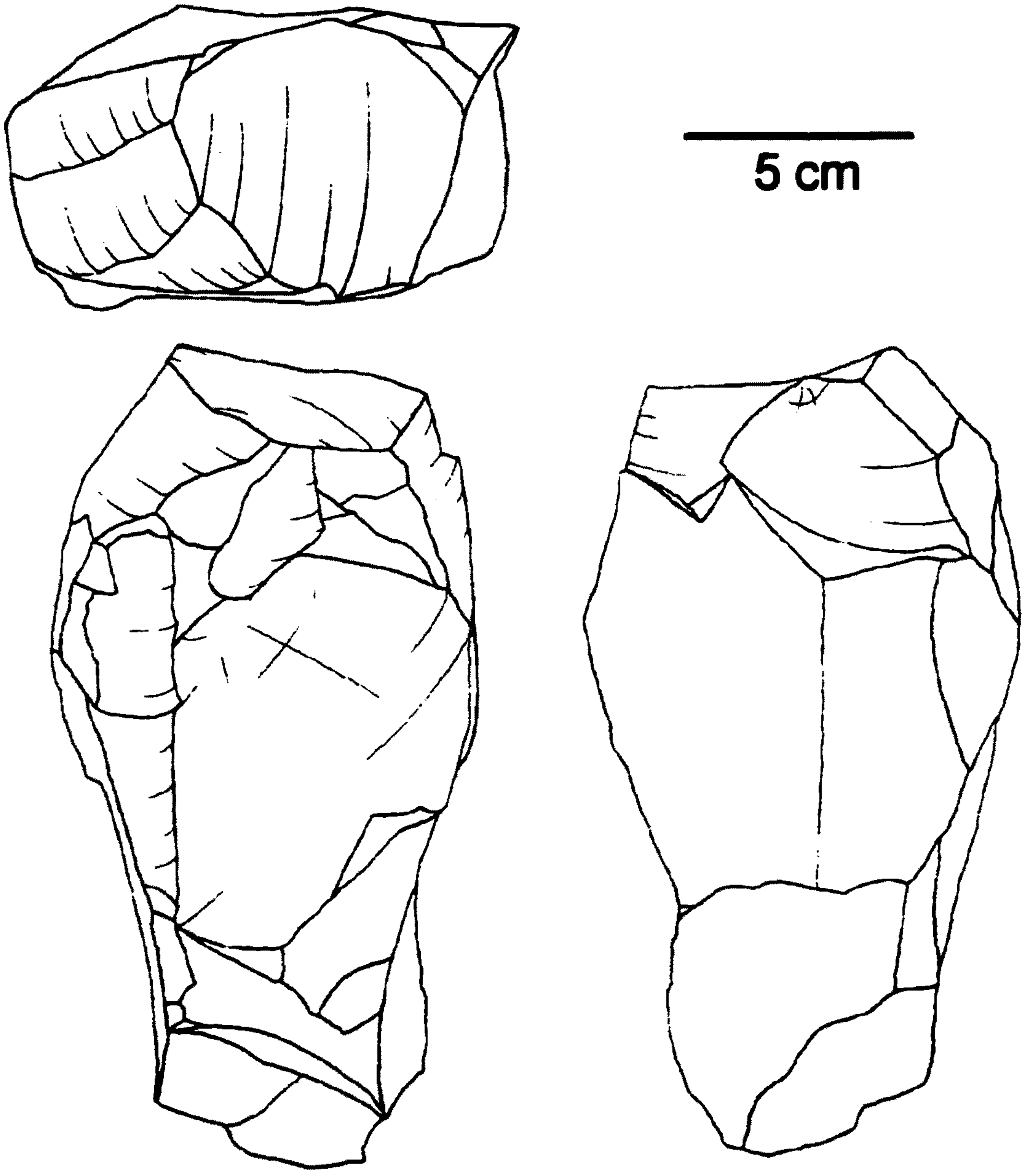

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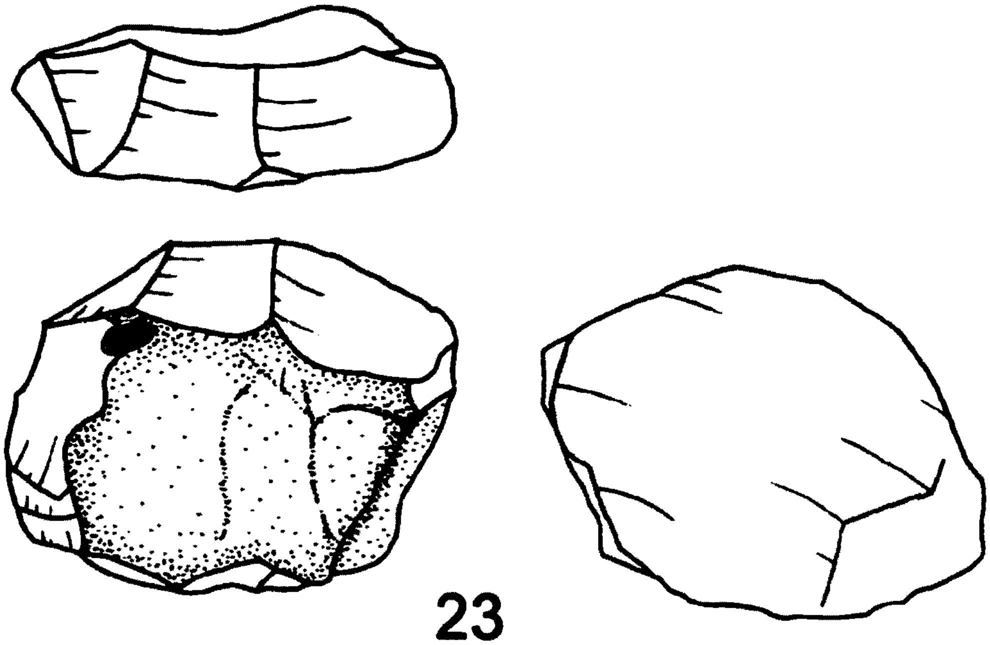
Figure 53. Nieto, 22) flake cores, 23-31) core base rejuvenation segments, 32) cortical ridge spall.



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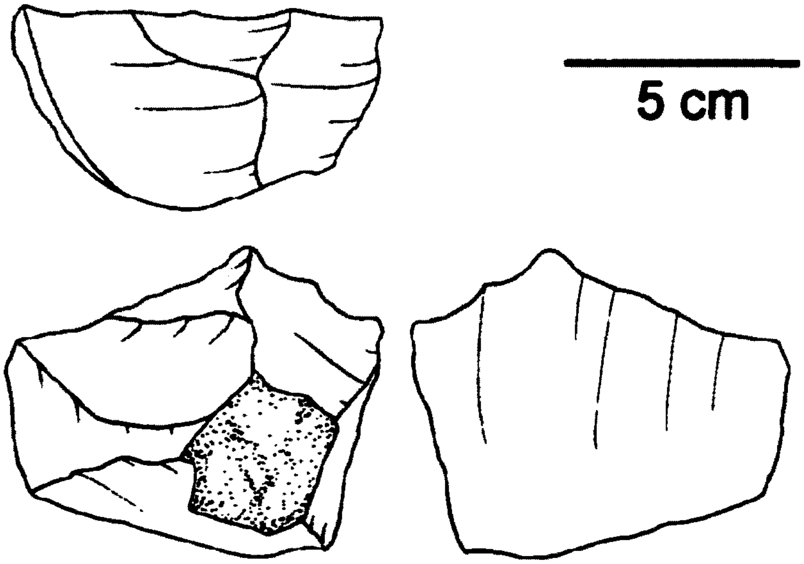

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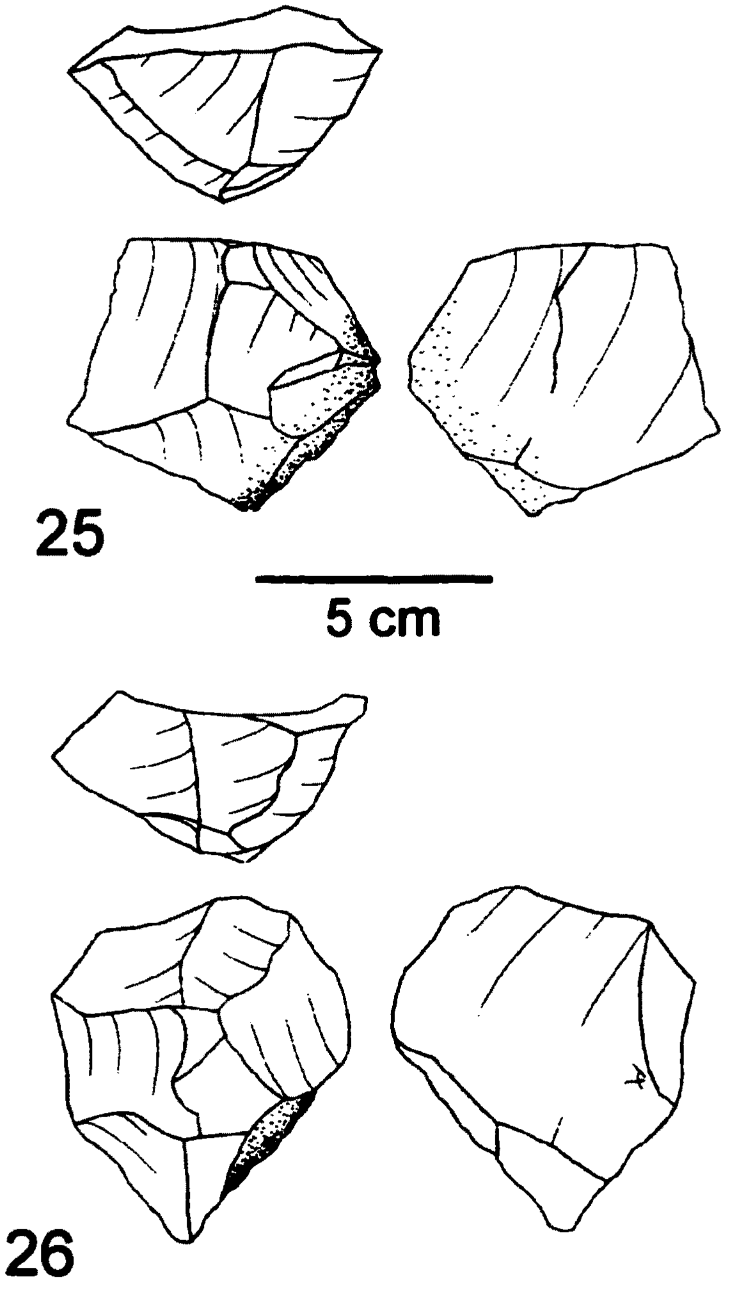
Figure 53. Continued.



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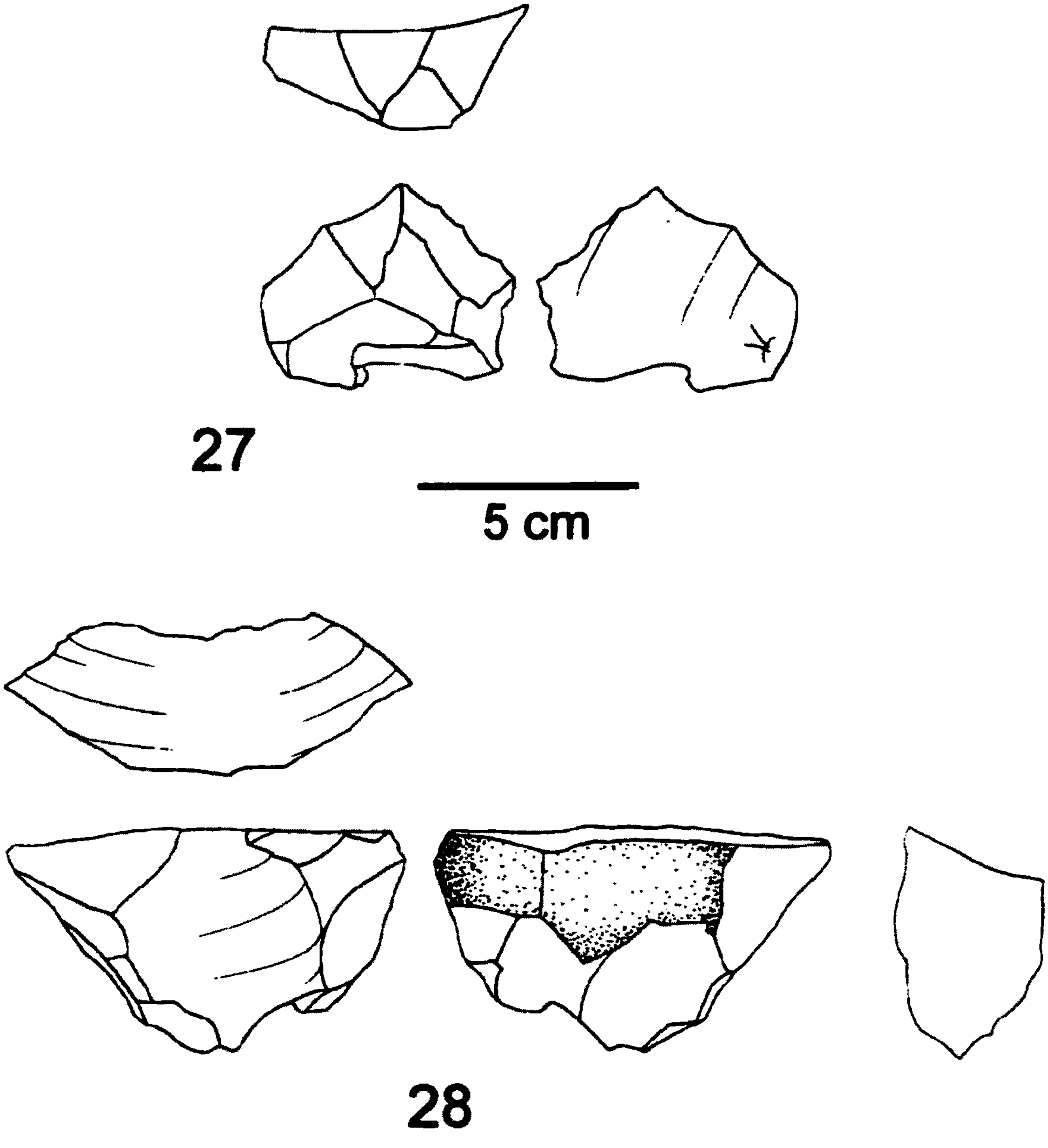

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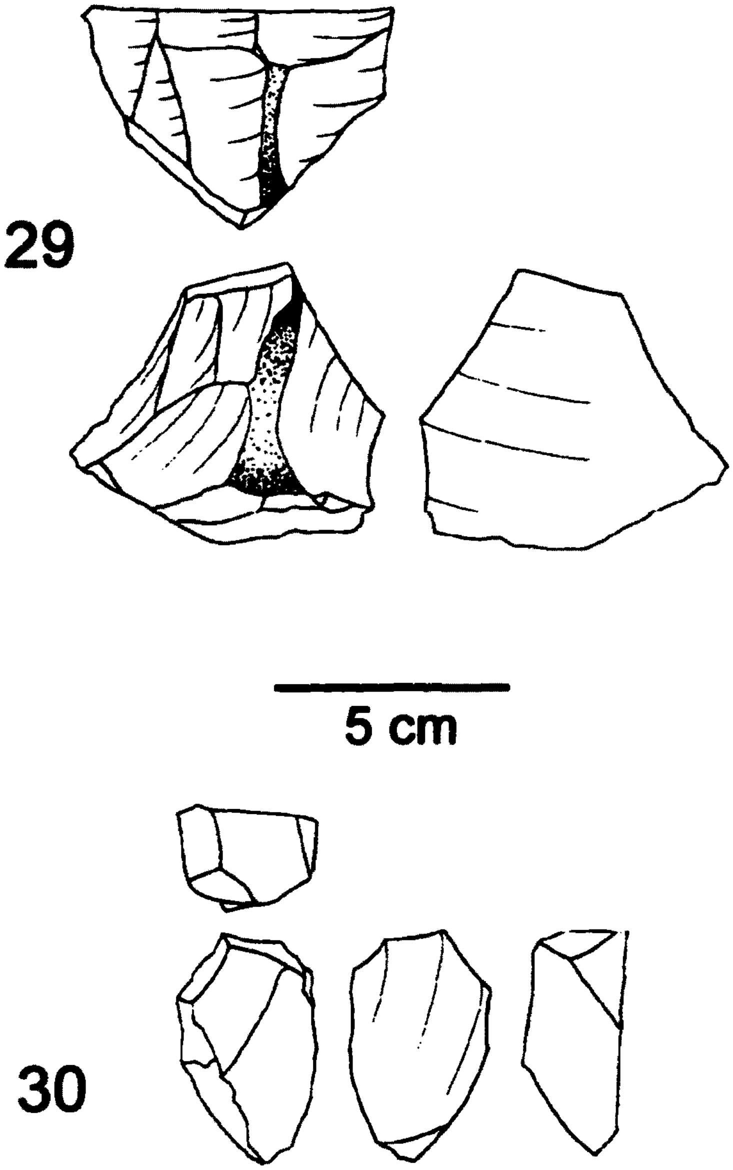

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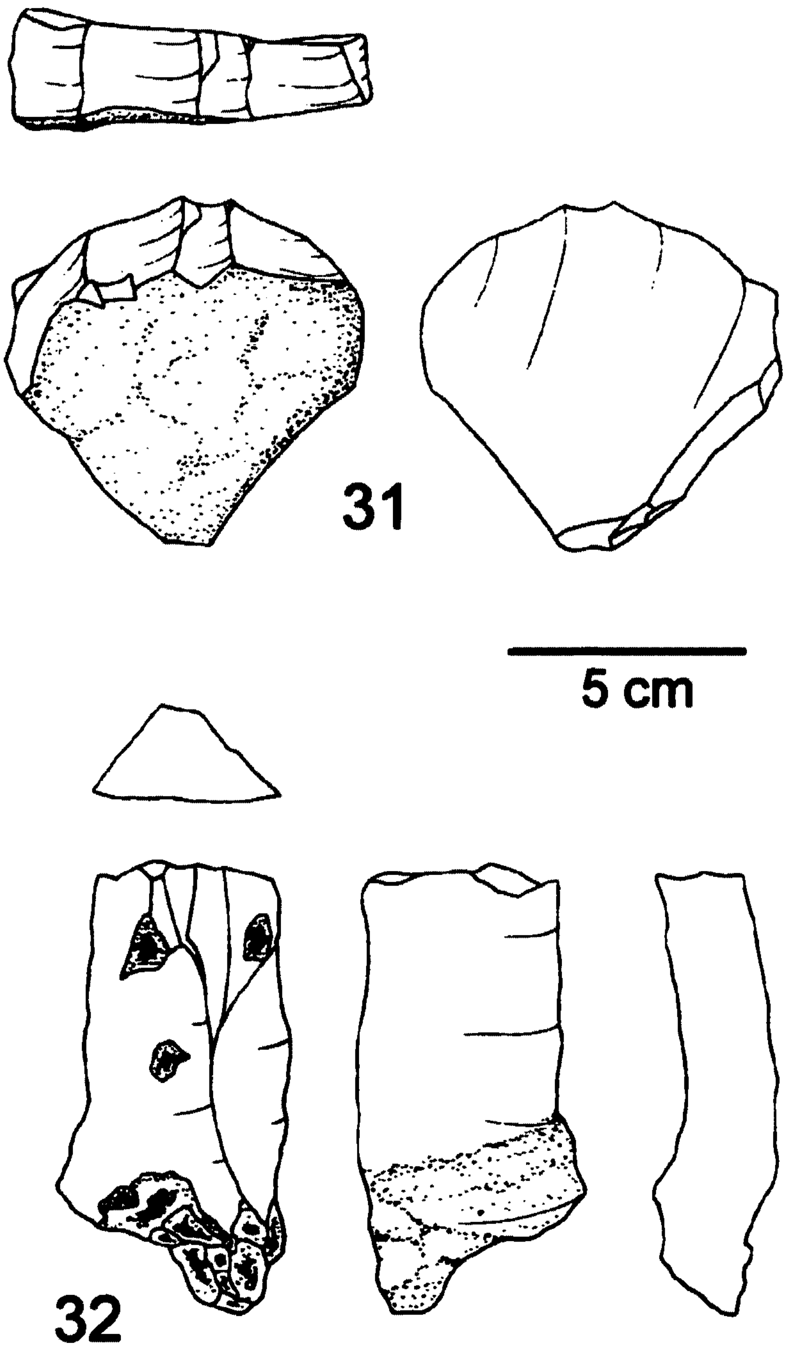

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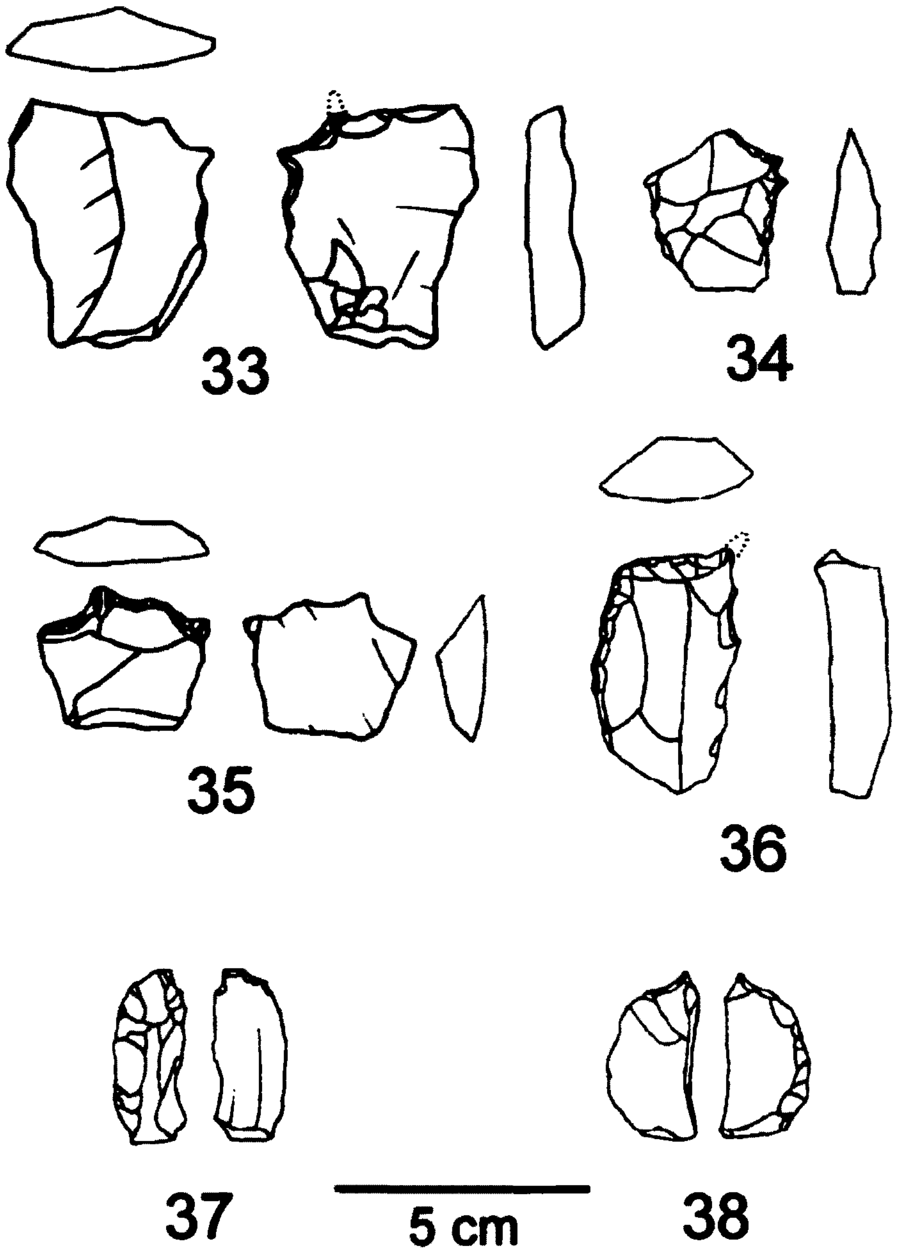
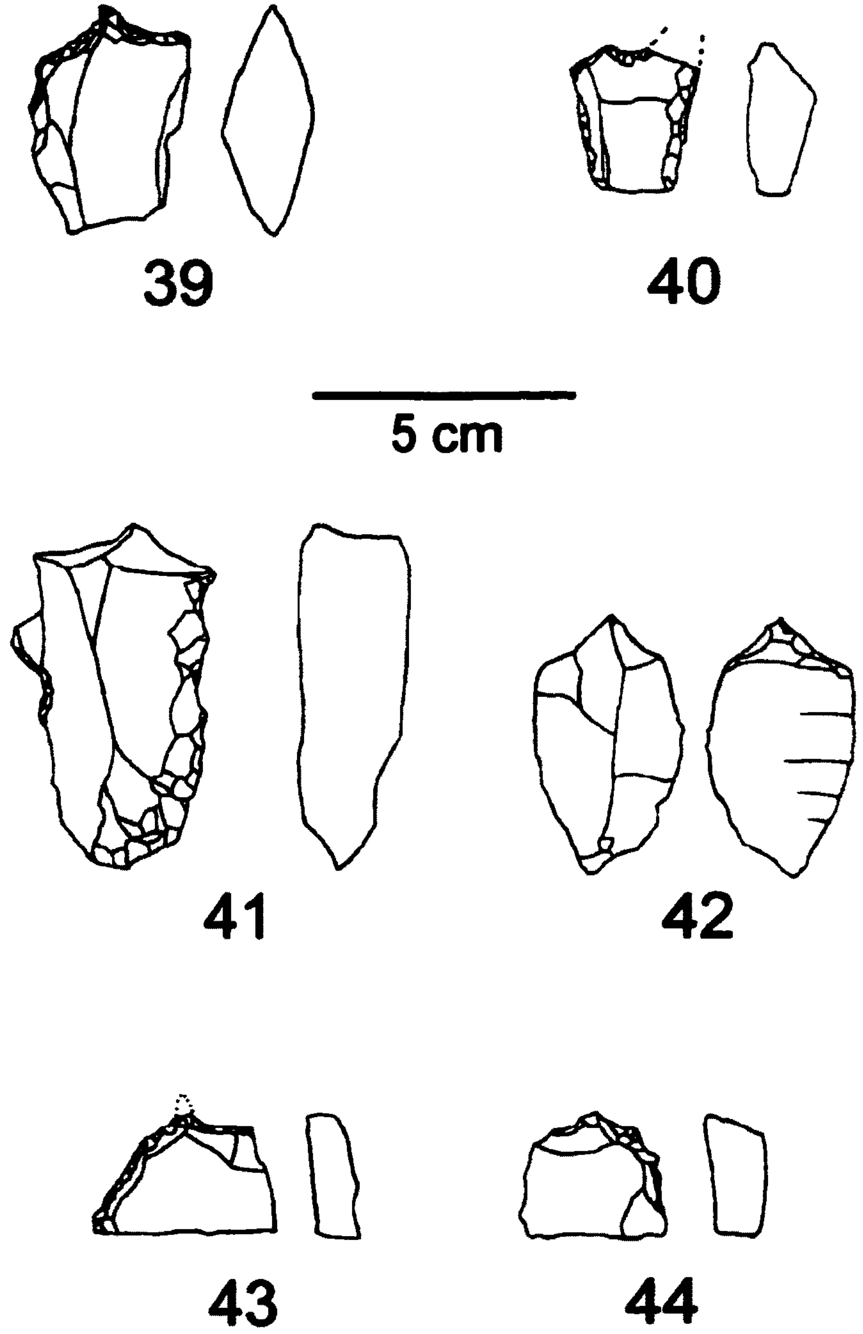


Figure 54. Nieto, unifacial tools, 33-47) gravers, perforators; 48-52) retouched flakes, denticulates; 53-55) spokeshaves; 56-62) large scrapers/planes; 63-75) retouched flakes, end scrapers; 76-77) large retouched flakes; 78-80) large flakes (possible blanks).



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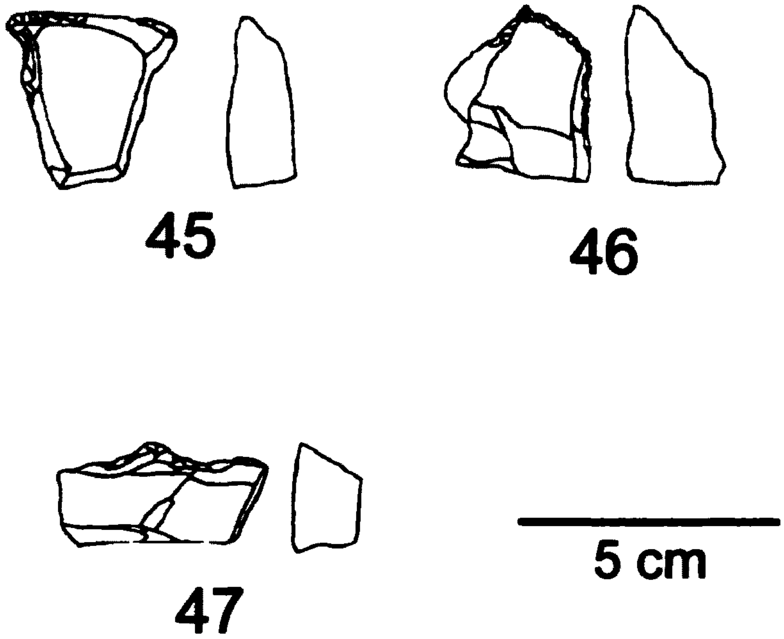

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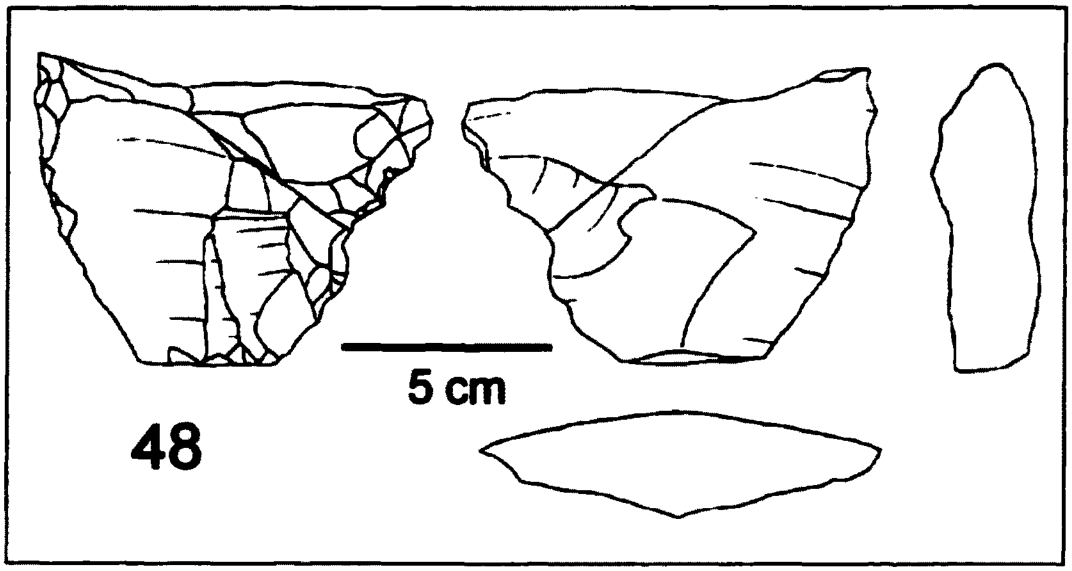

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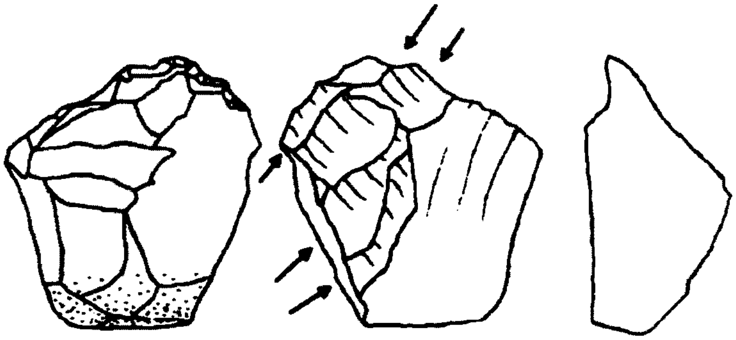

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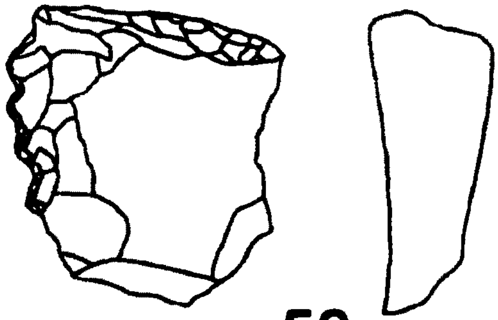

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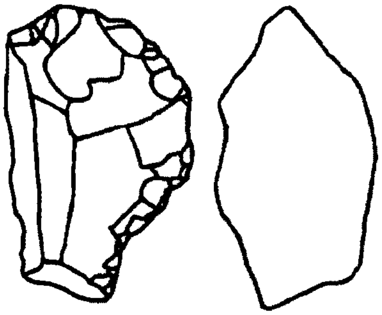

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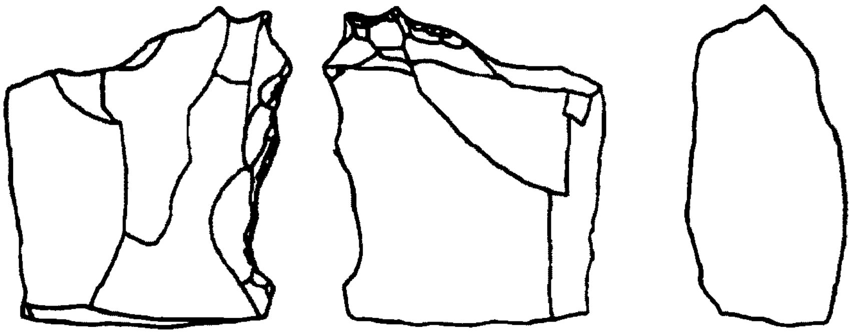

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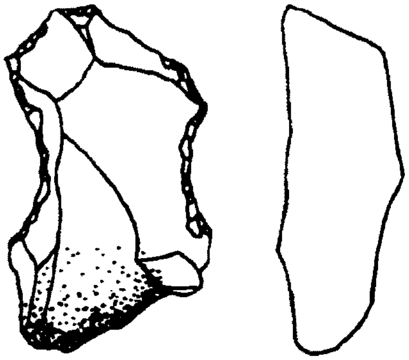

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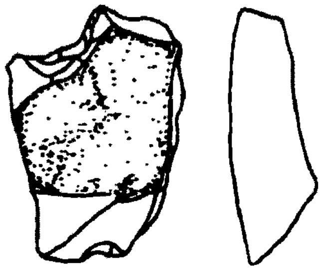

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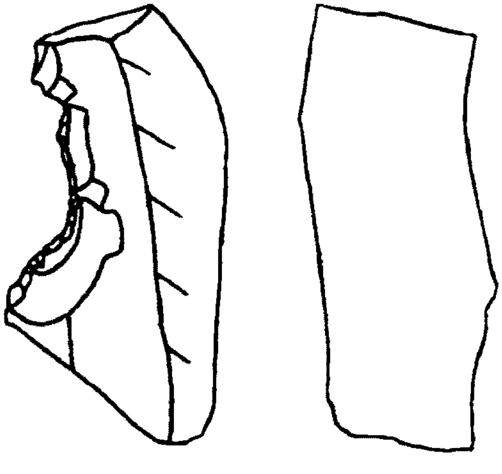

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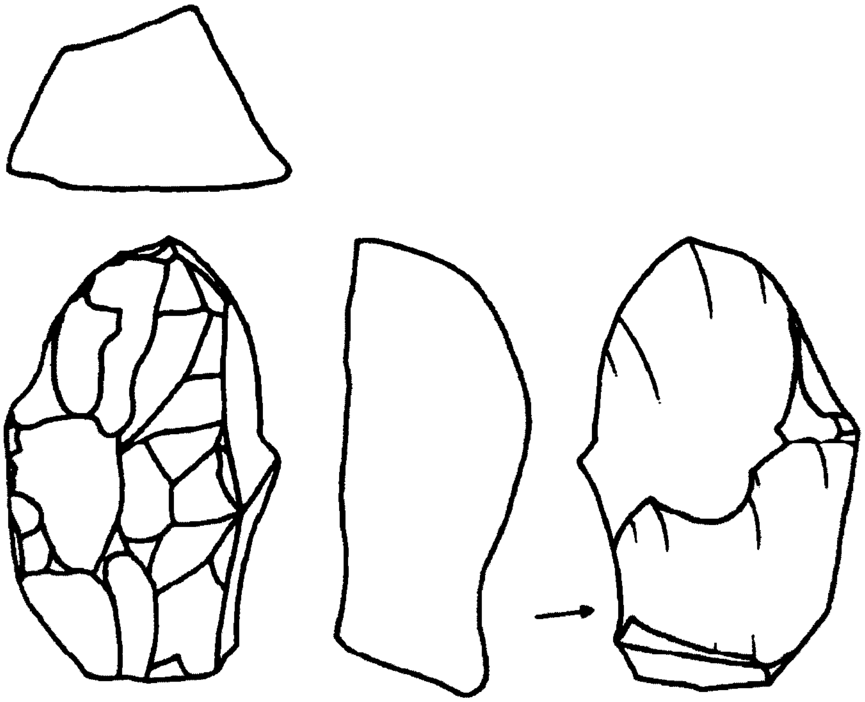

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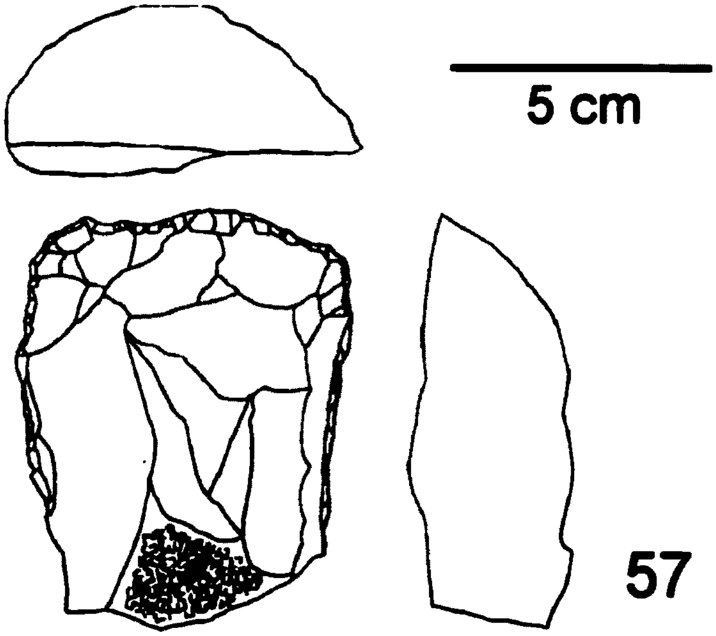

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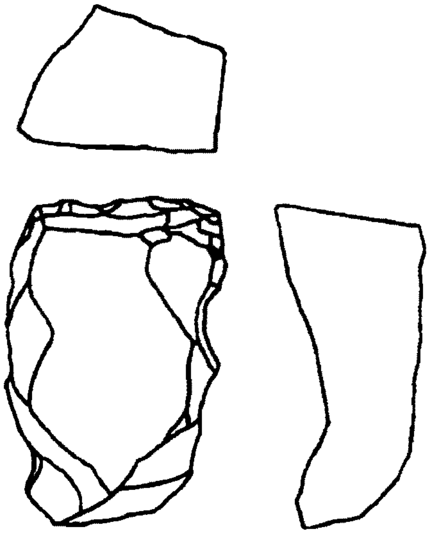

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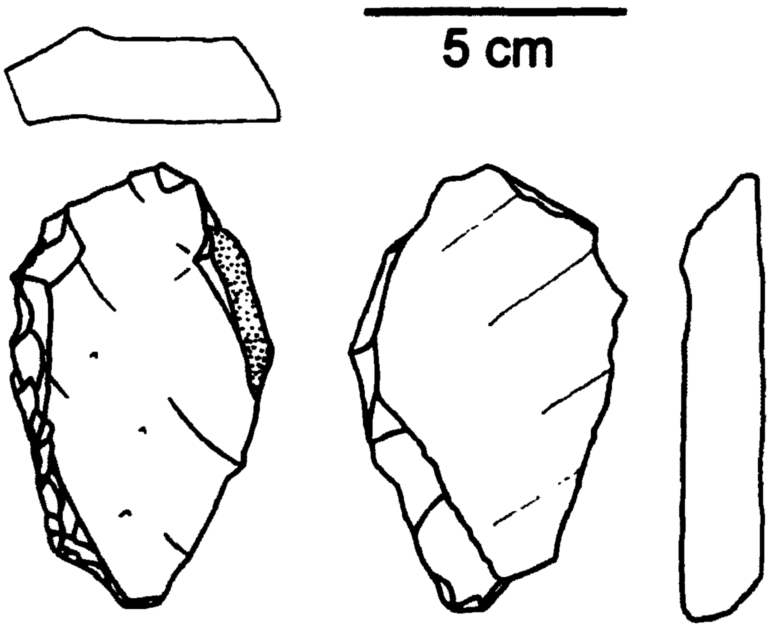

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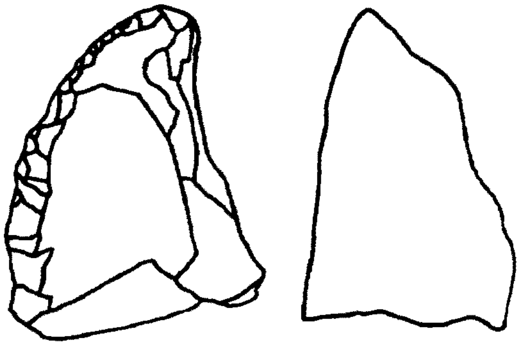

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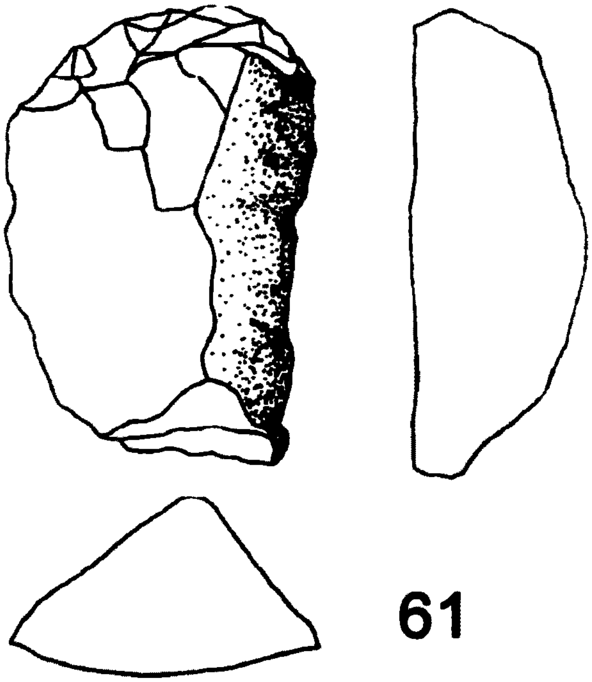

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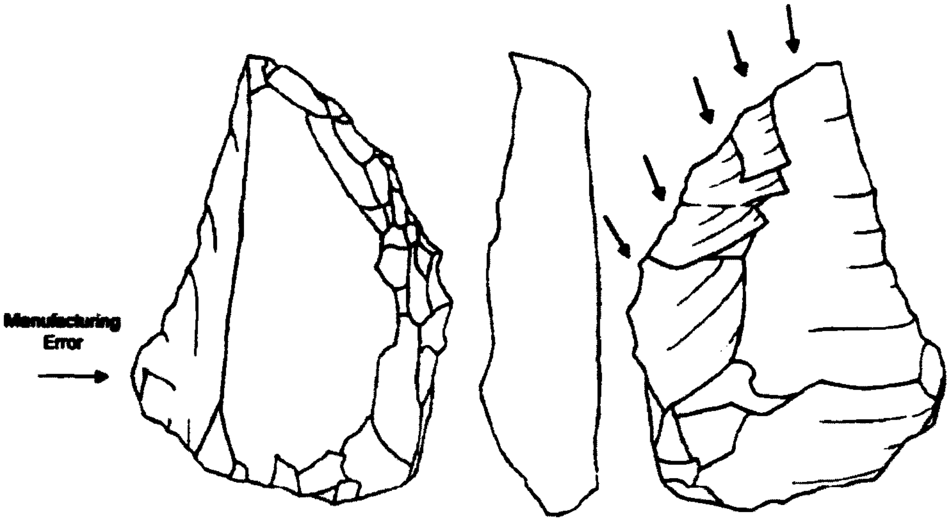

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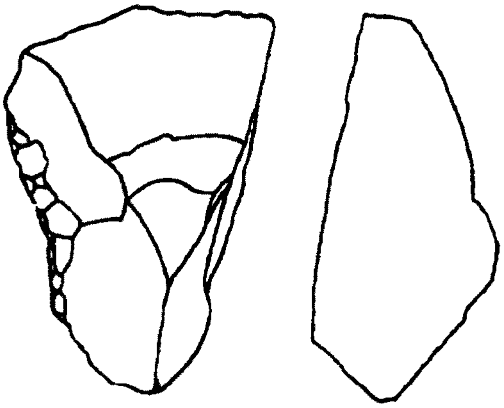

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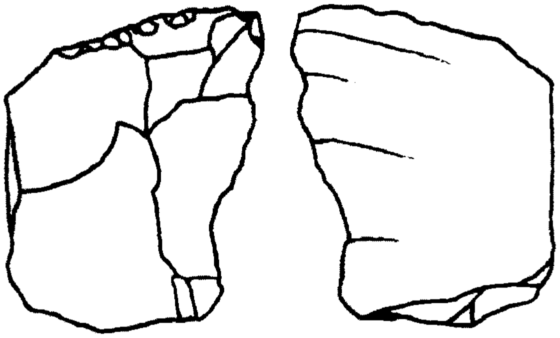

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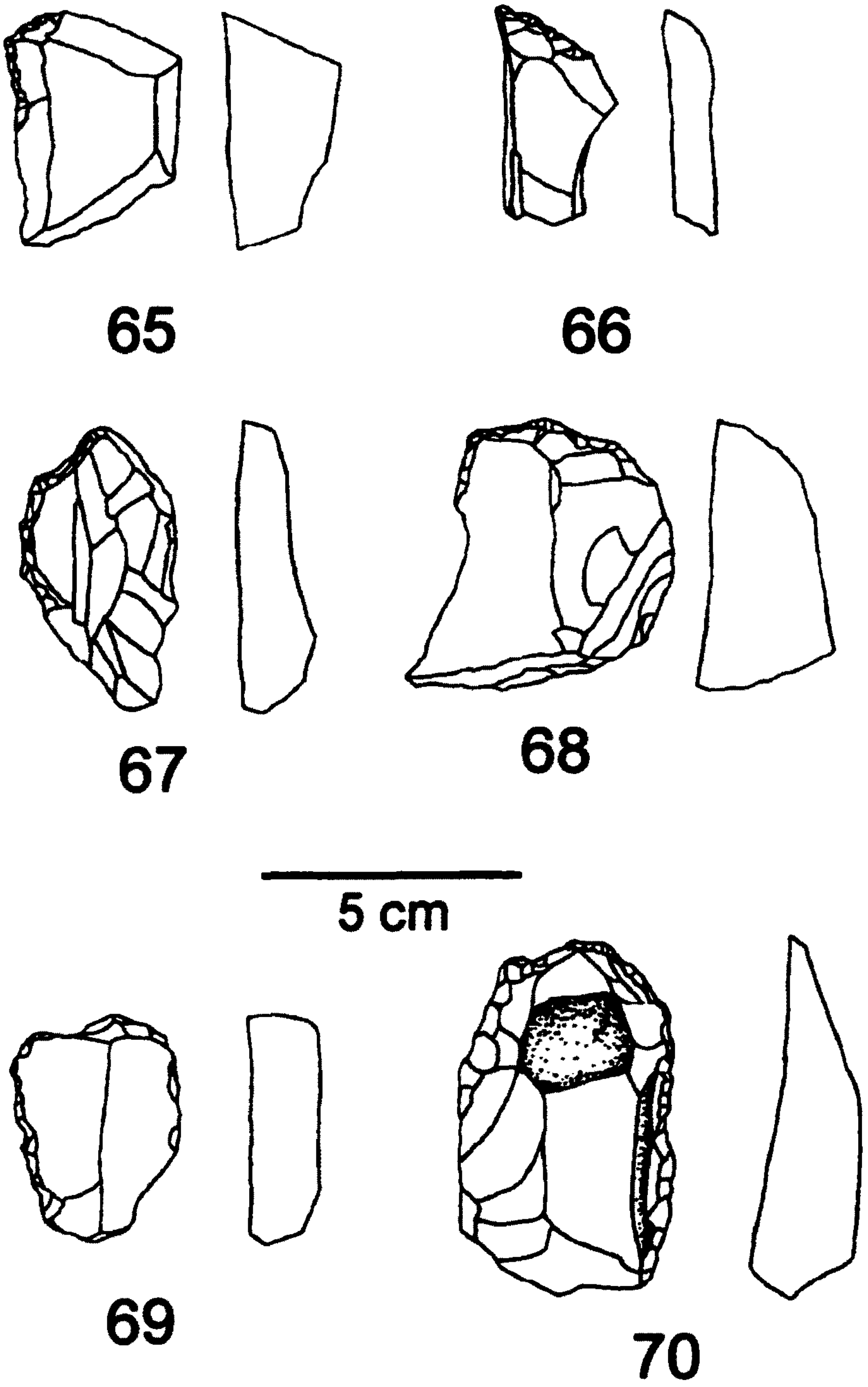

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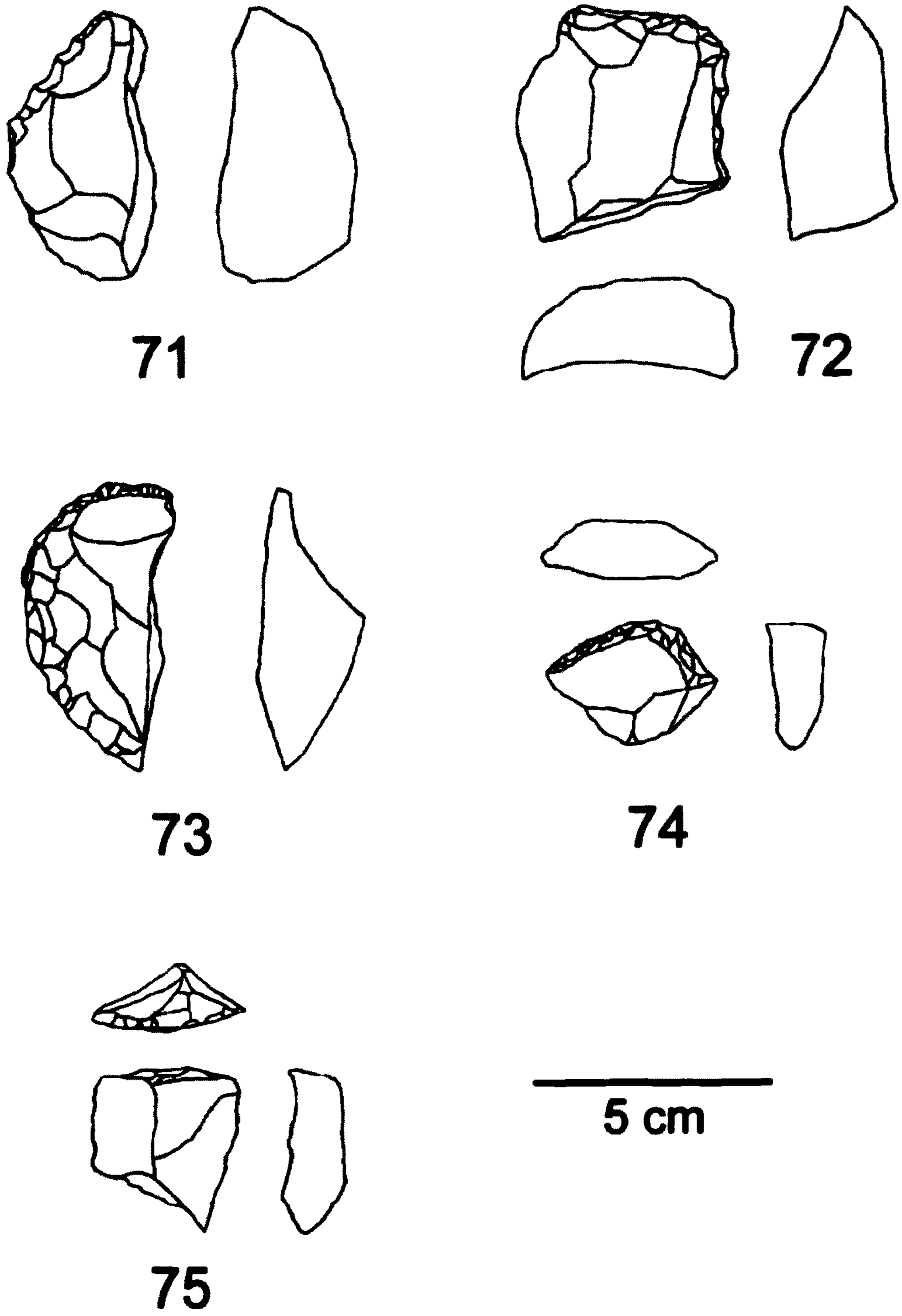

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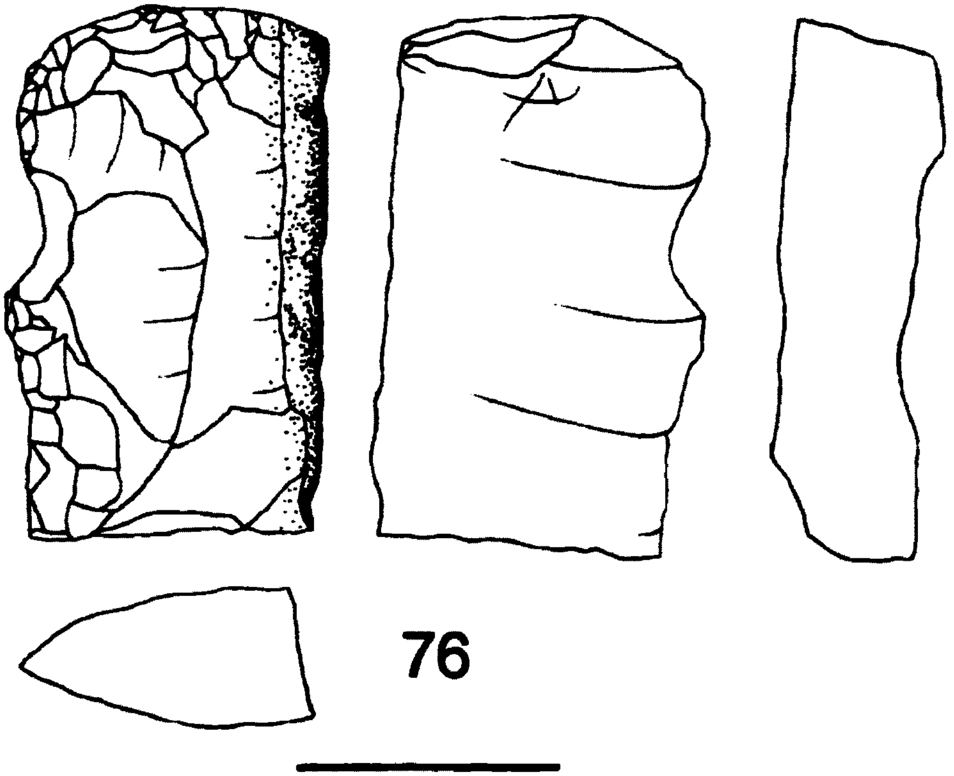

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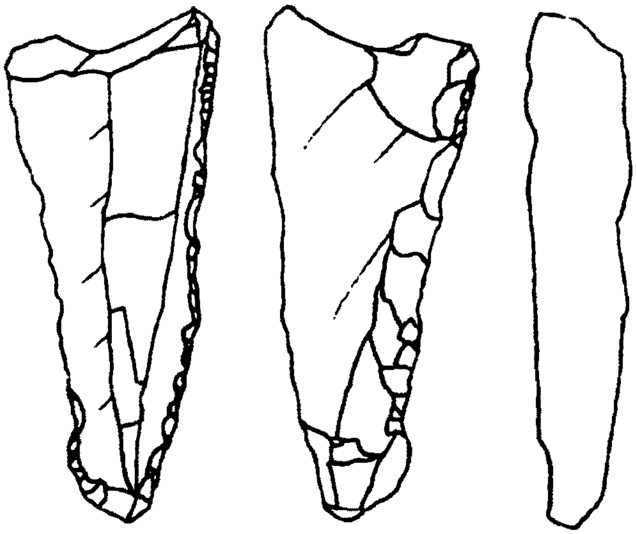

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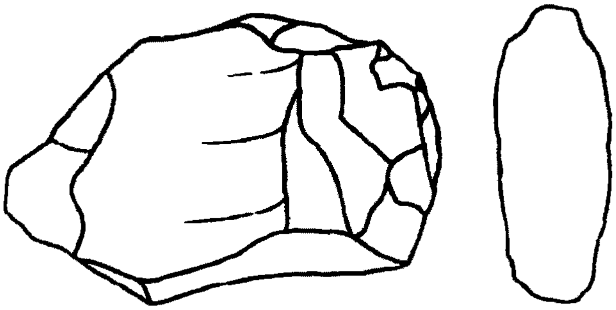

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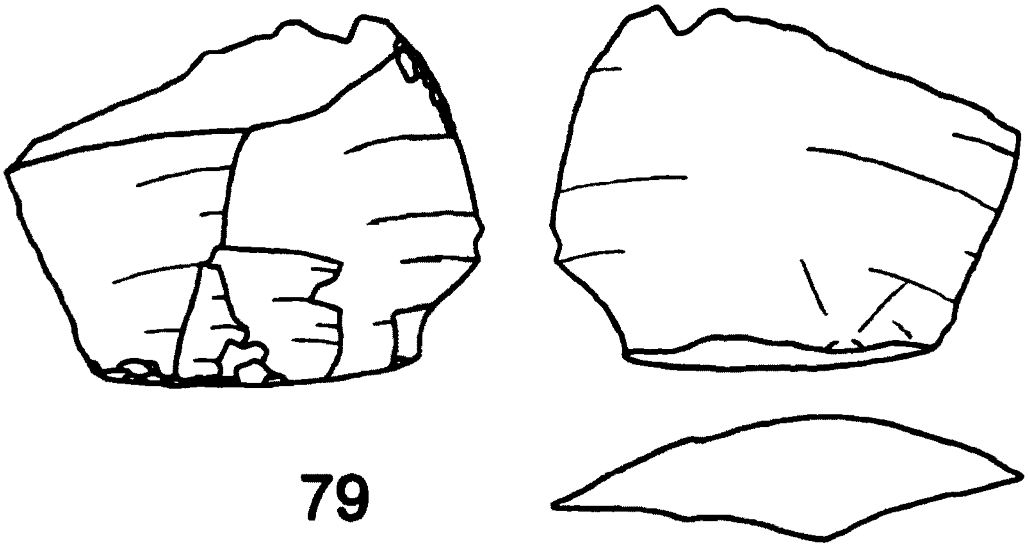

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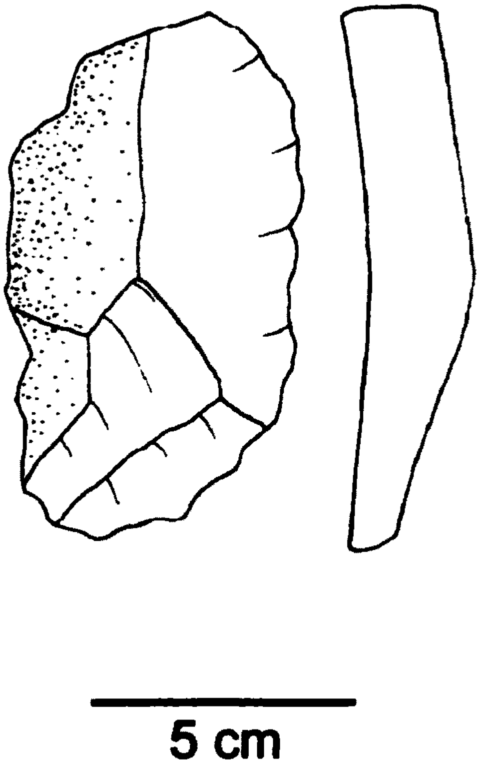

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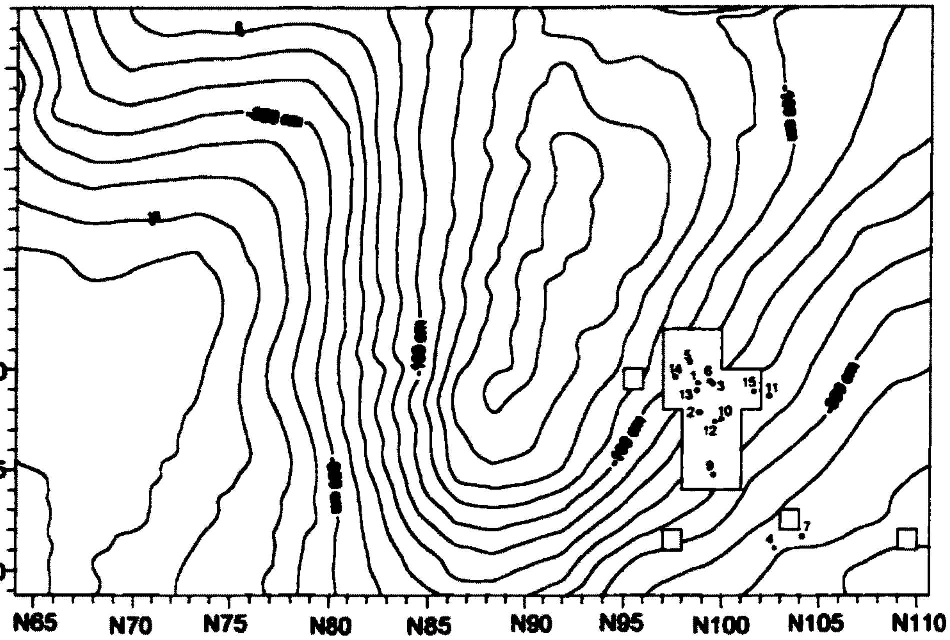
Figure 54. Continued.

Horizontal Distribution of Bifacial Tools



Horizontal Distribution of Blades and Blade-like Flakes

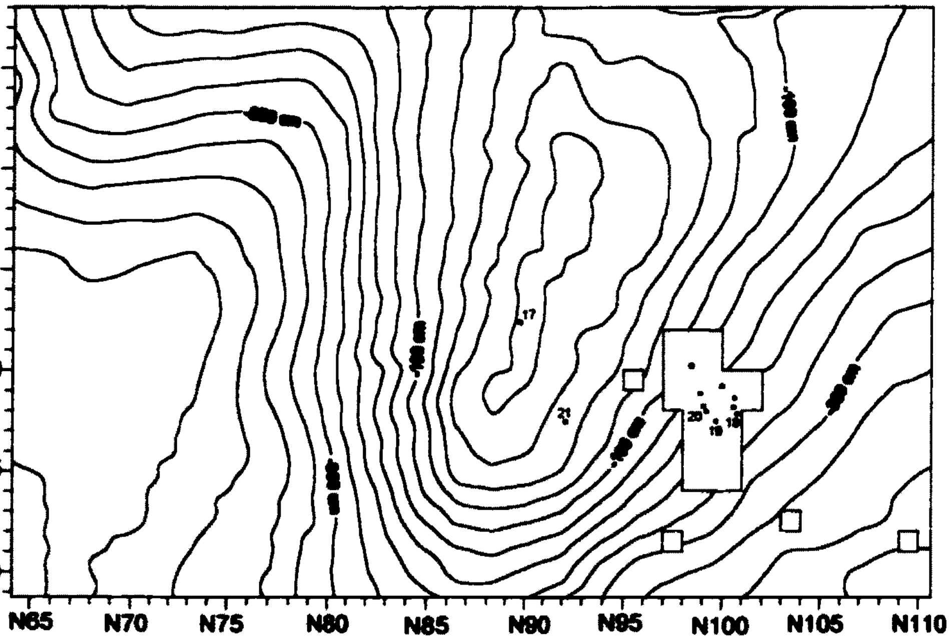


Figure 55. Nieto, horizontal distribution of tools and bifacial thinning flakes.

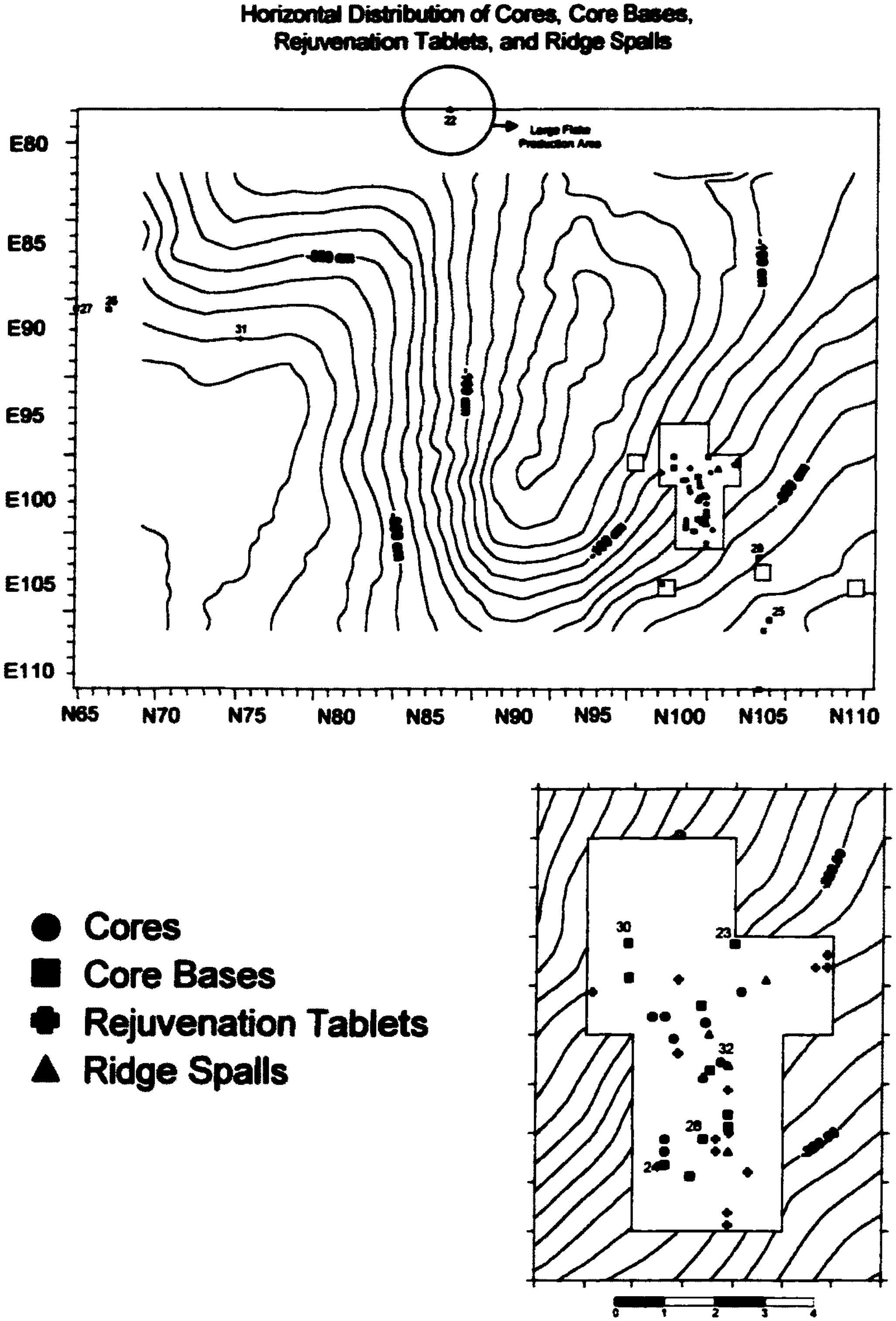
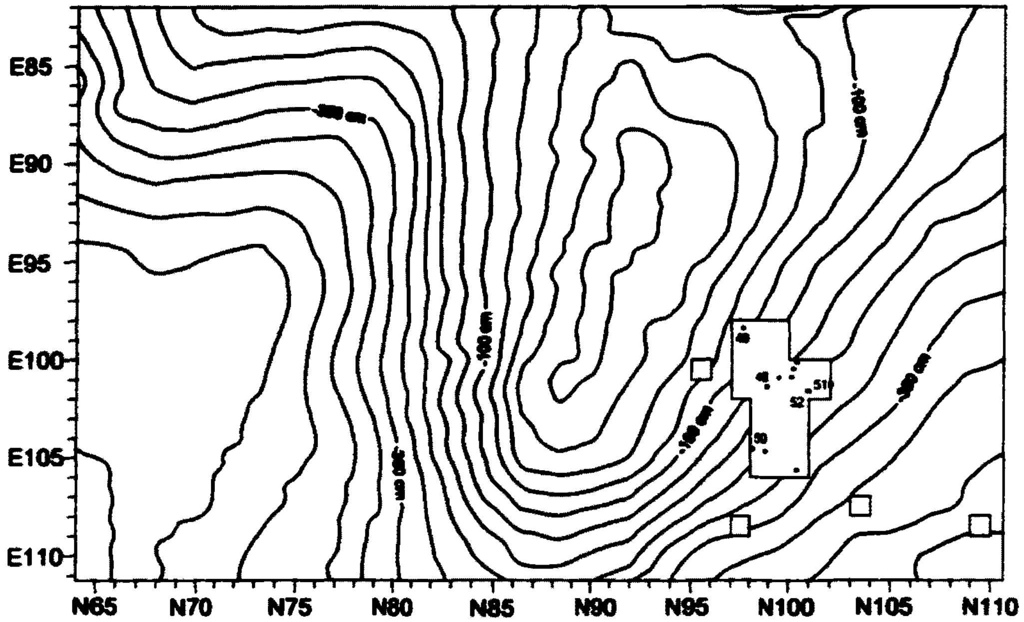
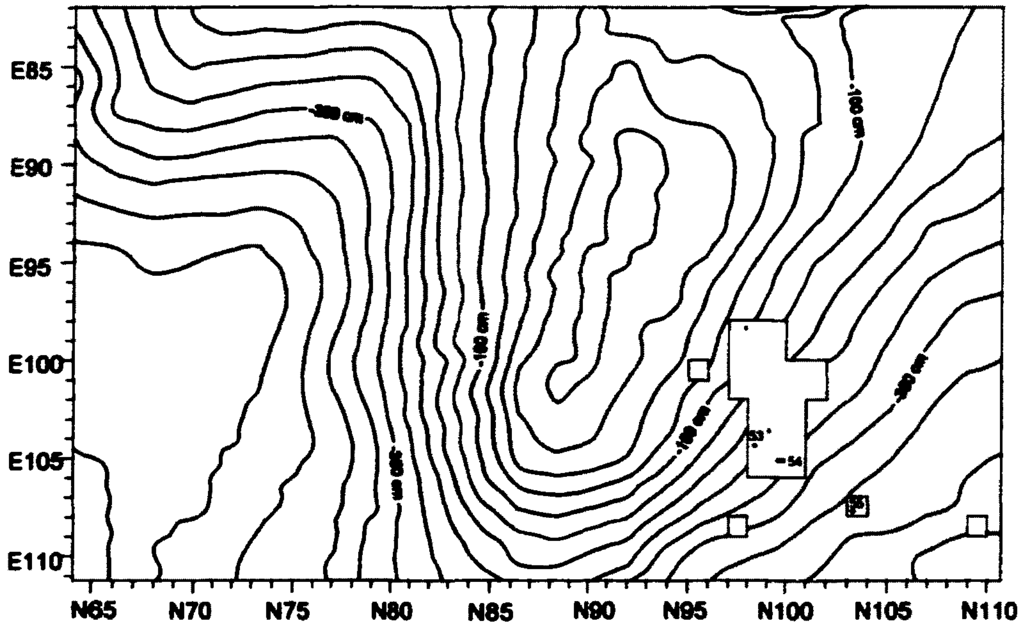


Figure 55. Continued.

Horizontal Distribution of Denticulate Tools



Horizontal Distribution of Spokeshaves



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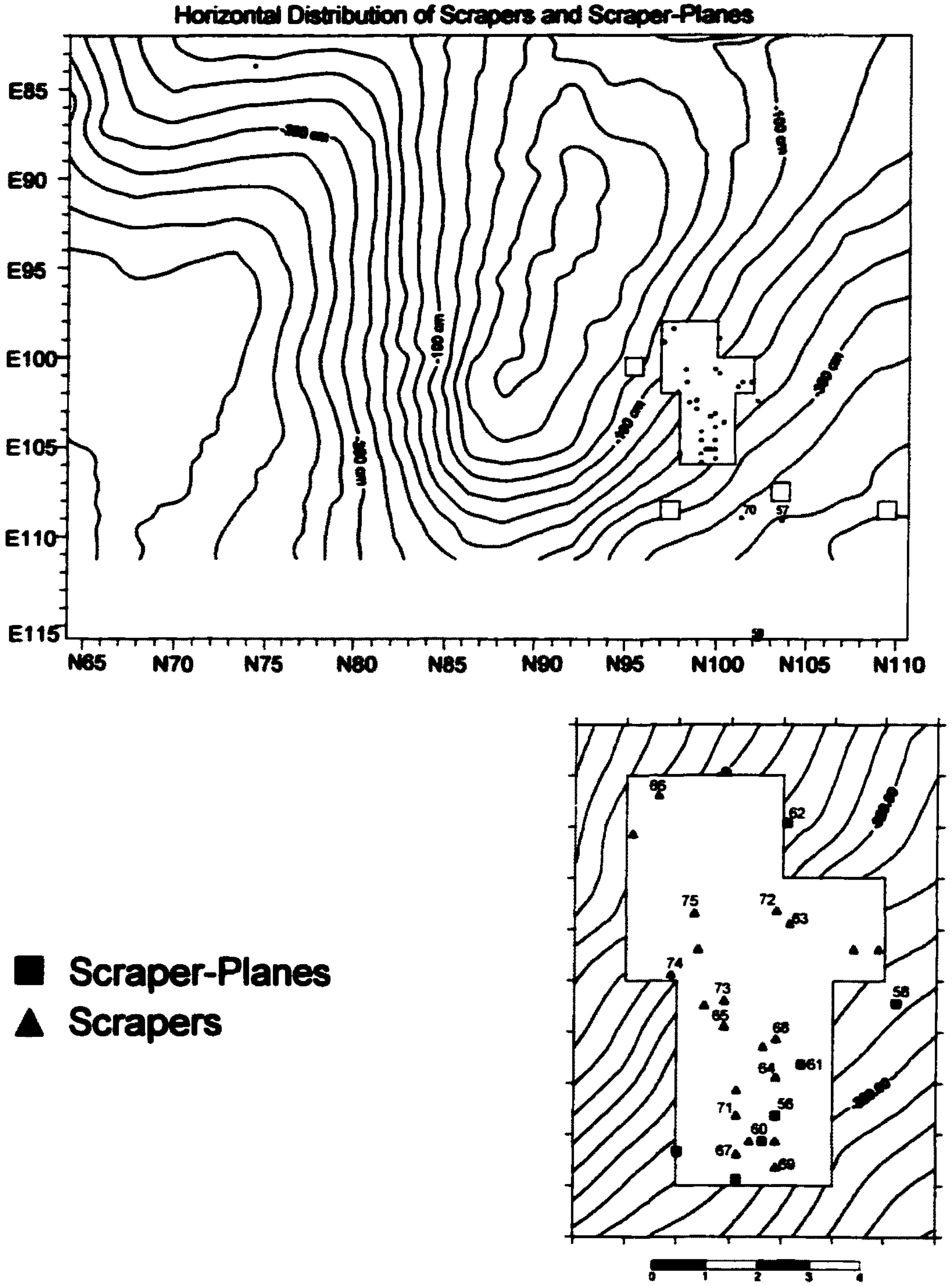

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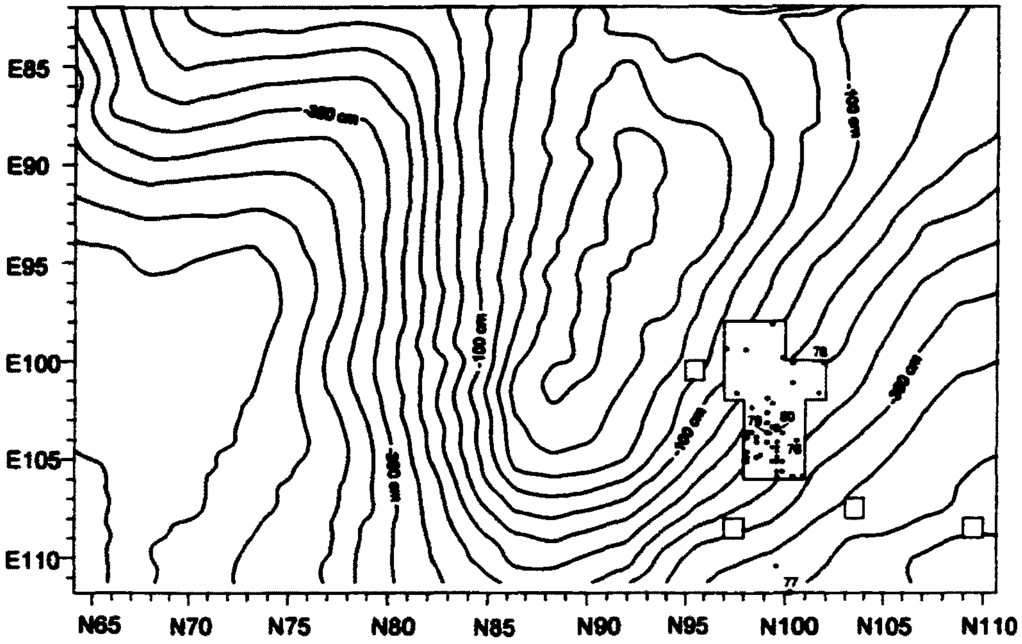
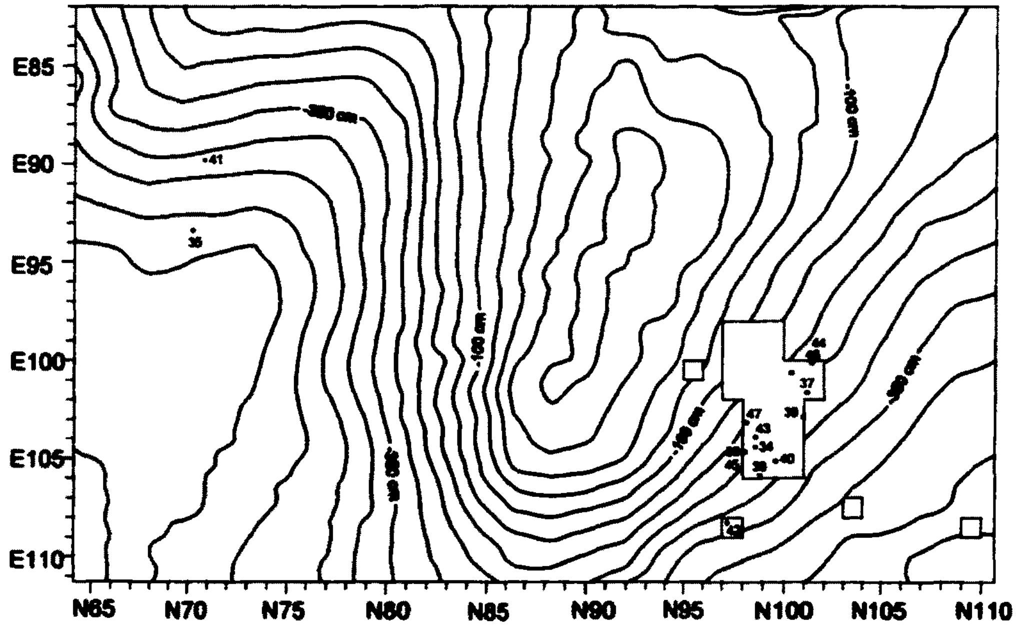


Horizontal Distribution of Retouched Flakes and Large Blanks



Horizontal Distribution of Graving Tools

Figure 55. Continued.

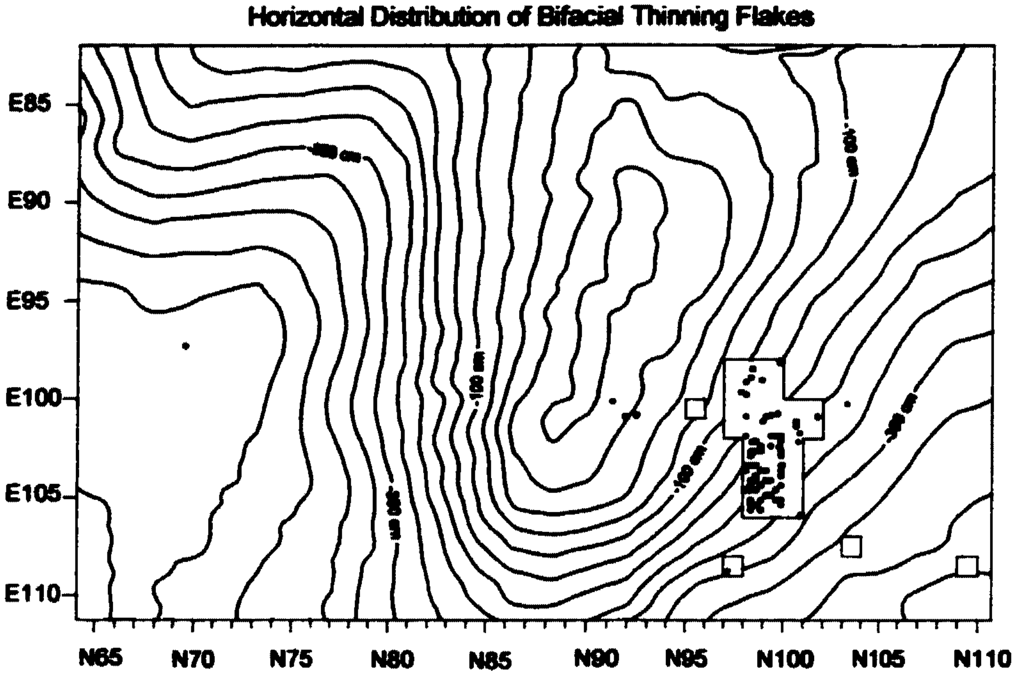


Figure 55. Continued.

a) Cerro El Tigre surrounded by shrimp tanks b) Cueva de Los Vampiros before 2002 excavations

c) Test Pit No. 1 d) Cueva de Los Vampiros after 2002 excavations

Figure 56. Cueva de Los Vampiros and Test Pit No. 1 (TP1) excavation.

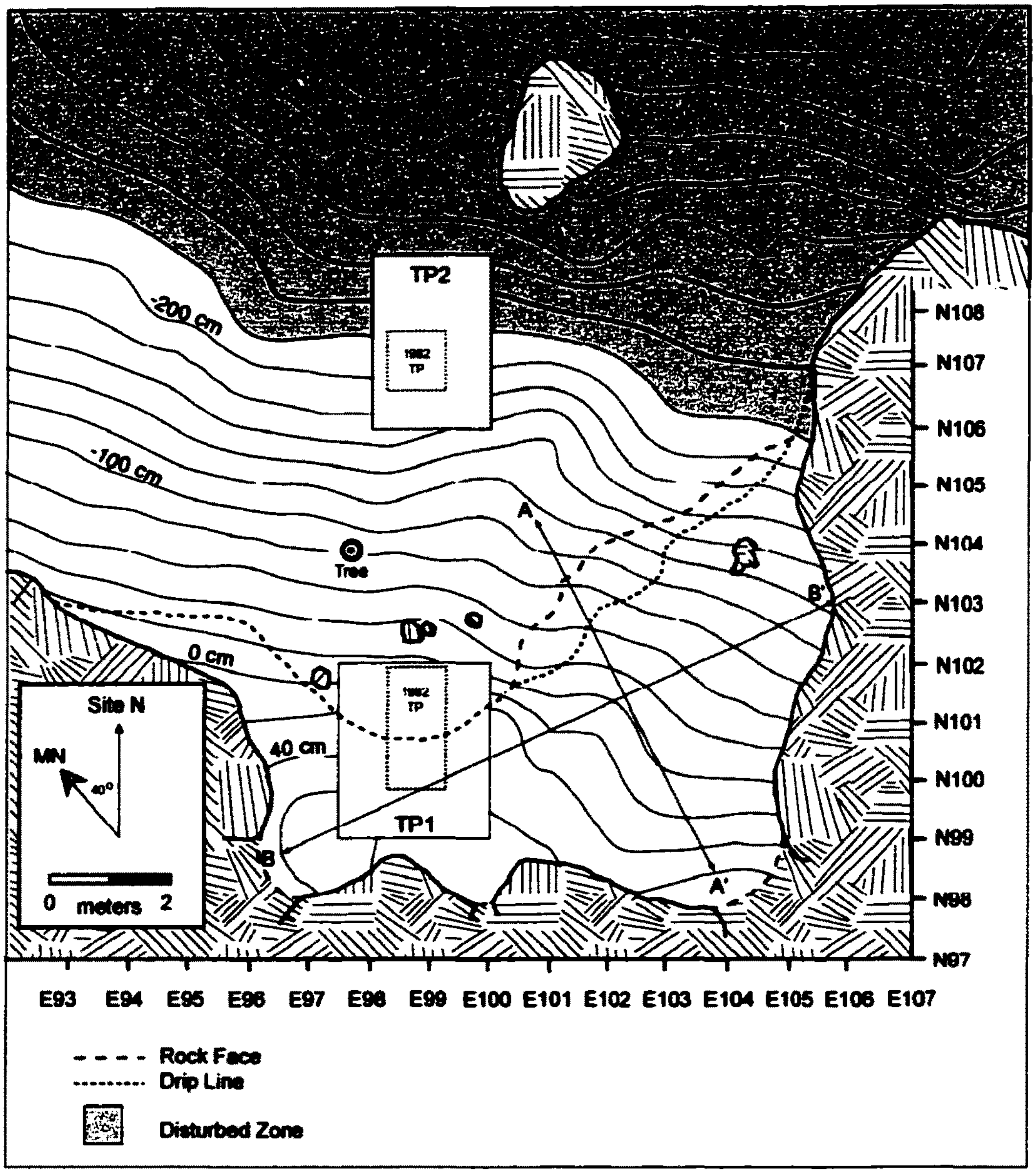


Figure 57. Cueva de Los Vampiros, position of 1982 and 2002 test pits, and disturbed section of the talus.

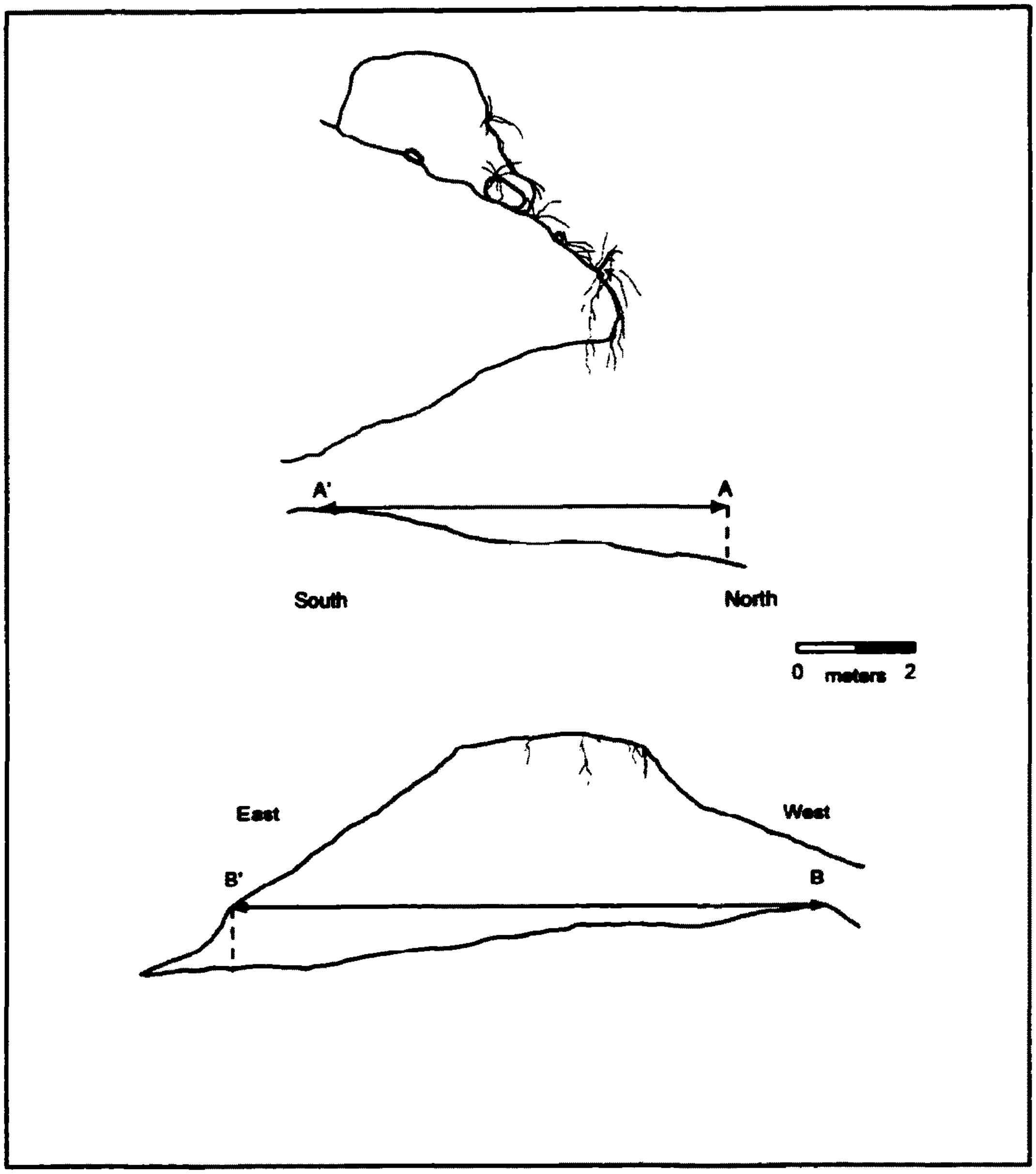


Figure 58. Cueva de Los Vampiros, transects (see Figure 57).

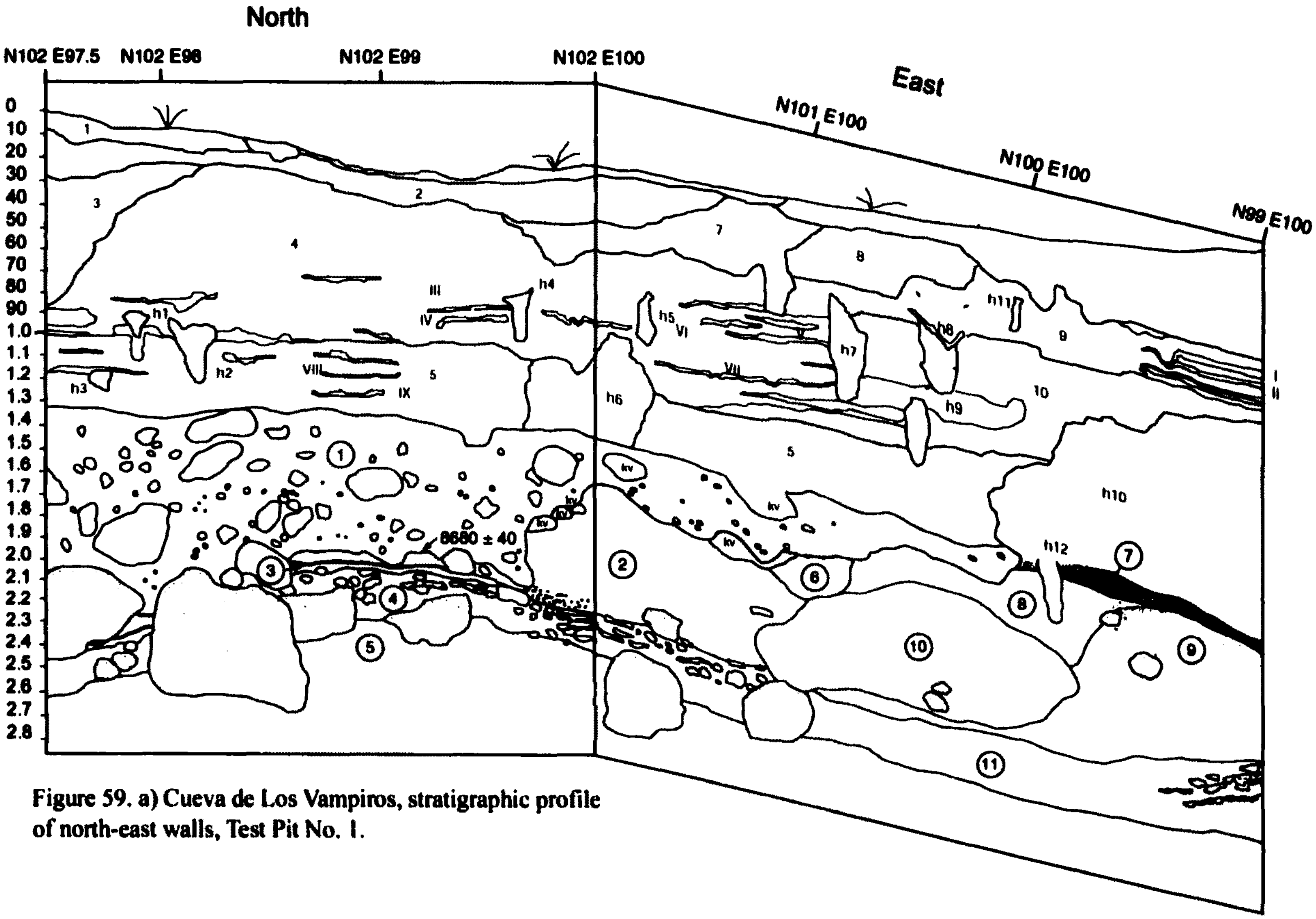


Figure 59. a) Cueva de Los Vampiros, stratigraphic profile of north-east walls, Test Pit No. 1.

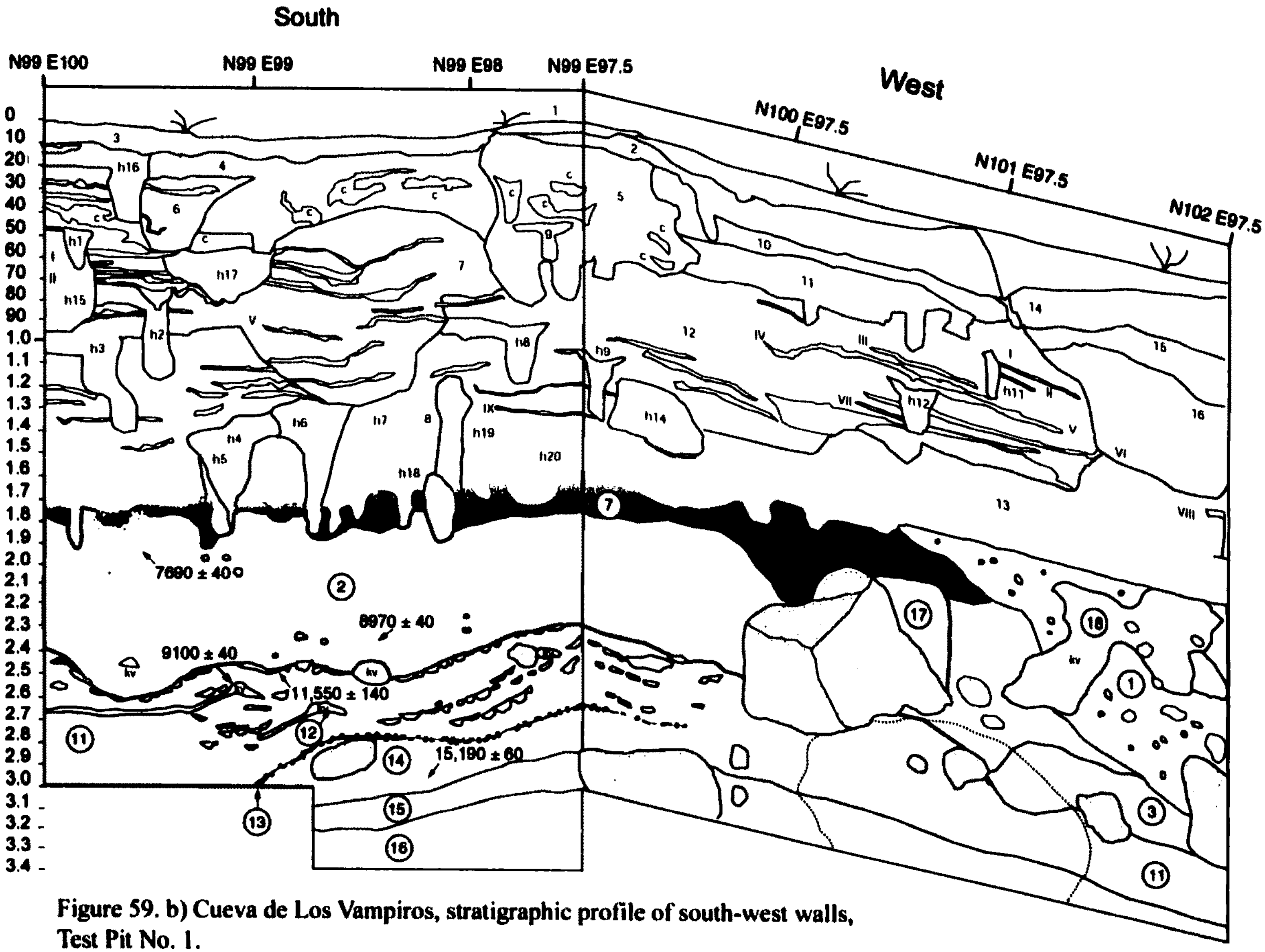


Figure 59. b) Cueva de Los Vampiros, stratigraphic profile of south-west walls, Test Pit No. 1.

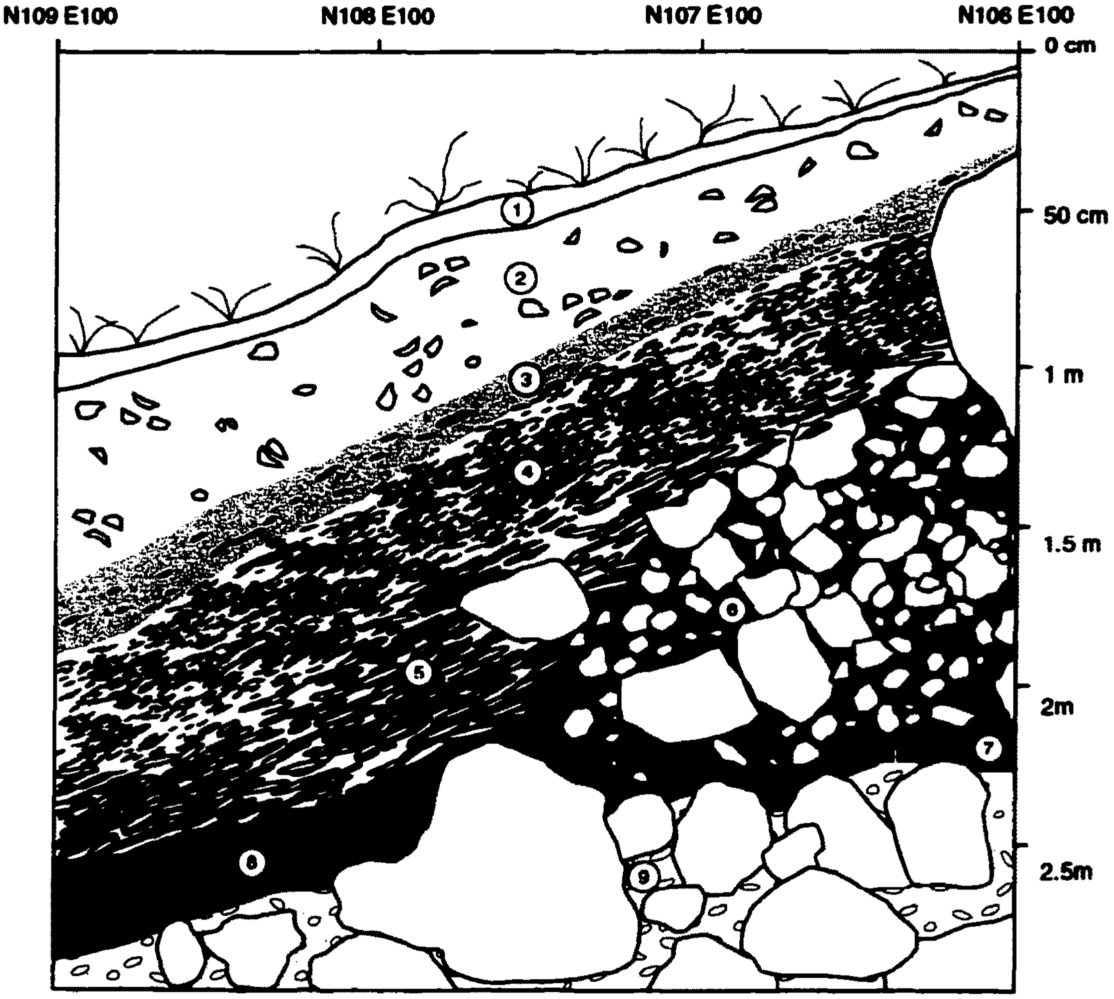


Figure 60. Cueva de Los Vampiros, Test Pit No. 2, stratigraphic profile of east wall.

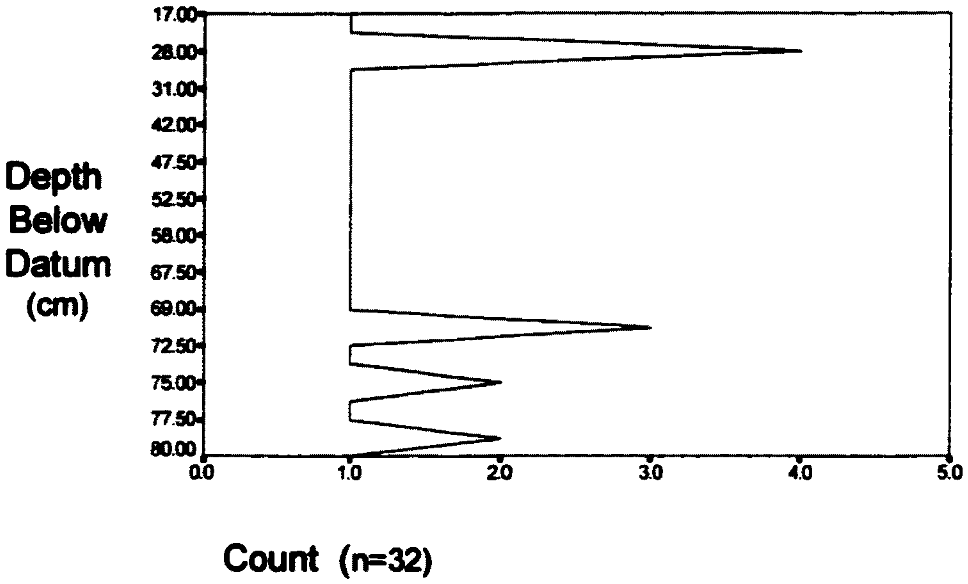


Figure 61. Cueva de Los Vampiros, TP1, vertical distribution of artifacts in lower stratigraphic zone.

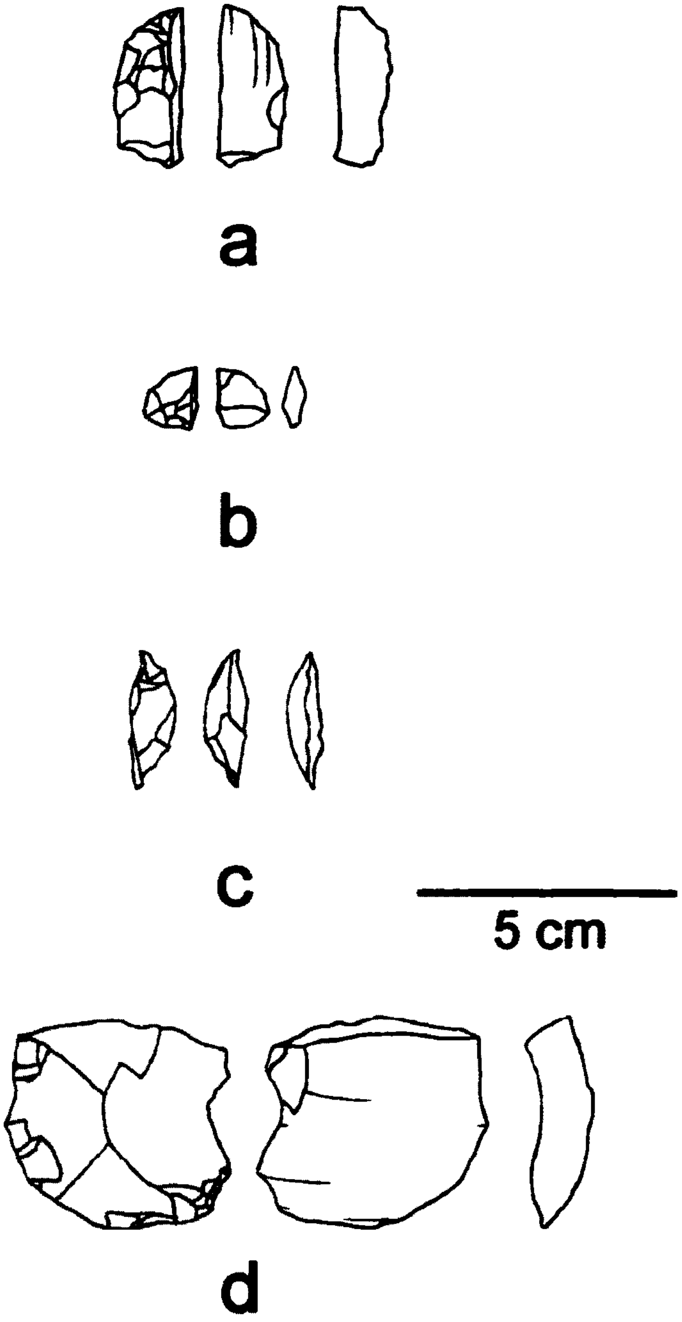


Figure 62. Cueva de Los Vampiros, TP1 and TP2, lithic artifacts from lower stratigraphic zone.

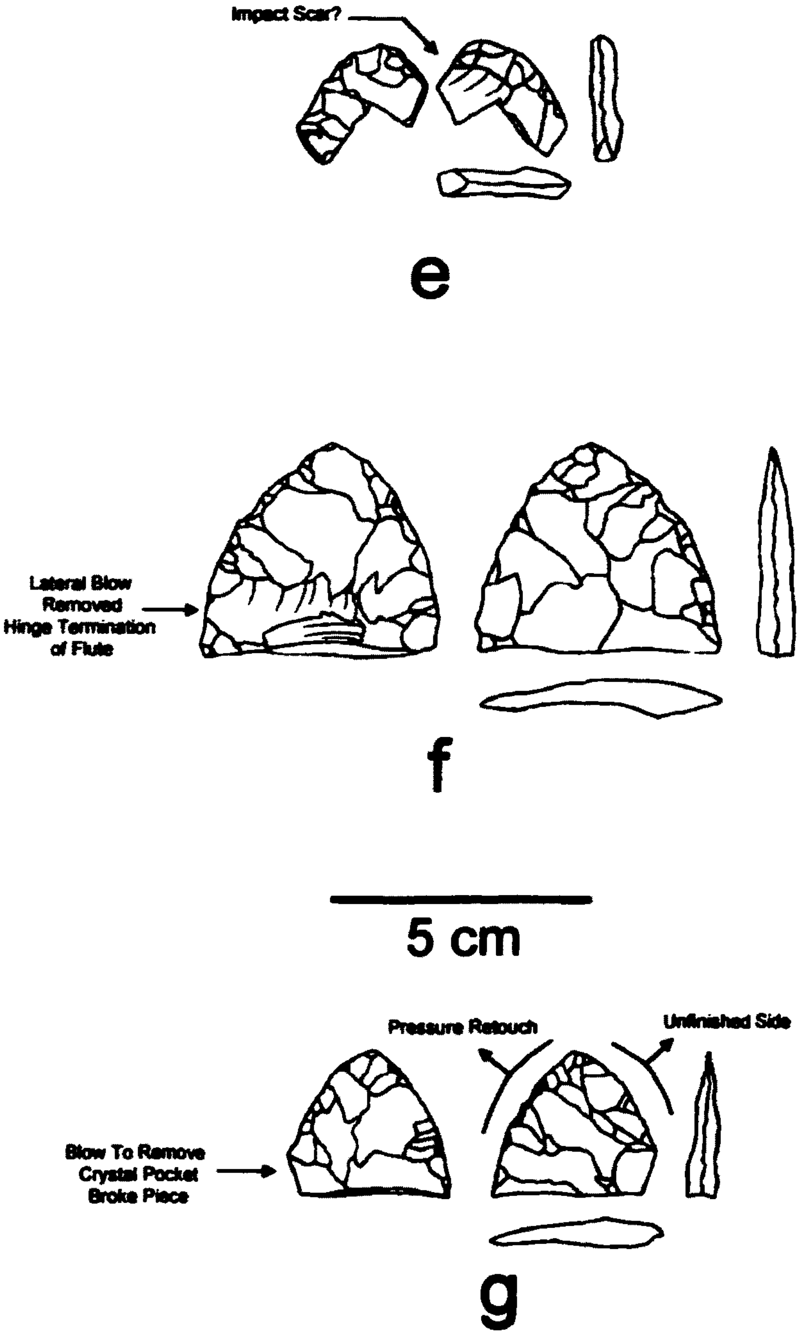


Figure 62. Continued.

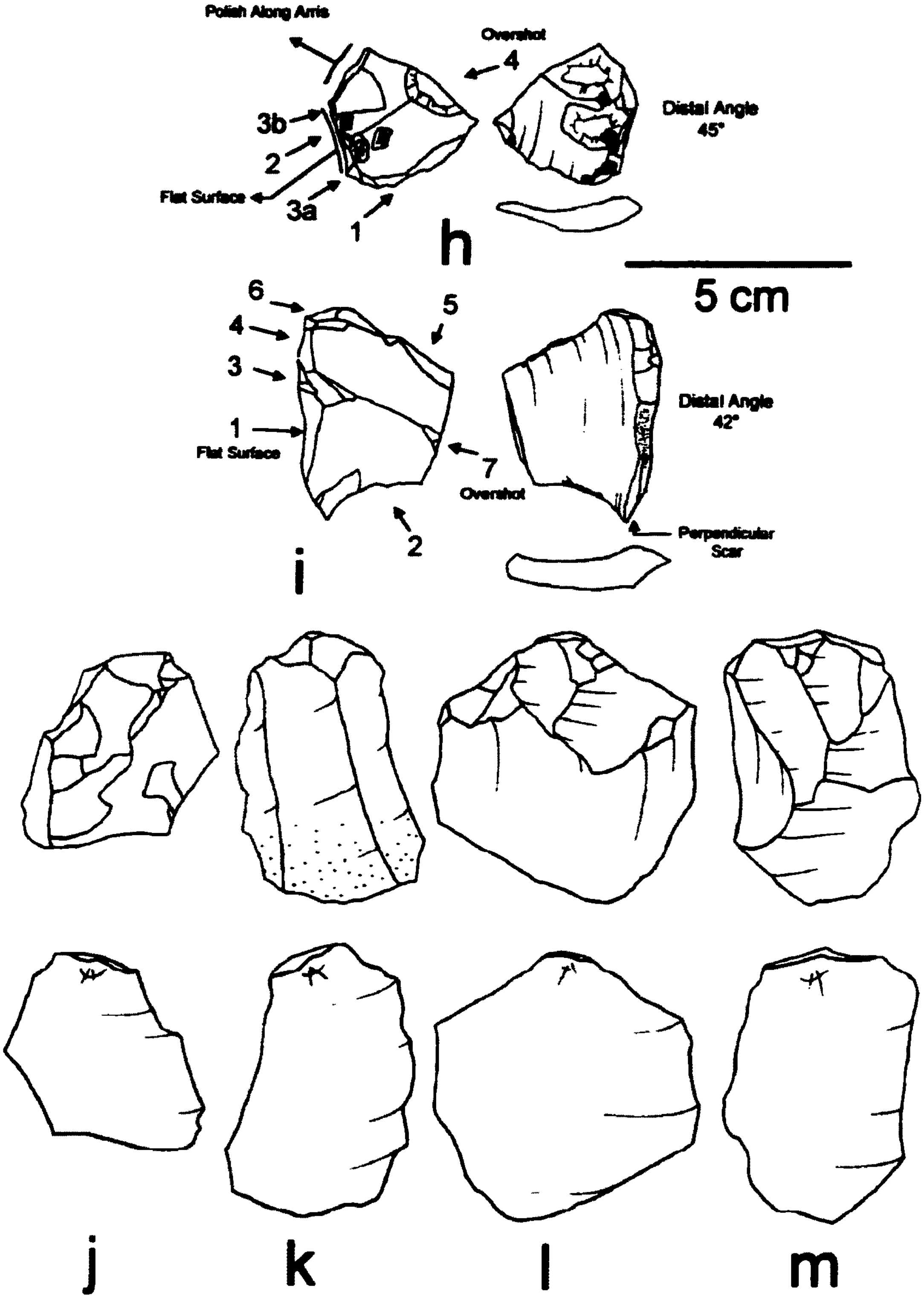


Figure 62. Continued.

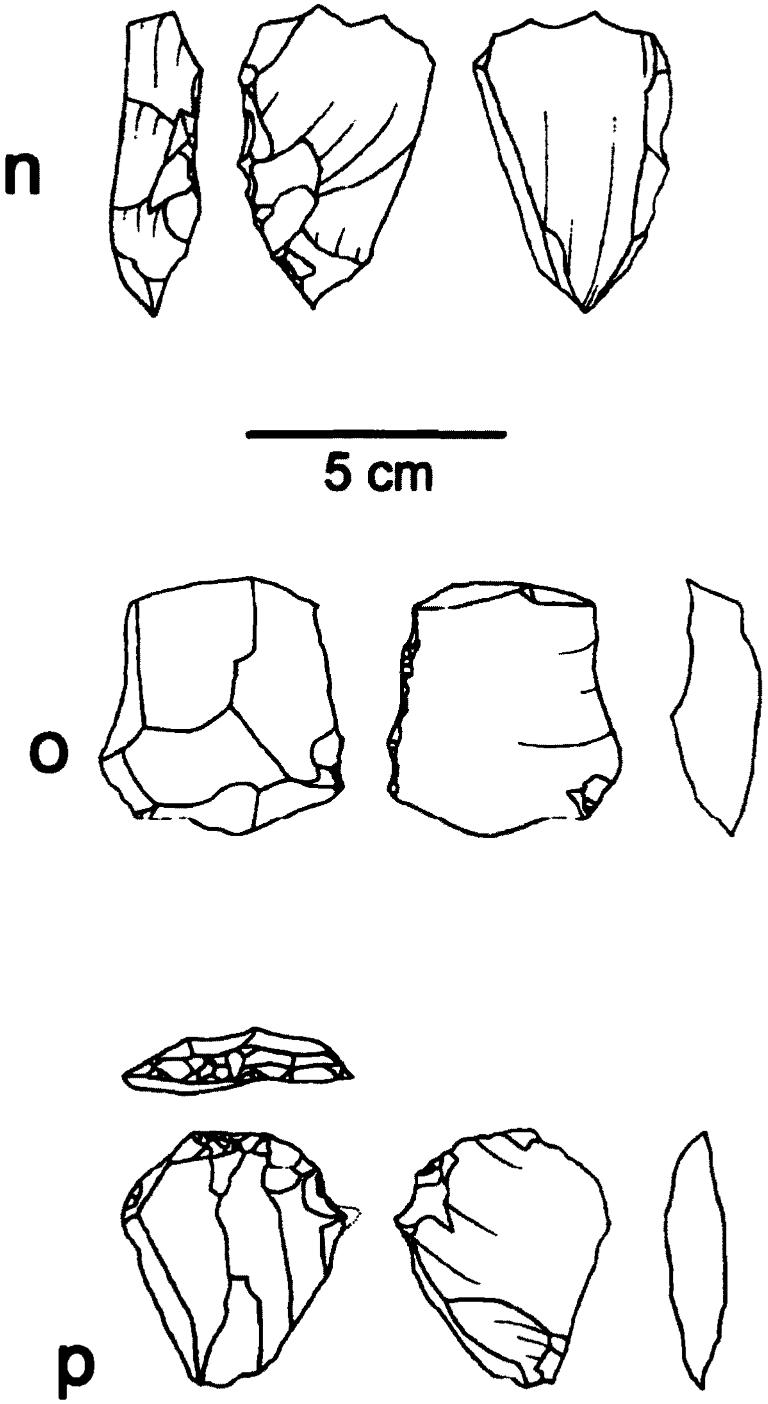


Figure 62. Continued.

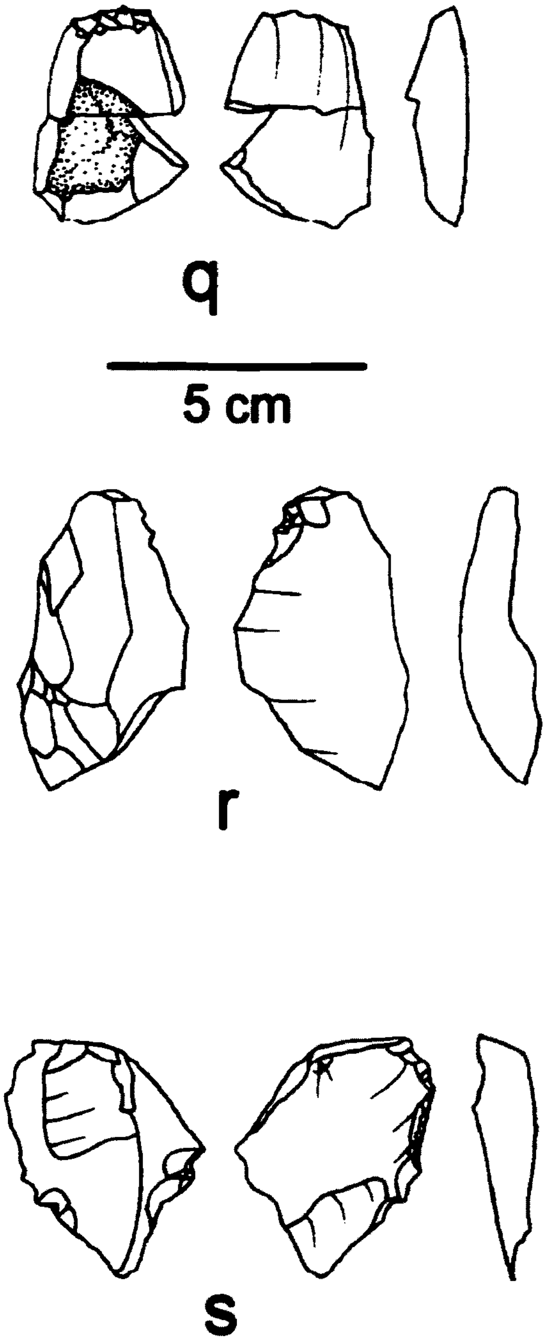


Figure 62. Continued.

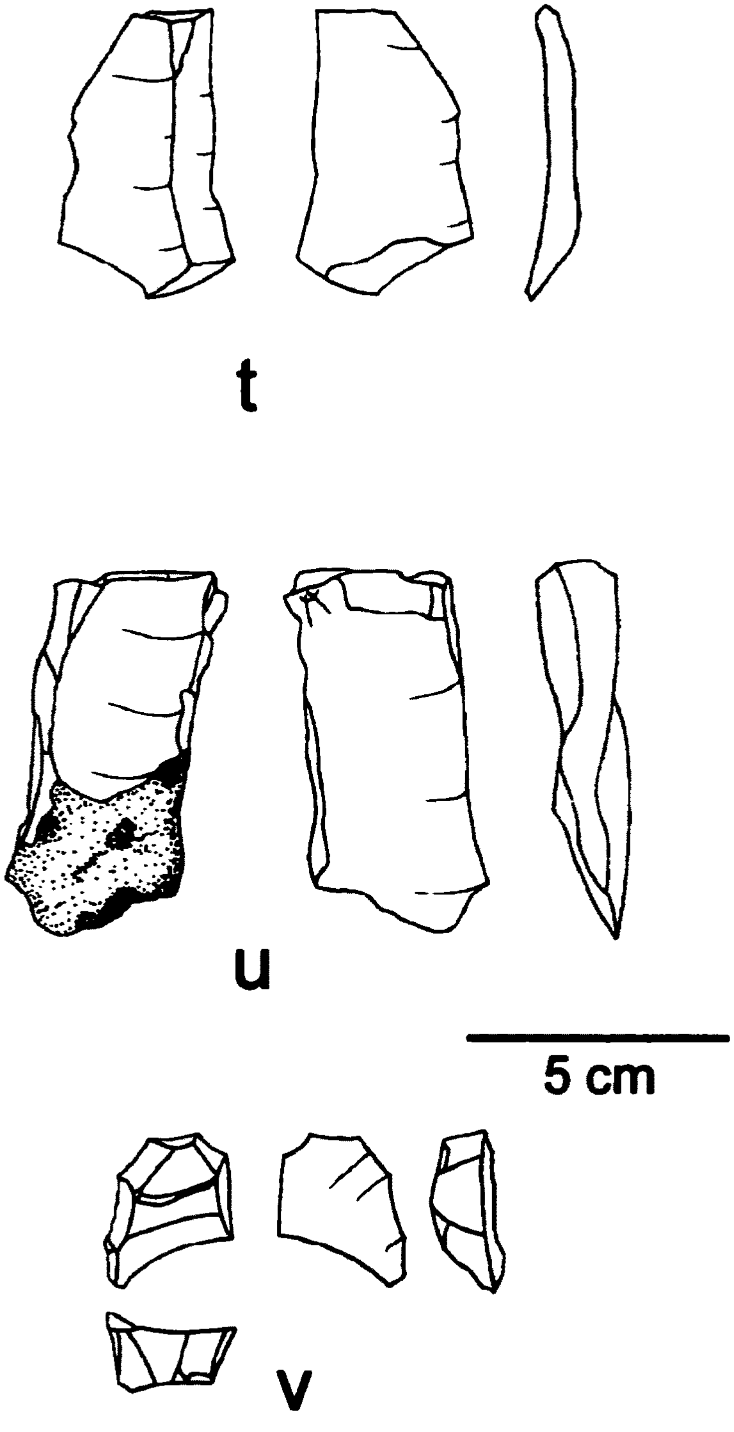
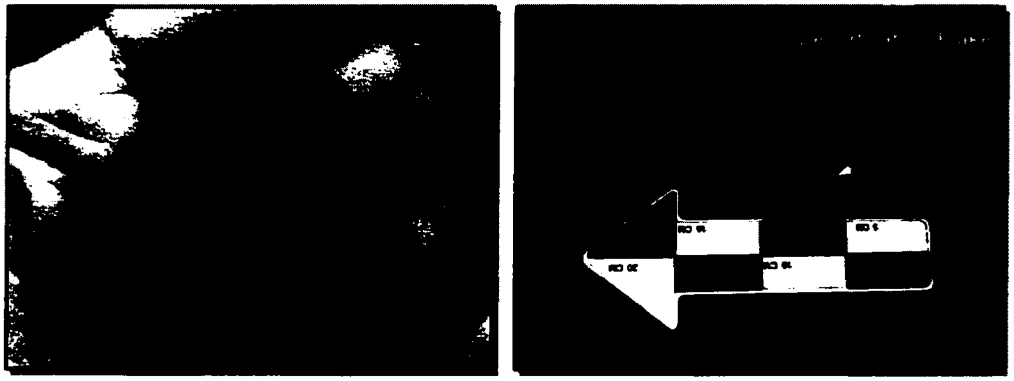


Figure 62. Continued.

a) TP1 during excavations

b) Fluted point in situ



c) Fluted point

d) Spurred end scraper in situ

Figure 63. Cueva de Los Vampiros, TP1, excavation, spurred end scraper and fluted point.

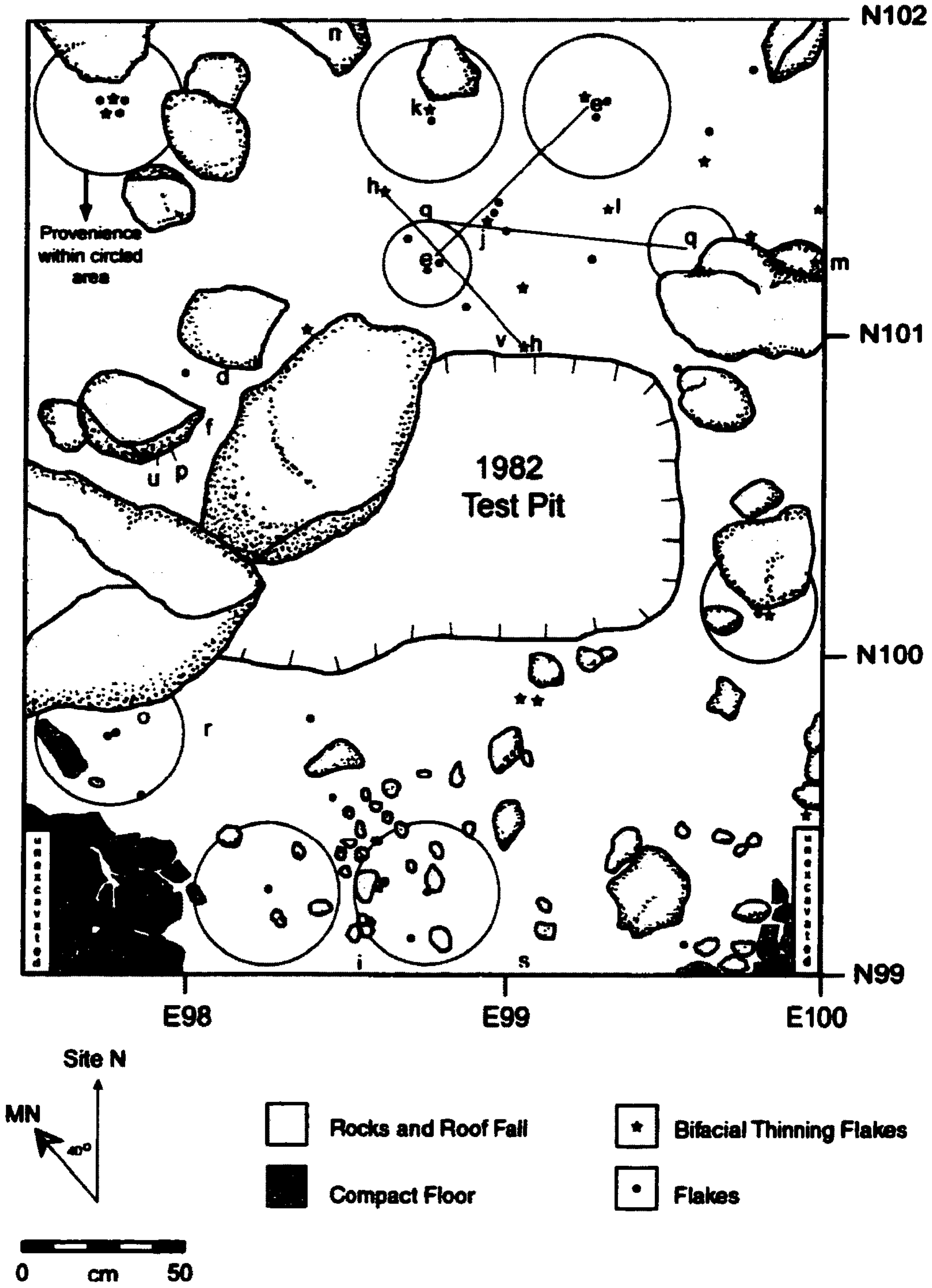


Figure 64. Cueva de Los Vampiros, TP1, artifact distribution, lower component (letters refer to artifacts from Figure 62).

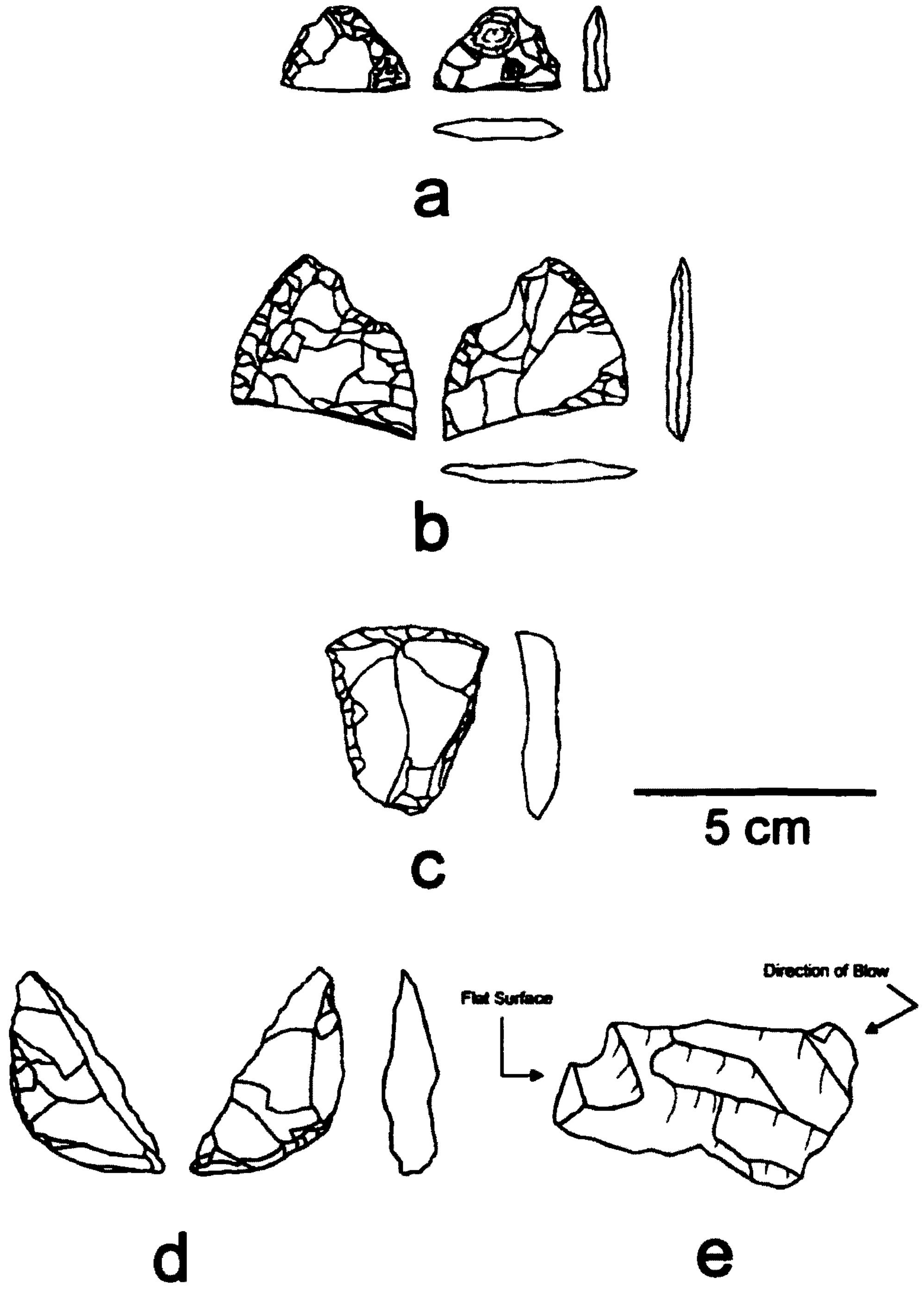


Figure 65. Projectile point fragments from a) Corona and b) Aguadulce rockshelters, c) endscraper from SA-27, d) bifacial fragment, and e) large bifacial thinning flake from 2002 Parita River survey (Haller 2003).

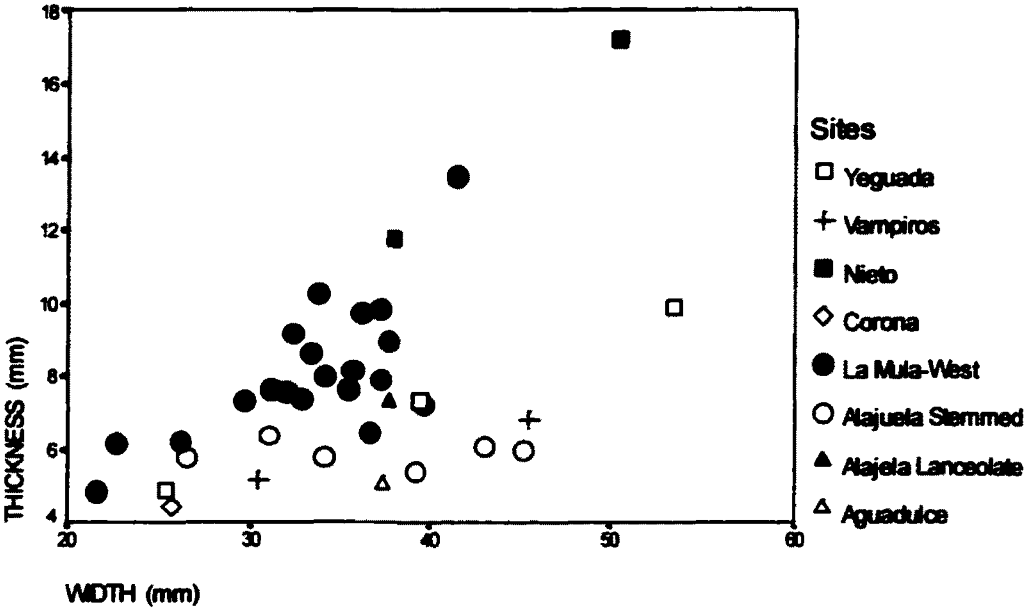


Figure 66. Scatter plot of Panamanian Paleoindian points.

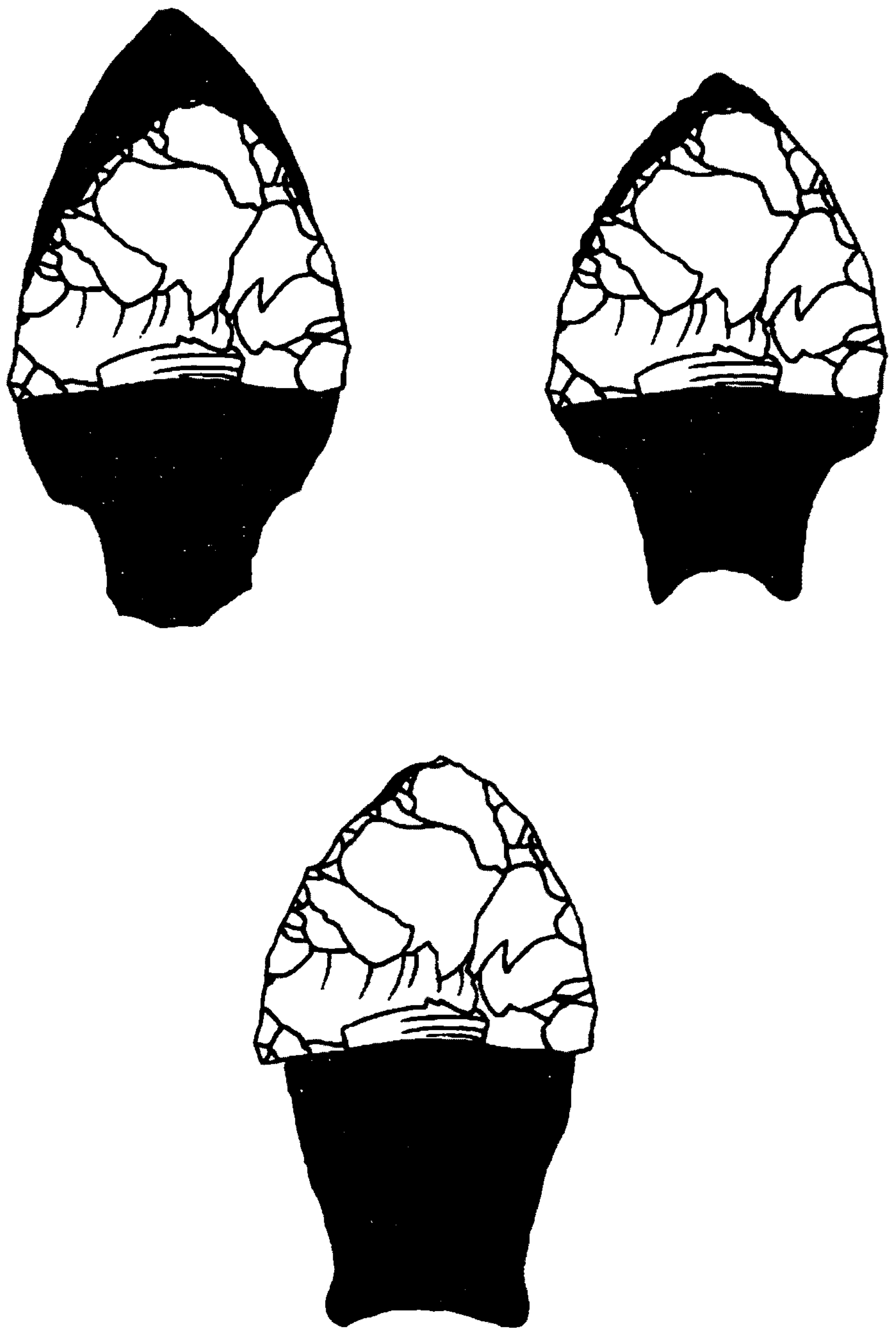


Figure 67. Montage superimposing Vampiros Cave point over FPPs and lanceolate point from Lake Alajuela and Balboa.

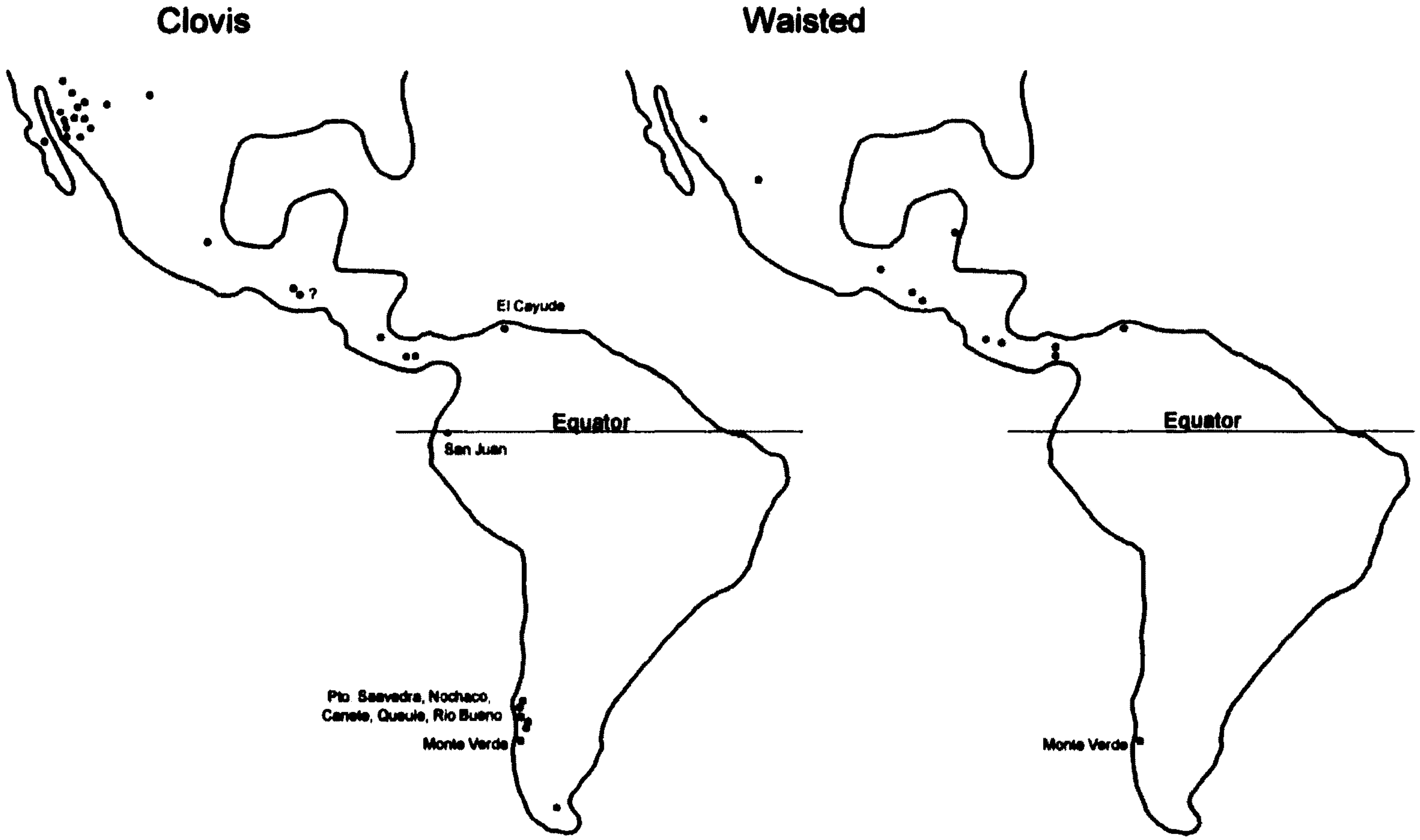
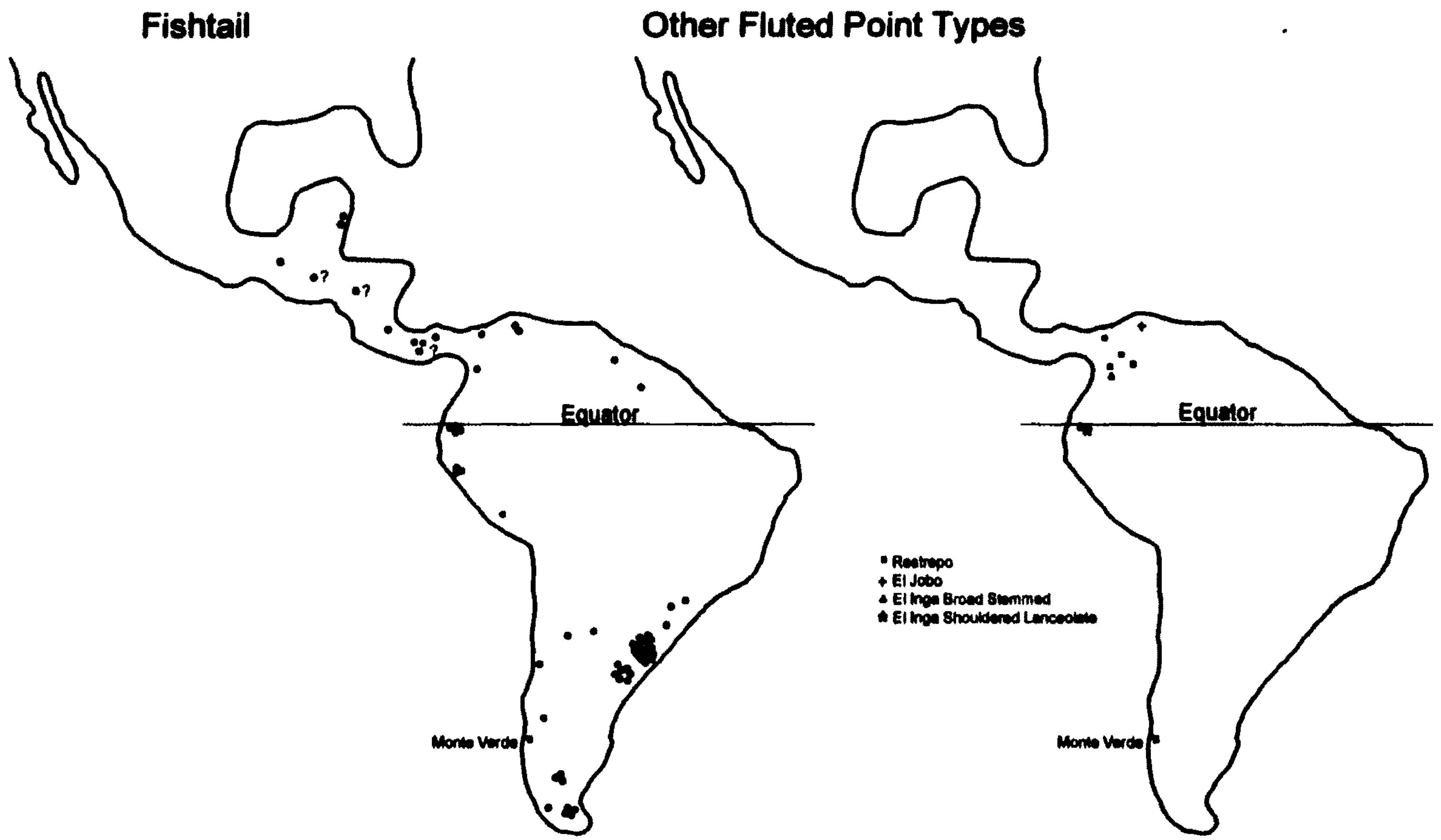


Figure 68. Geographic distributions of lanceolate and stemmed fluted points in Middle and South America.


Fishtail

Other Fluted Point Types

Figure 68. Continued.

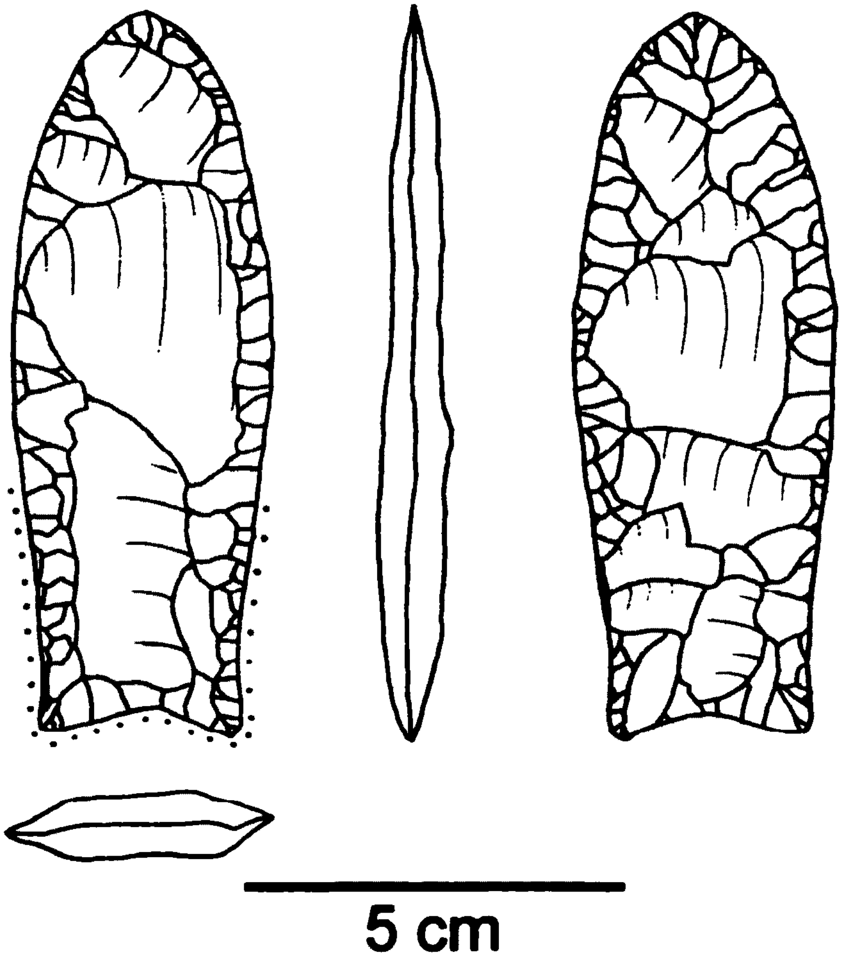


Figure 69. Ross County Clovis variant projectile point from Sloth Hole site in Florida. (length 97.1 mm, width 36.4 mm, thickness 8.7 mm, Hemmings 1999:94). Drawn from cast.

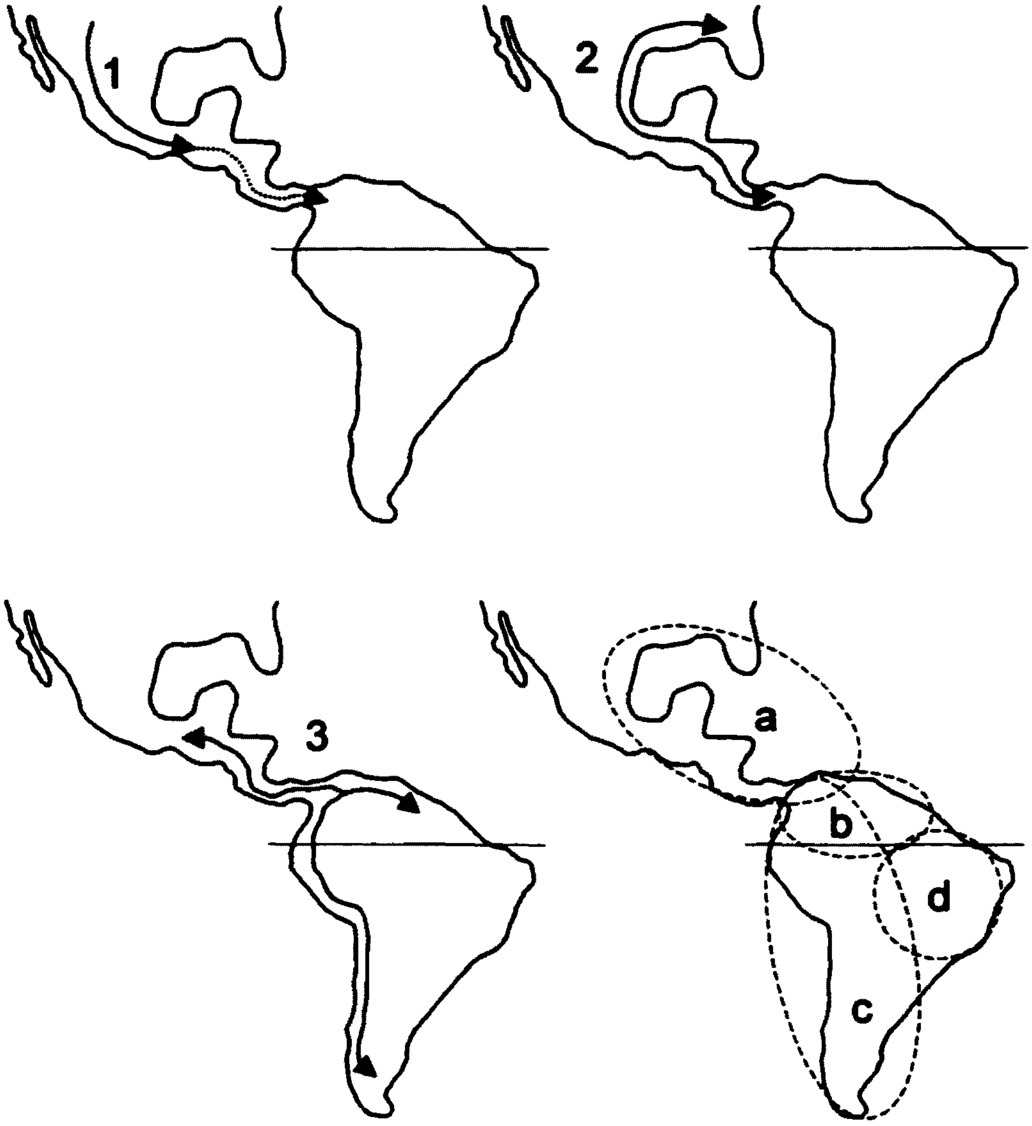


Figure 70. Tentative Migrations and Point Dispersion Sequences

1. Initial (Classic) Clovis Migration
2. Circum-Gulf and Caribbean Ross County Clovis Expansion (Later Simpson Influence?)
3. Fell I FPP Expansion into South America and Stemmed Broad Blade Back Migration or Diffusion into Central America

Major Cultural Networks and Innovation Centers

a. Circum-Gulf and Caribbean Zone
b. Zone of Evolutionary Change or Contact
c. Fell I FPP Cultural Zone
d. Eastern Brazil (Pre-Clovis?, non-Clovis?)

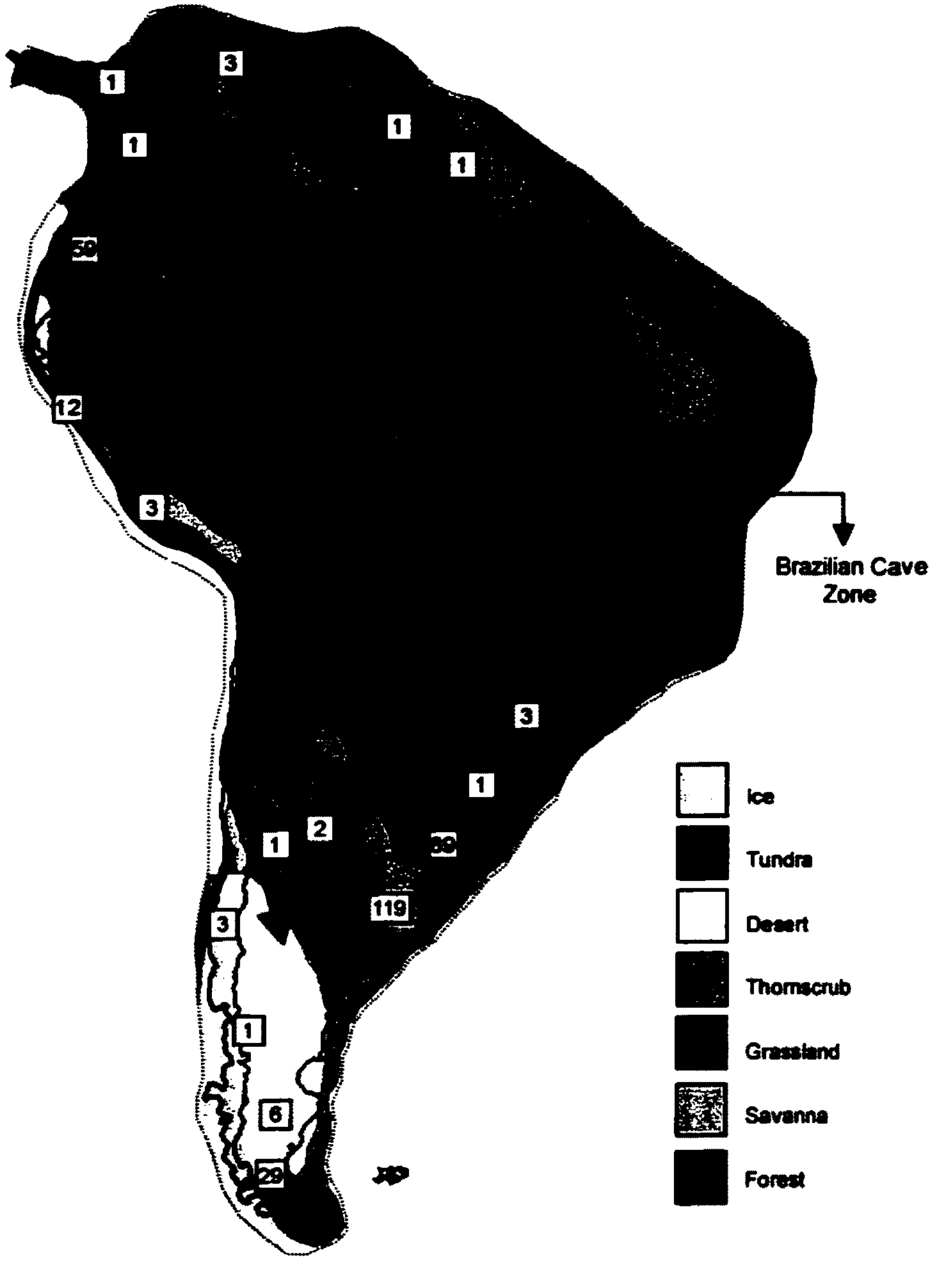


Figure 71. Distribution of South American FPPs and Pleistocene vegetation.

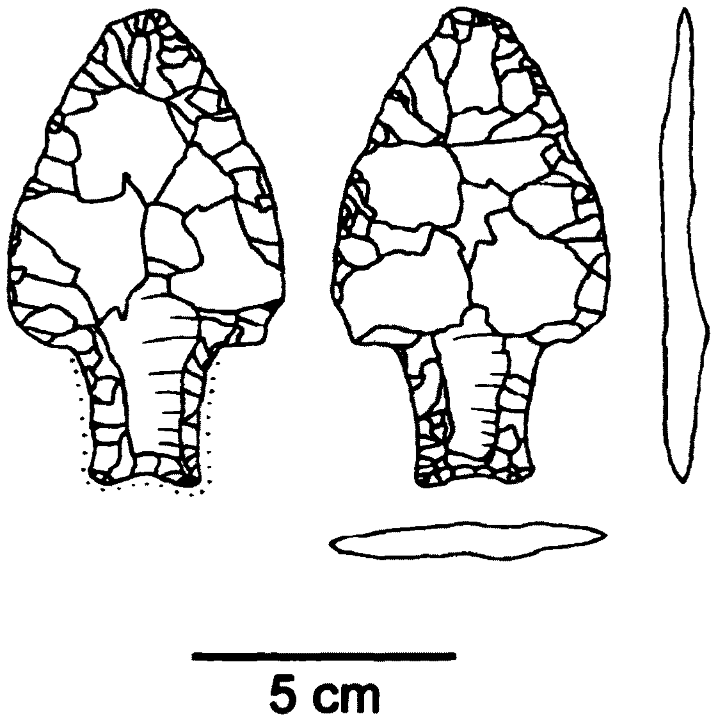


Figure 72. Fluted stemmed point from Belize.
(from Pearson and Bostrom 1998)

TABLES

Table 1. Radiocarbon Dates from South American Fishtail Projectile Point Sites

Country	Site	Lab No.	^{14}C Date	Material	References
Ecuador	El Inga	R-1070/2	9030 ± 144	Soil Org.	Bell 1965
Ecuador	El Inga	R-1073/3	7928 ± 132	Soil Org.	Bell 1965
Argentina	Cerro La China 1	AA-8953	10,804 ± 75	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro La China 1	AA-1327	10,790 ± 120	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro La China 1	AA-8952	10,745 ± 75	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro La China 1	I-12741	10,730 ± 150	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro La China 1	AA-8954	10,525 ± 75	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro La China 2	AA-8955	11,150 ± 135	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro La China 2	AA-8956	10,560 ± 75	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro La China 3	AA-1328	*10,610 ± 180	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro el Sombrero	AA-4765	10,725 ± 90	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro el Sombrero	AA-4767	10,675 ± 110	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro el Sombrero	AA-5220	10,480 ± 70	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro el Sombrero	AA-4766	10,270 ± 85	Charcoal	Flegenheimer and Zarate 1997
Argentina	Cerro el Sombrero	AA-5221	8060 ± 140	Charcoal	Flegenheimer and Zarate 1997
Argentina	Piedra Museo	LP-949	9230 ± 105	Bone	Miotti 1999
Argentina	Piedra Museo	LP-859	9710 ±105	Bone	Miotti 1999
Argentina	Piedra Museo	AA-8428	10,400 ± 80	Bone	Miotti 1995
Argentina	Abrigo Los Pinos	-	9570 ± 120	Charcoal	Mazzanti 1997
Argentina	Cueva Tixi	AA-12130	*10,375 ± 90	Charcoal	Mazzanti 1997
Argentina	Cueva Tixi	AA-12131	*10,045 ± 95	Charcoal	Mazzanti 1997
Argentina	Paso Otero 5	AA-19291	10,190 ± 120	Burned bone	Martínez 2001
Argentina	Paso Otero 5	AA-39363	10,440 ± 100	Burned bone	Martínez 2001
Chile	Cueva del Medio	PITT-0343	12,390 ± 180	Burned bone	Borrero et al. 1998
Chile	Cueva del Medio	NUTA-1737	11,120 ± 130	Bone	Borrero et al. 1998
Chile	Cueva del Medio	NUTA-2197	11,040 ± 250	Bone	Borrero et al. 1998
Chile	Cueva del Medio	NUTA-2330	10,960 ± 150	Bone	Borrero et al. 1998
Chile	Cueva del Medio	NUTA-2331	10,860 ± 160	Bone	Borrero et al. 1998
Chile	Cueva del Medio	NUTA-1812	10,850 ± 130	Bone	Borrero et al. 1998
Chile	Cueva del Medio	NUTA-2332	10,710 ± 190	Bone	Borrero et al. 1998
Chile	Cueva del Medio	NUTA-1811	10,710 ± 100	Bone	Borrero et al. 1998
Chile	Cueva del Medio	NUTA-1735	10,450 ± 100	Bone	Borrero et al. 1998
Chile	Cueva del Medio	Beta-52522	10,430 ± 80	Charcoal	Nami 1996
Chile	Cueva del Medio	NUTA-1734	10,430 ± 100	Bone	Borrero et al. 1998
Chile	Cueva del Medio	Gr-N 14913	10,310 ± 70	Charcoal	Nami 1996
Chile	Cueva del Medio	Beta-39081	10,930 ± 230	Charcoal	Nami 1996
Chile	Cueva del Medio	Gr-N 14911	10,550 ± 120	Bone	Nami 1996
Chile	Cueva del Medio	Beta-58105	10,350 ± 130	Burned bone	Menegaz and Nami 1994
Chile	Cueva del Medio	Beta-40281	9770 ± 70	Bone	Nami 1996
Chile	Cueva del Medio	PITT-0344	9595 ± 115	Charcoal	Nami 1996
Chile	Tres Arroyo	Beta-20219	11,880 ± 250	Charcoal	Nami 1996
Chile	Tres Arroyo	Beta-101023	10,600 ± 90	-	Borrero 1999
Chile	Tres Arroyo	DIC-2333	10,420 ± 100	Charcoal	Nami 1996
Chile	Tres Arroyo	DIC-2732	10,280 ± 110	Charcoal	Nami 1996
Chile	Fell's Cave	I-3988	11,000 ± 170	Charcoal	Bird 1969
Chile	Fell's Cave	W-915	10,720 ± 300	Charcoal	Bird 1969
Chile	Fell's Cave	I-5146	10,080 ± 160	-	Saxon 1976
Chile	Pali Aike	C-485	8639 ± 450	Bone	Bird 1951
Chile	Tagua Tagua 1	GX-1205	11,380 ± 320	Charcoal	Montané 1968
Chile	Tagua Tagua 1	-	11,320 ± 300	-	Nuñez et al. 1994
Chile	Tagua Tagua 1	-	11,000± 170	-	Nuñez et al. 1994
Chile	Tagua Tagua 2	Beta-45518	9700 ± 90	Charcoal	Nuñez et al. 1994
Chile	Tagua Tagua 2	Beta-45519	9900 ± 100	Charcoal	Nuñez et al. 1994
Chile	Tagua Tagua 2	Beta-45520	10,190 ± 130	Bone	Nuñez et al. 1994

* No diagnostic tools but believed to be FTPP occupations

Table 2. Estimated Decrease in Temperature During the Late Pleistocene and Younger Dryas in Middle America.

Country	Site	Temperature Decrease	References
Mexico	Central Mexico	6° C	Heine 1994
Mexico	Neotropic region	5° C	Toledo 1982
Guatemala	Lake Quexil	6.5°-8° C	Leyden et al. 1993
Guatemala Younger Dryas	Lake Quexil	1.5° C	Leyden et al. 1994
Panama	Lake La Yeguada	5° C	Piperno et al. 1990
Panama	El Valle	6° C	Bush and Colinvaux 1990
Costa Rica	Lachner Bog	3.6° C	Martin 1964
Costa Rica	La Chonta	8° C	Hooghiemstra et al. 1992
Costa Rica Younger Dryas	La Chonta	2°-3° C	Islebe et al. 1995
Central America	-	4°-5° C	Markgraf 1989

Table 3. List of Major Central American Paleontological and Archaeological Localities Containing Possible Late Pleistocene Megafaunal Remains.

Country	Site/Locality (Figure 6)	Type of Site	Elephantidae Mammoths	Mammutidae Mastodons	Gomphotheriidae *Cuvieronius*	Bison	Horse	Camel	Toxodont	Ground Sloths	Others	Chronometric Dates	References
Mexico	Ciudad Delicias (1)	Paleon									X		Silva-Bárcenas 1969
Mexico	Arroyo El Arenal and Ojuelo (2)	Paleon	X										Silva-Bárcenas 1969
Mexico	San Josecito Cave (3)	Paleon					X	X		X	X	28,005 ± 1035 (INAH-943A), 31,290 ± 1270 (SMU-2518), 34,830 ± 470 (SMU-2589), 44,520 ± 2590 (SMU-2590), 37,975 ± 700 (SMU-2532), 33,700 ± 1365 (INAH-940)	Jakway 1958 Silva-Bárcenas 1969 Arroyo-Cabrales et al 1989, 1993, 1995 Arroyo-Cabrales and Johnson 1995
Mexico	El Cedral (4)	Arch ?	X	X		X	X	X		X	X	See Table 4	Lorenzo and Mirambell 1981
Mexico	Cueva del Diablo (5)	Arch ?					X						Lorenzo 1975
Mexico	Xicotencatl (6)	Arch ?	X										García-Bárcena 1989
Mexico	Villa Hidalgo (7)	Paleon	X	X			X	X					Polaco et al. 1998
Mexico	Laguna Las Cruces (8)	Arch ?	X										García-Bárcena 1989
Mexico	Rancho Peotillos (9)	Paleon					X						Silva-Bárcenas 1969
Mexico	Apazo (10)	Paleon									X		Silva-Bárcenas 1969
Mexico	Jilotepec (11)	Paleon	X										Silva-Bárcenas 1969
Mexico	Zacapu (12)	Paleon	X										Silva-Bárcenas 1969
Mexico	Chapala, Sayula (13)	Arch	X								X		Aveleyra 1964
Mexico	Cueva Encantada (14)	Arch ?			X								García-Bárcena 1989
Mexico	Valle de Mexico (Multiple Localities, 15)	Paleon	X			X	X	X		X	X		Silva-Bárcenas 1969
Mexico	Tlapacoya (15)	Arch ?	X			X	X	X			X		Mirambell 1978; Lorenzo and Mirambell 1999
Mexico	Tepexpan (15)	Paleon	X				X						Silva-Bárcenas 1969
Mexico	Tequixquiac (15)	Paleon	X		X	X	X	X			X		Silva-Bárcenas 1969 Hibbard 1955
Mexico	Atepehuacan (15)	Arch	X										Aveleyra 1964

Table 3. Continued.

Country	Site/Locality (Figure 6)	Type of Site	Elephantidae Mammoths	Mammutidae Mastodons	Gomphotheriidae Cuvieronius	Bison	Horse	Camel	Toxodont	Ground Sloth	Others	Chronometric Dates	References
Mexico	Chimalhuacan (15)	Arch	X			X					X	See Table 4	Garcia-Cook 1968
Mexico	Tocuila (15)	Paleon.	X			X	X	X				ca. 11,000	Morett et al. 1998a,b Siebe et al. 1999
Mexico	Los Reyes Acozac (15)	Arch.	X								X	See Table 4	Aveleyra 1964
Mexico	Los Reyes La Paz (15)	Paleon.	X									10.600 Obs. Hyd.	Garcia-Bárcena 1989
Mexico	Zumpango de Ocampo (15)	Paleon	X	X							X		Silva-Bárcenas 1969
Mexico	Sta. Isabel Iztapan (15)	Arch.	X									See Table 4	Aveleyra and Maldonado-Koerdell 1953 Aveleyra 1956
Mexico	Valle de Bravo (16)	Paleon								X			Silva-Bárcenas 1969
Mexico	Ario de Rosales (17)	Paleon.					X						Silva-Bárcenas 1969
Mexico	Tonatico (18)	Paleon.					X						Silva-Bárcenas 1969
Mexico	Cuauchichinola (19)	Paleon.									X		Pocalo et al. 1997
Mexico	Tecacaxco (20)	Arch.?	X				X	X					Irwin-Williams 1967, 1978
Mexico	El Mirador (20)	Arch.?	X				X	X					Irwin-Williams 1967, 1978
Mexico	Hueyatlaco (20)	Arch.	X	X			X	X			X		Irwin-Williams 1967, 1978
Mexico	El Horno (20)	Arch.		X			X				X		Irwin-Williams 1967, 1978
Mexico	Arenillas (20)	Arch.	X										Armenta 1978
Mexico	Hacienda de Zotoluca (21)	Paleon.	X										Silva-Bárcenas 1969
Mexico	Tepeji de Rodriguez (2)	Paleon.	X		X	X	X				X	13,710 ± 430 (Beta-45625)	Torres Martinez and Agenbroad 1991
Mexico	Tamazulapan (23)	Arch.	X										Aveleyra 1964
Mexico	Cueva Blanca (24)	Arch.									X	See Table 4	Flanery et al. 1981
Mexico	Villa Flores (25)	Paleon.	X				X						Silva-Bárcenas 1969
Mexico	Aguacatenango (26)	Arch.?	X										Garcia-Bárcena 1989
Mexico	Loltun Cave (27)	Arch ?		X		X	X	X		X			Xelhuantzi-López 1986 Velázquez Valadéz 1980

Table 3. Continued.

Country	Site/Locality (Figure 6)	Type of Site	Elephantidae Mammoths	Mammutidae Mastodons	Gomphotheriidae *Cuvieronius*	Bison	Horse	Camel	Toxodont	Ground Sloth	Others	Chronometric Dates	References
Guatemala	Chivacabé (28)	Paleon.			X		X			X	X		Cano and Schuster 1995
Guatemala	Rio de la Pasion (29)	Arch.?			X	X?	X	X	X	X	X		Woodburn 1969
Honduras	Yeroconte (30)	Paleon.			X		X	X	X	X	X		Webb and Perrigo 1984
Honduras	San Pedro Sula (31)	Paleon.		X									Lucas and Alvarado 1991
Honduras	Orillas del Humuya (32)	Paleon.	X				X		X	X	X		Webb and Perrigo 1984
El Salvador	Hormiguero (33)	Paleon.			X	X	X	X	X	X	X		Stirton and Gealey 1943, 1949: Webb and Perrigo 1984
Nicaragua	El Bosque (34)	Paleon.			X		X		X?	X	X		Page 1978
Nicaragua	Rio Viejo (35)	Paleon.			X	X	X		X				Howell 1969
Costa Rica	Hacienda las Animas (36)	Paleon.			X								Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Cirri de Naranjo (37)	Paleon.	X?	X?	X?								Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	San Ramon (38)	Paleon.	?	?	?	?	X	?	X	?	?		Laurito 1988, 1993 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Hacienda del Silencio (39)	Paleon.	X										Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Santa Ana (40)	Paleon.			X								Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Rio Maria Aguilar (40)	Paleon.		X									Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Paseo Colon (40)	Paleon.		X									Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Tibas 1 (40)	Paleon.			X								Lucas et al. 1997 Laurito 1988 Snarskis et al. 1977
Costa Rica	Tibas 2 (40)	Paleon.			X								Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997

Table 3. Continued.

Country	Site/Locality (Figure 6)	Type of Site	Elephantidae Mammoths	Mammutidae Mastodons	Gomphotheriidae *Cuvieronius*	Bison	Horse	Camel	Toxodont	Ground Sloth	Others	Chronometric Dates	References
Costa Rica	Sto. Domingo (40)	Paleon.		X									Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Agua Caliente (40)	Paleon.			X								Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Cachi (40)	Paleon.			X								Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Aserri (40)	Paleon.					X						Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Saborio (41)	Paleon.					X						Laurito 1988 Alvarado 1986, 1994 Lucas et al. 1997
Costa Rica	Valle de la Estrella (42)	Paleon.					X						Lucas et al. 1997
Panama	La Coca (Ocú) (43)	Paleon.							X	X			Gazin 1956
Panama	El Hatillo (Pesé) (44)	Paleon.			X		X			X	X		Gazin 1956
Cuba	Baños de Ciego (45)	Paleon.								X	X		Matthew and de Paula Couto 1959

* Average of 5 dates

Table 4. Radiometric Dates from Middle American Localities.

Country	Site	Lab No.	^{14}C Date	Material	Remarks	References
Mexico	San Marcos Necoxtla	TX-7916	8581 ± 78	Humates	Water well	Caran et al. 1996
Mexico	Tamaulipas (TM c 81)	M-499	9270 ± 500	Hearth Charcoal		MacNeish 1958
Mexico	Early Ajuereado phase (Tehuacan Valley)	I-4602	17,500 ± 320			MacNeish 1978
Mexico	Atepehuacan		9670 ± 400	Charcoal		Avaleyra 1964:404
Mexico	Atepehuacan		9390	Obsidian		Avaleyra 1964:404
Mexico	Becerra Formation		>16,000	Wood		Avaleyra 1964:402
Mexico	Becerra Formation		11,003 ± 500	Peat		Avaleyra 1964:402
Mexico	Becerra Formation		8950	Organic Material		Avaleyra 1964:402
Mexico	Chimalhuacan		8300	Obsidian		Garcia-Bárcena 1989
Mexico	Los Reyes Acozac		10,400	Obsidian		Garcia-Bárcena 1989
Mexico	La Calsada	Tx-675	10,640 ± 210	Charcoal	Charcoal recovered from screen	Nance 1992
Mexico	La Calsada	Tx-352	9940 ± 150	Charcoal	Charcoal recovered from screen	Nance 1992
Mexico	La Calsada	Tx-772	9670 ± 70	Charcoal	Charcoal recovered from screen	Nance 1992
Mexico	La Calsada	Tx-695	9550 ± 130	Charcoal	Charcoal recovered from screen	Nance 1992
Mexico	Cueva Blanca		10,950	Hearth Charcoal	No diagnostics	Stark 1981
Mexico	Cueva Blanca		10,750	Hearth Charcoal	No diagnostics	Stark 1981
Mexico	Cueva Blanca		11,000 ± 400		No diagnostics	Rodriguez-Loubet 1988
Mexico	Cueva Blanca		10,500 ± 350		No diagnostics	Rodriguez-Loubet 1988
Mexico	Valsequillo	W-1897	20,780 ± 800			Kelley et al. 1978
Mexico	Valsequillo (Caulapan)	W-1898	>35,000	Shell		Irwin-Williams 1978
Mexico	Valsequillo (Caulapan)	W-2189	30,000 ± 1000	Shell		Irwin-Williams 1978
Mexico	Valsequillo (Caulapan)	W-1975	>29,000	Shell		Irwin-Williams 1978
Mexico	Valsequillo (Caulapan)	W-1911	23,940 ± 1000	Bone		Reeves 1965
Mexico	Valsequillo (Caulapan)	MB-6	22,000 ± 2000, 231	Bone		Reeves 1965
Mexico	Valsequillo (Caulapan)	W-1895	21,850 ± 850	Shell		Irwin-Williams 1978
Mexico	Valsequillo (Caulapan)	MB-6	20,000 ± 1500, 230	Bone		Reeves 1965
Mexico	Valsequillo (Caulapan)	W-1896	9150 ± 500	Shell		Irwin-Williams 1978

Table 4. Continued.

Country	Site	Lab No.	^{14}C Date	Material	Remarks	References
Mexico	Sta. Isabel Iztapan	C-204	16,000			Reeves 1965
Mexico	Sta. Isabel Iztapan	C-205	11,003 ± 500			Reeves 1965
Mexico	Sta. Isabel Iztapan	L-191	9000 ± 200			MacNeish 1978
Mexico	Sta. Isabel Iztapan	OxA-7746	11,100 ± 80	Bone		Dixon 1999
Mexico	Santa Lucia	IX6628	26,300 ± 880			MacNeish and Nelken-T. 1983
Mexico	Santa Lucia	I-10427	23,400 ± 600			MacNeish and Nelken-T. 1983
Mexico	Tlapacoya 1	I-4449	21,700 ± 500	Hearth Charcoal		Mirambell 1978
Mexico	Tlapacoya 1	A-794 b	24,000 ± 4000	Hearth Charcoal		Haynes 1967 Mirambell 1978
Mexico	Tlapacoya 1	A-790 a	22,000 ± 2600	Wood		Haynes 1967 Mirambell 1978
Mexico	Tlapacoya 1	A-793	24,200 ± 500	Peat		Haynes 1967
Mexico	Tlapacoya	GX-1103	33,500 ± 3200, 2300	Peat		Mirambell 1978
Mexico	Tlapacoya 2	GX-0950	23,150 ± 950	Tree Trunk		Mirambell 1994
Mexico	Tlapacoya 2	GX-0959	23,950 ± 950	Tree Trunk		Lorenzo and Mirambel 1999
Mexico	Tlapacoya 2		21,250-25,000	Obsidian Hydration	Hydration dating on blade associated with 23,950 14C year old tree trunk	Lorenzo and Mirambel 1999
Mexico	Tlapacoya 18	I-6897	9920 ± 250			Mirambell 1978 Lorenzo and Mirambel 1999
Mexico	Tlapacoya 18	OxA-7557	9730 ± 65	Human Cranium		Dixon 1999
Mexico	Santa Marta (RS)	I-9260	9330 ± 290			García-Bárcena and Santamaria 1982
Mexico	Santa Marta (RS)	I-9259	9280 ± 290			García-Bárcena and Santamaria 1982
Mexico	Los Grifos	I-10762	9540 ± 150	Charcoal?	Under fluted and FPP points	Santamaria 1981
Mexico	Los Grifos	I-10761	9460 ± 150	Charcoal?	Under fluted and FPP points	Santamaria 1981
Mexico	Los Grifos		9330	Obsidian	Under fluted and FPP points	Santamaria 1981
Mexico	Los Grifos	I-10760	8930 ± 150	Charcoal?	Above fluted and FPP points	Santamaria 1981

Table 4. Continued.

Country	Site	Lab No.	^{14}C Date	Material	Remarks	References
Mexico	El Cedral	GX-7684	33,300 ± 2700			Lorenzo and Mirambel 1999
Mexico	El Cedral	I-10438	31,850 ± 1600	Charcoal		Lorenzo and Mirambell 1981
Mexico	El Cedral	I-10436	21,960 ± 540	Bone Tool		MacNeish and Nelken-T. 1983
Mexico	El Cedral	GX-6635	8150 ± 215			Lorenzo and Mirambell 1981
Mexico	Rancho la Amapola	INAH-305	37,694 ± 1963	Hearth Charcoal		Mirambell 1994
Mexico	Rancho la Amapola	INAH-302A	33,630 ± 2066	Hearth Charcoal		Mirambell 1994
Mexico	Rancho la Amapola	INAH302B	28,841 ± 831	Hearth Charcoal		Mirambell 1994
Mexico	Rancho la Amapola	INAH-389	28,709 ± 828	Hearth Charcoal		Mirambell 1994
Mexico	Rancho la Amapola	INAH-384	>27,000	Hearth Charcoal		Mirambell 1994
Mexico	Rancho la Amapola	INAH-390	27,459 ± 812	Hearth Charcoal		Mirambell 1994
Mexico	Rancho la Amapola	INAH-391	26,984 ± 850	Hearth Charcoal		Mirambell 1994
Mexico	Rancho la Amapola	INAH-303	25,682 ± 1416	Hearth Charcoal		Mirambell 1994
Mexico	Rancho la Amapola	INAH-388	21,468 ± 458	Hearth Charcoal		Mirambell 1994
Mexico	Tepexpan Skeleton	AA-2667	1980 ± 330	Collagen		Stafford 1994
Mexico	Tepexpan Skeleton	AA-2956	1430 ± 60	Fulvic Acids		Stafford 1994
Mexico	Tepexpan Skeleton	AA-2954	1090 ± 180	Glutamic Acid		Stafford 1994
Mexico	Tepexpan Skeleton	AA-2955	960 ± 340	Glycine		Stafford 1994
Mexico	Tepexpan Skeleton	AA-2953	920 ± 190	Aspartic Acid		Stafford 1994
Guatemala	Los Tapiales	GaK-4885	4730 ± 100	Hearth Charcoal	Rejected	Gruhn and Bryan 1977
Guatemala	Los Tapiales	GaK-4886	4790 ± 100	Charcoal		Gruhn and Bryan 1977
Guatemala	Los Tapiales	GaK-4887	7150 ± 130	Hearth Charcoal	Rejected	Gruhn and Bryan 1977
Guatemala	Los Tapiales	GaK-2769	7550 ± 150	Charcoal		Gruhn and Bryan 1977
Guatemala	Los Tapiales	GaK-4888	7820 ± 140	Hearth Charcoal	Rejected	Gruhn and Bryan 1977
Guatemala	Los Tapiales	Birm-703	7960 ± 160	Charcoal		Gruhn and Bryan 1977
Guatemala	Los Tapiales	TX-1630	8810 ± 110	Charcoal		Gruhn and Bryan 1977
Guatemala	Los Tapiales	GaK-4890	9860 ± 185	Charcoal		Gruhn and Bryan 1977

Table 4. Continued.

Country	Site	Lab No.	^{14}C Date	Material	Remarks	References
Guatemala	Los Tapiales	Tx-1631	10,710 ± 170	Charcoal	Accepted age of site	Gruhn and Bryan 1977
Guatemala	Los Tapiales	GaK-4889	11,170 ± 200	Charcoal		Gruhn and Bryan 1977
Guatemala	Piedra del Coyote	Tx-1633	5320 ± 90	Charcoal	No diagnostics	Gruhn and Bryan 1977
Guatemala	Piedra del Coyote	Tx-1635	9430 ± 120	Charcoal	No diagnostics	Gruhn and Bryan 1977
Guatemala	Piedra del Coyote	Tx-1634	10,020 ± 260	Charcoal	No diagnostics	Gruhn and Bryan 1977
Guatemala	Piedra del Coyote	Tx-1632	10,650 ± 1,350	Charcoal	No diagnostics	Gruhn and Bryan 1977
Nicaragua	El Bosque	WSU-1627	>35,000	Calcium Carbonate	Manuports of non-local stone?, cultural site?	Page 1978
Nicaragua	El Bosque	Gx-3623	>32,000	Bone Apatite	Manuports of non-local stone?, cultural site?	Page 1978
Nicaragua	El Bosque	Gx-3622	29,200 ± 3000, 3200	Bone Apatite	Manuports of non-local stone?, cultural site?	Page 1978
Nicaragua	El Bosque	WSU-1625	26,100 ± 800	Bone Apatite	Manuports of non-local stone?, cultural site?	Page 1978
Nicaragua	El Bosque	Gx-3504	22,640 ± 1100, 900	Bone Apatite	Manuports of non-local stone?, cultural site?	Page 1978
Nicaragua	El Bosque	WSU-1626	18,100 ± 500	Calcium Carbonate	Manuports of non-local stone?, cultural site?	Page 1978
Panama	Lake La Yeguada	Multiple Assays	11,050	Charcoal	Estimate for anthropogenic burning of forest	Piperno et al. 1991
Panama	Corona Rockshelter	Beta-19105	10,440 ± 650	Charcoal	Associated with a bifacial industry	Cooke and Ranere 1992a:120
Panama	Alvina de Parita	FSU-300	11,350 ± 250	Hearth Charcoal		Crusoe and Felton 1974
Panama	Aguadulce Rockshelter	NZA-9622	10,529 ± 184	Phytoliths		Piperno et al. 2000
Panama	Aguadulce Rockshelter	NZA-10930	10,725 ± 80	Phytoliths		Piperno et al. 2000
Panama	Cueva los Vampiros	Beta-5101	8560 ± 650	Charcoal	Associated with a bifacial industry	Cooke and Ranere 1984

Table 5. Number of Clovis-Like Points in Middle America.

Country	n	Specimens not Illustrated in Publications	Total
Mexico	38	1 Cueva del Tecolote? (Lorenzo 1987:235) ~4 (Cerro de Izabal, Rancho El Plomo, Las Peñitas, and La Playa, Robles Ortiz 1974)	43
Belize	2		2
Guatemala	3		3
Honduras	0		0
El Salvador	0		0
Nicaragua	0		0
Costa Rica	20		20
Panama	19		19
Total	82	~5	~87

Table 6. Geographic Distribution of Paleoindian Projectile Points in Middle America.

Map No. (Fig. 7)	Country	Point Type	Number of Specimens	References
1	Mexico	Clovis-like	1	Ashman 1952
2	Mexico	Clovis-like	1?	Roblez Ortiz and Taylor 1972; Robles Ortiz 1974
3	Mexico	Clovis-like	1?	Roblez Ortiz and Taylor 1972; Robles Ortiz 1974
4	Mexico	Clovis-like	10	Roblez Ortiz and Taylor 1972; Robles Ortiz 1974
5	Mexico	Clovis-like?	1	Robles Ortiz 1974
6	Mexico	Clovis-like?	1	Robles Ortiz 1974
7	Mexico	Clovis-like	1?	Robles Ortiz 1974
8	Mexico	Clovis-like	2	Robles Ortiz 1974
9	Mexico	Clovis-like	1	Robles Ortiz 1974
10	Mexico	Clovis-like	2	Di Peso 1955
11	Mexico	Clovis-like	1	Robles Ortiz 1974
12	Mexico	Clovis-like	1?	Robles Ortiz 1974
13	Mexico	Clovis-like	5	Robles Ortiz 1974
14	Mexico	Clovis-like	1	Robles Ortiz 1974
15	Mexico	Clovis-like?	1	Di Peso 1965
16	Mexico	Clovis-like	2	Phelps 1990
17	Mexico	Clovis-like	3	Chandler and Kump 1997
18	Mexico	Clovis-like	1	Lorenzo 1953
19	Mexico	Clovis-like?, Plainview?	1	Weigand 1970
20	Mexico	Clovis-like?, Plainview?	3	Lorenzo 1964; Davis and Irish 2000
21	Mexico	Clovis-like	1?	Irwin Williams 1963
22	Mexico	Clovis-like	1	García Cook 1973
23	Mexico	Clovis-like	1	García-Bárcena 1979; Santamaria 1981
26	Belize	Clovis-like	2	Hester et al. 1980a, b; MacNeish 1982
27	Guatemala	Clovis-like	1	Brown 1980
28	Guatemala	Clovis-like?, FPP?	1	Gruhn and Bryan 1977
29	Guatemala	Clovis-like	1	Coe 1960
31	Costa Rica	Clovis-like	1	Sheets and McKee 1994
32	Costa Rica	Clovis-like	1	Swauger and Mayer-Oakes 1952
33	Costa Rica	Clovis-like	18+	Snarskis 1977, 1979; Castillo Campo et al. 1987
36	Panama	Clovis-like	11+	Cooke and Ranere 1992b; Ranere and Cooke 1995
37	Panama	Clovis-like	1	Bird and Cooke 1978
38	Panama	Clovis-like	1	Sander 1959, 1964
35	Panama	La Elvira/El Inga	1	Pearson 2000b
23	Mexico	FPP	2	García-Bárcena 1979; Santamaria 1981
24	Belize	FPP	1	Pearson and Bostrom 1998
25	Belize	FPP	1+11?	MacNeish et al. 1980b; Zeitlin 1984:362
27	Guatemala	FPP	3	Brown 1980:317
30	Honduras	FPP?	2	Bullen and Plowden 1963
33	Costa Rica	FPP	2	Snarskis 1977, 1979; Castillo Campo et al. 1987
34	Panama	FPP	1	Ranere and Cooke 2002
38	Panama	FPP	7	Sander 1959, 1964; Bird and Cooke 1978 Ranere and Cooke 1996
35	Panama	El Jobo-like	1	Pearson 2000b
38	Panama	El Jobo-like	1	Ranere and Cooke 2002
1	Mexico	Folsom	2	Krone 1980
2	Mexico	Folsom	1	Aveleyra 1961
3	Mexico	Folsom	1	González Rul 1959
4	Mexico	Folsom	1	Chandler and Kump 1997
5	Mexico	Folsom	1	Epstein 1961
6	Mexico	Folsom	1	Rodriguez 1983
7	Mexico	Folsom?	1	Marcus and Flannery 1996
1	Mexico	Plainview	1	Krone 1978
2	Mexico	Plainview	1	De La Borbolla and Aveleyra 1953
3	Mexico	Golondrina and Plainview	16+	Epstein 1961, 1969
4	Mexico	Plainview	1	MacNeish 1958
5	Mexico	Plainview, Dalton?	1	Muller 1961
6	Mexico	Cody?	1	Aveleyra 1964
7	Mexico	Cody?	1	Aveleyra 1956
8	Belize	Plainview	1	MacNeish et al. 1980b

Table 7. Number of FPPs in Middle America.

Country	n	n Specimens Not Illustrated in Publications	Total
Mexico	2		2
Belize	2	11, BAAR Survey, Zeitlin 1984:362	13
Guatemala	0	3, Brown 1980:317	3
Honduras	2		2
El Salvador	0		0
Nicaragua	0		0
Costa Rica	2		2
Panama	7	1, Cooke 2002, pers. comm.	8
Total	15	15?	30

Table 8. Possible Early Human Remains of Middle America (n>20).

Site	Age	Material Dated/Method Association	Number of Individuals	Type of Remains	References
Lake Chapala Mexico	Pleistocene	Mineralization, Extinct Fauna, Rugosity	>3	Loose Elements	Lobdell et al. 1998 Irish et al. 2000
Zacoalco Playa Mexico	Pleistocene	Mineralization, Extinct Fauna, Rugosity	>3	Loose Elements	Lobdell et al. 1998 Irish et al. 2000
Xico Mexico	Pleistocene	Fluorine, Associated with Fossil Horse Bones	1	Mandible (lost)	Romano 1970
Tepexpan Mexico	Pleistocene	Associated with Mammoth Bones	1	Tooth	Romano 1970
Astahuacan Mexico	c. 9640 ± 400	Fluorine, Obsidian Hydration	3	Skeleton	Romano 1955, 1970
Chicoloapan Mexico	c. 5600-7000	Obsidian Hydration	1	Calotte	Romano 1963, 1970
El Peñon 2 Mexico	Pleistocene	Mineralization, Tephra	1	Skeleton	Romano 1970
El Peñon 3 Mexico	10,755 ± 75 ^{14}C yr B.P.	Bone (AMS)	1	Skeleton	Jiménez López 2002 pers. comm.
Tlapacoya 18 Mexico	9920 ± 250 ^{14}C yr B.P. (I-6897) 9730 ± 65 ^{14}C yr B.P. (OxA-7557)	Bone (AMS)	2	Crania	Lorenzo and Mirambell 1999 Dixon 1999:140
Tlapacoya 1 Mexico	10,200 ± 65 ^{14}C yr B.P.	Bone (AMS)	1	?	Jiménez López 2002 pers. comm.
Texcal Man	7480 ± 55 ^{14}C yr B.P.	Bone (AMS)	1	?	Jiménez López 2002 pers. comm.
Metro Man	c. 10,500	Tephra	1	?	Anonymous 2002
Chimalhuacan	c. 10,500	Tephra	1	?	Anonymous 2002

Table 9. Distribution of Ancient mtDNA Haplogroups in Middle America (n=>30).

mtDNA Haplogroup	Age (^{14}C yr B.P.)	Cultural Group/Site/Region	Number of Individuals	References
C and D	1000	Maya, Copan, Honduras	30	Merriwether et al. 1992, 1994
C	1250-700	Copan	8	Merriwether et al. 1997
D	1450	Copan	1	Merriwether et al. 1997
A	1350-429	Xcaret	21	González-Oliver et al. 2001
B	1350-429	Xcaret	1	González-Oliver et al. 2001
C	1350-429	Xcaret	2	González-Oliver et al. 2001
Other	1350-429	Xcaret	1	González-Oliver et al. 2001

Table 10. North and Middle Early Paleoindian Lithic and Organic Tool Types.

	North America	Middle America
End Scrapers	Present	Present
Side Scrapers	Present	Present
Spurred End Scrapers	Present	Present
Scraper Planes	Present	Present
Keeled scrapers (limaces)	Present	Common
Large blades and by-products	Present	Almost none
Flake tools and cores	Present	Present
Burins	Rare	Common
Gravers	Present	Present
Denticulates	Rare	Common
Crescents	Present	Absent
Bifacial Cores	Present	Rare
Burnisher Billets	Present	Absent
Shaft Wrenches	Present	Absent
Bone/Ivory Points	Present	Absent
Bone/Ivory Rods	Present	Absent

Table 11. Technological Attributes and Metric Data of Bifaces fromGuardiria*.

Site	Figure No.	Cat. No	Integrity	Length	Width	Thickness	FLA	FWA	FLB	FWB	PFR	BC
Guardiria	15a	B5	MDP	62.83	47.60	11.61	NA	NA	NA	NA	NA	NA
Guardiria	15b	912RS	MDP	59.49	46.78	8.24	NA	NA	NA	NA	NA	NA
Guardiria	15c	911OS	MPP	73.80	47.00	11.27	NA	NA	NA	NA	NA	NA
Guardiria	15d	912SS	BP	37.85	48.48	11.05	35.00+	23.00	NA	NA	NA	NA
Guardiria	15e	913TS	BP	35.11	44.93	11.68	27.00	20.00	19.00	13.00	NA	NA
Guardiria	15f	B4	MP	35.91	41.50	7.40	NA	NA	NA	NA	NA	NA
Guardiria	15g	9PN1TS	BP	39.16	51.86	15.13	NA	NA	NA	NA	NA	NA
Guardiria	15h	919AN	C	50.45	32.34	7.70	14.00	13.00	NA	NA	NA	NA
Guardiria	15i	912SS	BP	40.83	27.21	6.55	23.00	12.00	NA	NA	NA	NA
Guardiria	15j	912TS	MDP	50.15	41.06	10.43	NA	NA	NA	NA	NA	NA
Guardiria	15k	911PS	MDP	45.59	27.96	8.28	NA	NA	NA	NA	NA	NA
Guardiria	15l	914OS	MDP	68.16	42.84	10.21	NA	NA	NA	NA	NA	NA
Guardiria	15m	911RS	DP?	48.40	61.10	12.94	NA	NA	NA	NA	NA	NA
Guardiria	15n	914GS	AC	67.46	38.83	9.49	NA	NA	NA	NA	NA	NA
Guardiria	15o	911US	MPP	65.40	43.57	10.31	NA	NA	NA	NA	NA	NA
Guardiria	15p	9PN1TS	MDP	73.71	55.67	12.33	NA	NA	NA	NA	NA	NA
Guardiria	15q	913MS	MDP?	73.42	41.14	10.91	NA	NA	NA	NA	NA	NA
Guardiria	15r	B4	MPP?	56.84	46.08	16.25	NA	NA	NA	NA	NA	NA
Guardiria	15s	911TS	MPP?	74.71	60.00	18.92	NA	NA	NA	NA	NA	NA
Guardiria	15t	940A10A	MPP?	70.98	64.78	22.48	NA	NA	NA	NA	NA	NA
Guardiria	15u	912US	?	42.93	75.51	11.64	NA	NA	NA	NA	NA	NA
Guardiria	15v	9PN1TS	MDP	60.25	49.44	12.37	NA	NA	NA	NA	NA	NA

Table 11. Continued.

Figure No.	BW	MBT	BLG	Nipple	Raw Mat	Break
15a	NA	NA	No	NA	Chert	IMPUR
15b	NA	NA	No	NA	Chert	Manufacture
15c	NA	NA	Yes	NA	Chert	IMPUR
15d	30.03	-	No	No	Chert	Manufacture
15e	22.45	-	Yes	Yes	Chert	IMPUR
15f	NA	NA	No	NA	Chert	?
15g	NA	NA	Yes	Yes	Chert	Manufacture
15h	16.25	-	Yes	No	Chert	NA
15i	20.45	-	Yes	No	Chert	Manufacture
15j	NA	NA	-	NA	Chert	IMPUR
15k	NA	NA	-	NA	Chert	Manufacture
15l	NA	NA	-	NA	Chert	Manufacture
15m	NA	NA	-	NA	Chert	IMPUR
15n	NA	NA	-	NA	Chert	Manufacture
15o	NA	NA	-	No	Chert	Manufacture
15p	NA	NA	No	NA	Chert	Manufacture
15q	NA	NA	-	No	Chert	Manufacture
15r	NA	NA	-	No	Chert	Manufacture
15s	NA	NA	-	No	Chert	Manufacture
15t	NA	NA	-	No	Chert	IMPUR
15u	NA	NA	-	NA	Chert	Manufacture
15v	NA	NA	-	No	Chert	IMPUR

***See Appendix A for explanations of table abbreviations and measurements**

Table 12. Technological Attributes and Metric Data of Keeled Scrapers and Planes from Guardiria.

Site	Cat. No	Length	Width	Thickness	Raw Mat
Guardiria	940A17F	122.06	50.24	36.36	Chert
Guardiria	94A3D	74.04	37.19	25.65	Chert
Guardiria	940A12CH	70.5	31.08	25.03	Chert
Guardiria	940A6F	61.98	28.77	21.92	Chert
Guardiria	940A22CH	82.71	42.11	31.15	Chert
Guardiria	940A16G	76.39	29.41	20.00	Chert
Guardiria	940A6G	50.93	27.92	19.74	Chert
Guardiria	940A14CH	52.08	29.56	21.67	Chert
Guardiria	940A14D	67.24	37.58	18.63	Chert
Guardiria	940A15E	57.94	25.13	14.49	Chert
Guardiria	940A11E	51.21	29.84	23.26	Chert
Guardiria	940A19D	105.98	30.65	20.85	Chert
Guardiria	940A5C	Broken	25.27	22.44	Chert
Guardiria	940A14F	Broken	37.00	28.42	Chert
Guardiria	940A22E	Broken	34.10	14.80	Chert
Guardiria	940A8E	Broken	31.03	24.62	Chert
Guardiria	940A14CH	Broken	31.82	19.27	Chert
Guardiria	940A14F	95.65	31.16	26.85	Chert
Guardiria	940A15G	64.16	35.30	15.86	Chert

Table 13. Technological Attributes and Metric Data of Bifaces from Lake Alajuela.

Site	Figure No.	Cat. No	Integrity	Length	Width	Thickness	FLA	FWA	FLB	FWB	PFR	BC
L. Alajuela	19a	2F 200 B	C	76.40	37.70	7.30	23.26	16.19	19.85	13.42	Yes?	2.25
L. Alajuela	19b	-	MDP	52.00	38.00	-	NA	NA	NA	NA	NA	NA
L. Alajuela	19c	2F 200 P	BP	20.10	26.54	5.80	27.05+	15.89	27.05+	17.10	?	2.64
L. Alajuela	19d	2F 200 Q	C	46.00	33.90	5.80	23.57	13.35	NA	NA	NA	2.40
L. Alajuela	19e	-	AC	82.83	43.03	6.08	35.31	25.05	24.05	12.67	Yes	NA
L. Alajuela	19f	ZF 200 W	C	44.00	31.00	6.40	26.60	15.34	NA	NA	?	1.36
L. Alajuela	19g	-	AC	58.42	39.25	5.4	11.8 0-+	11	NA	NA	Yes	NA
L. Alajuela	19h	-	C	72.4	45.2	6	19.5	16	18.5	16	?	4.5
L. Alajuela	19i	2F 200 88 43	DBP	135.78	61.50 77.55	11.50	NA	NA	NA	NA	NA	NA
L. Alajuela	19j	2F 200 98 1	BP?	61.75	65.77	11.84	NA	NA	NA	NA	NA	NA
L. Alajuela	19k	2F 200 P	MP	38.02	13.94 25.50	7.84 13.70	NA	NA	NA	NA	NA	NA

Table 13. Continued.

Figure No.	BW	MBT	BLG	Nipple	Raw Mat	Break	Remarks/References
19a	25.46	3.70	Yes	No	Fossilized Wood	NA	Bird and Cooke 1977, 1978
19b	NA	NA	?	NA	?	Use?	Bird and Cooke 1977, 1978
19c	18.00	4.45	Yes	No	Turitella Agate	Use?	Bird and Cooke 1977, 1978
19d	18.27	4.16	Yes	No	Mottled Agate	NA	Bird and Cooke 1977, 1978
19e	18.48+	3.45	Yes	No	Silicified Tuff	Use	Bird and Cooke 1977, 1978
19f	16.70	5.05	Yes	No	Mottled Agate	NA	Bird and Cooke 1977, 1978
19g	17	3.89	Yes	NA	Red Jasper	Use?	Bird and Cooke 1977, 1978
19h	19.4	4	Yes	No	Grey Chert	NA	
19i	NA	NA	No	No	Banded Green-Purple Chert	Manufacture	
19j	NA	NA	No	No	Mottled Purple-Brown Chert	Manufacture	
19k	NA	NA	No	NA	Purplish Chert	?	

Table 14. Technological Attributes and Metric Data of Keeled Scrapers and Other Tools from Lake Alajuel

Site	Figure No.	Cat. No	Length	Width	Thickness	Raw Mat
L. Alajuela	21a	2F 200 88 BE 94	14.82	34.3	7.25	Yellow Jasper
L. Alajuela	21b	2F 200 B	98.85	54.15	19.90	Orange-Brown Chert
L. Alajuela	22a	2F 200 88 MA 11A	153.25	56.55	23.72	Silicified Mudstone?
L. Alajuela	22b	2F 200 B	102.40	42.26	24.85	Silicified Mudstone?
L. Alajuela	22c	2F 200 B 26A	103.81	51.12	29.10	Brown Chert
L. Alajuela	22d	2F 200 88 54/21	136.54	44.20	24.44	Silicified Mudstone?
L. Alajuela	22e	2F 200 B	109.20	51.46	23.15	Silicified Mudstone?
L. Alajuela	22f	2F 200 B	101.35	43.20	26.02	Pinkish-Brown Chert
L. Alajuela	22g	2F 200 B	73.96	40.55	20.40	Red-Purple Jasper
L. Alajuela	22h	2F 200 B	117.45	48.50	26.45	Yellow Jasper
L. Alajuela	22i	2F 240 B	83.57	45.90	33.20	Silicified Mudstone?
L. Alajuela	22j	2F 200B 44	80.60	46.58	30.20	Silicified Mudstone?
L. Alajuela	22k	2F 200 88 30	56.30	45.25	27.45	Yellow Jasper
L. Alajuela	22l	2F 200 B	113.60	59.85	32.25	Silicified Mudstone?
L. Alajuela	22m	2F 200 B(W)	96.61	33.20	15.85	Pink-Beige Chert
L. Alajuela	22n	2F 200 B	102.46	47.75	24.50	Gray Chert
L. Alajuela	22o	2F 200 B	112.45	40.00	24.10	Silicified Mudstone?
L. Alajuela	22p	2F 200 B 44	119.25	51.60	22.45	Silicified Mudstone?
L. Alajuela	22q	2F 200 B 45	55.90	56.14	24.30	Yellow-Pink Siltstone
L. Alajuela	22r	2F 200 B	93.75	52.19	26.28	Silicified Mudstone?
L. Alajuela	22s	2F 200 B	106.30	56.70	39.76	Yellow-Red Siltstone
L. Alajuela	22t	2F 200 B(W)	81.20	40.00	27.45	Silicified Mudstone?
L. Alajuela	22u	2F 200 B	103.84	60.81	36.36	Blue-Gold Chert

Table 15. Technological Attributes and Metric Data of Bifaces from La Mula-West.

Site	Figure No.	Cat. No	Integrity	Length	Width	Thickness	FLA	FWA	FLB	FWB	PFR
La Mula-West	27a	PR14W Y4 30, 4 1	AC	94.30	36.00	9.74	27.63	16.18	24.85	20	Yes
La Mula-West	27b	4 99 1	MBP	65.60	37.60	8.96	28.9	19.46	NA	NA	Yes
La Mula-West	27c	PR14W 27S	MP	75.15	41.44	13.50	41.87-+	17.14	34.15-+	19.7	Yes
La Mula-West	27d	PR14W 21S	MDP	41.63	22.70	6.18	NA	NA	NA	NA	NA
La Mula-West	27d	PR14W 24S	BP	22.00	26.18	6.23	18.63+	11.4	NA	NA	No
La Mula-West	27e	PR14W	MBP	26.00	12.00	7.00	NA	NA	20.00	10.00	?
La Mula-West	27f	PR14W 22S	BP	48.45	62.48	12.86	NA	NA	NA	NA	NA
La Mula-West	27g	PR14W 8 16	BP?	31.85	45.10	10.00	NA	NA	NA	NA	NA
La Mula-West	27h	PR14W X4 2	BP?	29.81	39.16	15.40	NA	NA	NA	NA	NA
La Mula-West	27i	PR14W X13 9	BP	16.76	21.50	6.60	NA	NA	NA	NA	NA
La Mula-West	27j	PR14W 6 24	MP	32.55	44.08	11.75	NA	NA	NA	NA	NA
La Mula-West	27k	PR14W 3 249	BP	32.35	53.16	17.94	NA	NA	NA	NA	NA
La Mula-West	27l	PR14W X9 1	BP	15.97	33.67	10.26	NA	NA	NA	NA	NA
La Mula-West	27m	PR14W 4 4	BP	16.58	27.45	8.05	NA	NA	15.50+	15.74	No
La Mula-West	27n	PR14W 2 18	BP?	23.08	21.70	6.71	NA	NA	NA	NA	NA
La Mula-West	27o	PR14W 5 1	BP	29.70	29.60	7.36	27.85+	21.48	20.46	10.56 14.54	Yes
La Mula-West	27p	PR14W 5 194	BP	29.30	31.90	7.60	23.6	10.65	28.70+	13.79	Yes
La Mula-West	27q	PR14W 20S 1	BP	32.31	34.00	8.00	19.85	20.48	24.24	15.4	Yes
La Mula-West	27r	4 99 2	BP	25.10	31.14	7.67	22.70+	23.5	12.8	13.26	Yes
La Mula-West	27s	PR14W 30S	MP	32.96	33.30	8.63	NA	32.96++	15.85	NA	NA
La Mula-West	27t	PR14W 8S	BP	21.90	36.48	6.48	17.34+	13.83	13.1	12.56	No
La Mula-West	27u	PR14W 0 1	BP?	19.95	28.62	5.93	NA	NA	NA	NA	NA
La Mula-West	27v	PR14W MX 2 1	BP	19.75	28.40	5.75	NA	NA	NA	NA	NA

Table 15. Continued.

Figure No.	BC	BW	MBT	BLG	Nipple	Raw Mat	Break	Remarks/References
27a	2.6	25.49	5	Yes	No	Agate	Manufacture	Crazing
27b	0	19.95	5	Yes	Yes	Agate	Manufacture	Ranere 1992, fig. 2f
27c	NA	NA	7.25	Yes	NA	Agate	Manufacture	
27d	NA	NA	NA	Yes	NA	Red Jasper?	Use?	Point Tip, Waxy Luster, Crazing Cooke and Ranere 1992b, fig.4a
27d	0	24.35+	6.05	Yes	No	Red Jasper?	Use?	Point Base, Waxy Luster, Crazing
27e	?	?	?	?	No	Agate	Manufacture	Cooke and Ranere 1992b, fig.4g
27f	NA	NA	NA	No	No	Agate	Manufacture	Ranere 1992, fig. 2a
27g	NA	NA	NA	No	No	Agate	Manufacture	
27h	NA	NA	NA	No	No	Agate	Manufacture	
27i	0	21.50+	6.7	Yes	No	Agate	Manufacture	
27j	NA	NA	NA	No	NA	Agate	Manufacture	Ranere 1992, fig. 2g
27k	NA	NA	NA	No	No	Agate	Manufacture	
27l	NA	19.01	7.98	No	Yes	Agate	Manufacture	
27m	0	21.5	5.1	Yes	No	Agate	Manufacture	
27n	NA	NA	NA	Yes	No	Agate	Manufacture	
27o	0	25.77	6	Yes	No	Agate	Manufacture	Ranere 1992, fig. 2i
27p	0	27.86+	6	No	No	Agate	Manufacture	Cooke and Ranere 1992b, fig.4f
27q	0	20.38	6.71	No	No	Agate	Manufacture	Cooke and Ranere 1992b, fig.4d
27r	0	26.15	4.6	Yes	Yes	Agate	Manufacture	
27s	NA	NA	NA	No	NA	Agate	Manufacture	Fluted
27t	0	29.80+	4.53	Yes	No	Agate	Manufacture	Cooke and Ranere 1992b, fig4e
27u	NA	NA	NA	Yes	No	Agate	Manufacture	Cooke and Ranere 1992b, fig.4c
27v	0	18.7	5.55	Yes	No	Agate	Manufacture	

Table 16. Technological Attributes and Metric Data of Bifaces (Mid-Sections) from La Mula-West.

Site	Figure No.	Cat. No	Integrity	Length	Width	Thickness	FLA	FWA	FLB	FWB	PFR
La Mula-West	28a	PR14W 23S	MP	47.85	29.00	9.20	49.40++	18.65+	31.41++	13.75+	Yes
La Mula-West	28b	PR14W 12S	MP	29.22	35.26	7.68	NA	NA	NA	NA	NA
La Mula-West	28c	PR14W X12 1	MP	47.60	35.05	9.90	NA	NA	NA	NA	NA
La Mula-West	28d	PR14W 3 20	MF	31.41	37.00	13.15	NA	NA	NA	NA	NA
La Mula-West	28e	PR14W 5S, 7 40	MBP	42.34	32.30	9.18	39.44+ 25.50	13.66 11.06	NA	NA	Yes
La Mula-West	28f	PR14WE 4	MP	35.55	35.52	8.14	NA	NA	NA	NA	NA
La Mula-West	28g	PR14W ?	MP	20.90	19.75	6.10	NA	NA	NA	NA	NA
La Mula-West	28h	PR14W 25S	MP	35.60	30.40	12.95	NA	NA	NA	NA	NA

Table 16. Continued.

Figure No.	BC	BW	MBT	BLG	Nipple	Raw Mat	Break	Remarks
28a	NA	NA	NA	No	NA	Agate	Manufacture	
28b	NA	NA	NA	No	NA	Agate	Manufacture	
28c	NA	NA	NA	Yes	NA	Agate	Manufacture	
28d	NA	NA	NA	No	NA	Agate	Manufacture	Ranere 1992, fig. 2f
28e	0	32.30-	7.25	Yes	No	Agate	Manufacture	
28f	NA	NA	NA	No	NA	Agate	Manufacture	
28g	NA	NA	NA	No	NA	Agate	Manufacture	miniature?
28h	NA	NA	NA	No	NA	Agate	Manufacture	

Table 17. Technological Attributes and Metric Data of Bifaces (Distal Fragments) from La Mula-West.

Site	Figure No.	Cat. No	Integrity	Length	Width	Thickness	FLA	FWA	FLB	FWB	PFR
La Mula-West	29a	PR14W 29S	DP	49.40	32.75	7.40	NA	NA	NA	NA	NA
La Mula-West	29b	PR14W X3 12, 14S	DP	44.50	39.65	7.25	NA	NA	NA	NA	NA
La Mula-West	29c	PR14W ?	DP?	26.32	30.90	8.88	NA	NA	NA	NA	NA
La Mula-West	29d	PR14W 32S	DP	30.30	26.85	8.14	NA	NA	NA	NA	NA
La Mula-West	29e	PR14W 4S	DP	54.86	37.12	7.90	NA	NA	NA	NA	NA
La Mula-West	29f	PR14W 165	DP	34.60	21.65	4.90	NA	NA	NA	NA	NA
La Mula-West	29g	PR14W 8 17	DP	44.30	37.02	9.86	NA	NA	NA	NA	NA

Table 17. Continued.

Figure No.	BC	BW	MBT	BLG	Nipple	Raw Mat	Break
29a	NA	NA	NA	No	NA	Agate	Manufacture
29b	NA	NA	NA	No	NA	Agate	Manufacture
29c	NA	NA	NA	No	NA	Agate	Manufacture
29d	NA	NA	NA	Yes	NA	Agate	Manufacture
29e	NA	NA	NA	No	NA	Agate	Manufacture
29f	NA	NA	NA	No	NA	Brown Chert	Manufacture
29g	NA	NA	NA	Yes	NA	Agate	Manufacture

Table 18. Technological Attributes and Metric Data of Overshot Thinning Flakes from La Mula-West, La Yeguada, and Vampiros.

Site	Figure No.	Cat. No	Length	Width	Thickness	Distal Angle	Raw Mat
La Mula-West	31a	?	32.84	23.84	5.69	49°	Agate
La Mula-West	31b	PR14W 3 233	39.90	34.00	16.00	83°	Agate
La Mula-West	31c	PR14W 7 24	23.48	23.20	9.90	51°	Agate
La Mula-West	31d	PR14W 65	24.71	61.40	9.40	43°	Agate
La Mula-West	31e	PR14W 75	17.65	57.85	8.50	40°	Agate
La Mula-West	31f	PR14W 16 35	11.55	18.90	3.43	70°	Agate
La Mula-West	31g	PR14W 175	11.20	47.24	6.42	41°	Agate
La Mula-West	31h	?	25.67	45.19	5.58	41°	Agate
La Mula-West	31i	PR14W X14 1	40.54	68.44	17.60	54°	Agate
La Mula-West	31j	PR14W 4 105	23.30	60.25	12.47	55°	Agate
La Yeguada	38h	BEA-1 LYS 297 1	46.80	24.35	3.50	53°, 54°	Banded Yellow Jasper
Vampiros	62h	164A	30.90	31.00	4.90	45°	Red Jasper
Vampiros	62i	VP168A	48.00	35.60	8.00	42°	Yellow Jasper
Vampiros	62n	VP46	38.65	58.05	16.70	73°	Mottled Gray-Gold Chert

Table 19. Technological Attributes and Metric Data of Scrapers from La Mula-West, Vampiros, and SA-27

Site	Figure No.	Cat. No	Length	Width	Thickness	Edge Angle	WEC	Raw Mat
La Mula West	32a	PR14W 1S	33.89	24.10	10.00	-	-	Agate
La Mula West	32b	PR14W 3 30	39.44	46.20	20.50	-	-	Agate
La Mula West	32c	-	37.18	40.20	21.20	-	-	Agate
La Mula West	32d	PR14W 15 70	12.88	18.64	3.67	-	-	Agate
La Mula West	32e	PR14W 2 20	26.80	51.10	17.40	-	-	Agate
La Mula West	32f	PR14W 33 5	27.50	24.90	7.86	-	-	Agate
La Mula West	32g	PR14W 8 19	16.90	29.20	7.85	52°	5.40	Agate
Vampiros	62p	VP172A	48.85	40.40	10.60	53°	8.20	Red Jasper with Olive Brown Swirls
SA-27	65c	SA27117	39.43	31.80	7.60	67°	4.20	Red Jasper

Table 20. Technological Attributes and Metric Data of Blades from La Mula-West, and Nieto.

Site	Figure No.	Cat. No	Length	Width	Thick Bulb	Thick S. Bulb	Plat Width	Plat. Depth	Plat Angle	Plat. Type	Cross X	Raw Mat
La Mula-West	33a	PR14W 4 17	63.06++	22.4	NA	5.26	NA	NA	NA	NA	Tri/Tra	Spotted Golden-Olive Chert
La Mula-West	33b	PR14W 0 86	40.85+	25	6.28	5.65	9.1	2.75	120°	Fac, Slight Grnd	Tri/Tra	Spotted Golden-Olive Chert
La Mula-West	33c	PR14W 0 33	39.50+	22.85	5.63	5.45	7.55	1.3	97°	Flat	Tri	Spotted Golden-Olive Chert
La Mula-West	33d	PRW14 0 84	44.83+	23.95	7.56	4.9	11.72	4	120°	Fac	Tra	Spotted Golden-Olive Chert
La Mula-West	33e	PR14W 0 87	41.36+	25.45	8.1	4.64	9.86	6.45	105°	Fac	Tri/Tra	Spotted Golden-Olive Chert
La Mula-West	33g	PR14WE 86	46.20+	19.5	4.66	6.15	4.21	3.9	110°	Fac, Slight Grnd	Tri	Spotted Golden-Olive Chert
La Mula-West	33h	PR14WE 144 1	30.85++	20.2	NA	4.46	NA	NA	NA	NA	Tra	Spotted Golden-Olive Chert
La Mula-West	33i	PR14W X13 26	23.28++	27.7	NA	6.9	NA	NA	NA	NA	Tri	Spotted Golden-Olive Chert
La Mula-West	33j	PR14W 13 2	32.55+	20.6	NA	6.08	NA	NA	NA	NA	Tri	Spotted Golden-Olive Chert
La Mula-West	33l	PR14W 2 16	54.40+	25.17	7.8	10.74	8.68	5.44	117°	Cort	Tri/Tra	Agate
Nieto	52(17)	NTO-1043a	95.55	48.3	20.5	-	-	-	-	Flat	Trap	Quartz
Nieto	52(18)	22	37.60+	24.44	5.65	8.05	9.9	3.74	115°	NA	Tri	Quartz
Nieto	52(19)	NTO-918c	64.7	37.6	17.2	-	-	-	-	Fac	Trap	Quartz
Nieto	52(20)	NTO-925a	51.15++	24.25	NA	11.03	NA	NA	NA	NA	Trap	Quartz
Nieto	52(21)	NTO-678a	51.67+	28.5	NA	9.45	NA	NA	NA	Flat	Trap	Quartz

Table 21. Technological Attributes and Metric Data of Blade Core Platform Rejuvenation Tablets from La Mula-West.

Site	Figure No.	Cat. No	Length	Width	Thickness	Raw Mat
La Mula-West	34a	PR14W 0 92	21.20	44.89	8.75	Spotted Golden-Olive Chert
La Mula-West	34b	PR14W 15 18	36.88	29.22	5.97	Spotted Golden-Olive Chert
La Mula-West	34c	PR14W 11 18	31.70	19.35	4.61	Spotted Golden-Olive Chert
La Mula-West	34d		30.06	35.65	11.13	Spotted Golden-Olive Chert
La Mula-West	34e	PR14W X15 11	30.05	36.25	10.41	Spotted Golden-Olive Chert
La Mula-West	34f	PR14W 15 15	14.15	43.68	6.15	Spotted Golden-Olive Chert
La Mula-West	34g		20.05	49.71	11.92	Spotted Golden-Olive Chert
La Mula-West	34h	PR14W 0 89	25.66	49.84	6.90	Spotted Golden-Olive Chert
La Mula-West	34i	PR14W 13 21	29.00	36.84	8.95	Spotted Golden-Olive Chert
La Mula-West	34j	PR14w 5 109	43.17	47.60	10.54	Spotted Golden-Olive Chert
La Mula-West	34k		38.13	30.00	11.80	Spotted Golden-Olive Chert

Table 22. Technological Attributes and Metric Data of Bifacial Tools from La Mula Sarigua .

Site	Figure No.	Cat. No	Integrity	Length	Width	Thickness	FLA	FWA	FLB	FWB	PFR	BC
La Mula	35a	-	C	76.70	62.40	16.60	NA	NA	NA	NA	NA	NA
La Mula	35b	-	AC	51.55	47.88	9.35	NA	NA	NA	NA	NA	2.25
La Mula	35c	-	BP	26.10	28.50	7.38	NA	NA	NA	NA	NA	NA
La Mula	35d	-	MDP	69.73	52.30	30.00	NA	NA	NA	NA	NA	NA

Table 22. Technological Attributes and Metric Data of Bifacial Tools from La Mula Sarigua (Cont.).

Figure No.	BW	MBT	BLG	Nipple	Raw Mat	Break
35a	NA	NA	No	No	Brown Chert	NA
35b	23.35	7.20	No	No	Red Jasper	Use
35c	NA	NA	No	No	Green Chert	Manufacture
35d	NA	NA	No	NA	Red-Brown Chalcedony	Manufacture

Table 23. Technological Attributes and Metric Data of Bifaces from Lake La Yeguada.

Site	Figure No.	Site & Cat. No	Integrity	Length	Width	Thickness	FLA	FWA	FLB	FWB	PFR
Yeguada	38a	CL-7	MDP	42.10	25.45	4.90	NA	NA	NA	NA	NA
Yeguada	38b	Q1 LYS 269	AC	53.05	39.54	7.34	16.07	9.56	NA	NA	
Yeguada	38c	Q2 LYS 275	BP	30.31	29.26	8.70	NA	NA	NA	NA	NA
Yeguada	38d	Q1 LYS 267	BP	49.20	59.36	16.73	NA	NA	NA	NA	NA
Yeguada	38e	Q1 LYS 268	BP?	33.05	40.56	11.84	NA	NA	NA	NA	NA
Yeguada	38f	BEA-2 LYS 298	MDP	54.20	53.45	9.90	NA	NA	NA	NA	NA

Table 23. Continued.

Figure No.	BC	BW	MBT	BLG	Nipple	Raw Mat	Break
38a	NA	NA	NA	NA	NA	Red Jasper	Use?
38b	?	?	5.06	Yes	?	Spotted Yellow Jasper	Use
38c	NA	NA	NA	No	No	Yellow Jasper	Manufacture
38d	NA	NA	NA	N	No	Mottled Purple-White Chalcedony	Manufacture
38e	NA	NA	NA	No	No	Yellow Jasper	Manufacture
38f	NA	NA	NA	No	NA	Banded Red-Yellow Jasper	Manufactue

Table 24. Technological Attributes and Metric Data of Scrapers from Lake La Yeguada.

Site	Figure No.	Site & Cat. No	Lengtht	Width	Thickness	Raw Mat
Yeguada	45a	Q1 LYS 273	46.13	27.70	9.30	Banded Red-Purple Jasper
Yeguada	45b	Q6 LYS 279	34.15	22.55	11.70	Red Jasper
Yeguada	45c	23 LYS 293	79.26	32.10	20.15	White Chert (Patinated)
Yeguada	45d	Q1 LYS 272	36.70	22.00	22.90	Red-Purple Jasper
Yeguada	45e	Q6 LYS 278	80.42	39.05	25.65	Red Jasper
Yeguada	45f	Q8 LYS 288 3	62.40	31.58	22.25	Banded Yellow Jasper
Yeguada	45g	21 LYS 287	39.65	47.10	27.20	Mottled Purplish Jasper
Yeguada	45h	Q8 LYS 288 2	67.17	49.31	21.20	Red Jasper (Patinated?)
Yeguada	45i	Q3 LYS 276 2	66.06	56.20	27.96	Mottled Yellow Jasper
Yeguada	45j	18 LYS 283	49.30	48.06	22.40	Banded Red-Purple Jasper
Yeguada	45k	Q8 LYS 288 1	70.63	55.47	38.05	Yellow-Caramel Jasper

Table 25. Technological Attributes and Metric Data of Bifaces from Nieto.

Site	Figure No.	Cat. No	Integrity	Length	Width	Thickness	FLA	FWA	FLB	FWB	PFR
Nieto	48(1)	NTO-2b	MDP	87.87	50.50	17.20	NA	NA	NA	NA	NA
Nieto	48(2)	NTO-1113a	AC	92.65	42.27	14.63	NA	NA	NA	NA	NA
Nieto	48(3)	NTO-60a	BP	28.40	37.90	11.75	NA	NA	NA	NA	NA
Nieto	48(4)	NTO-688a	MP?	60.95	43.86	25.87	NA	NA	NA	NA	NA
Nieto	48(5)	NTO-421b	MP	39.45	29.02	11.40	NA	NA	NA	NA	NA
Nieto	48(6)	NTO-80a	MP	20.16	23.77	4.24	NA	NA	NA	NA	NA
Nieto	48(7)	NTO-696a	BP	55.90	66.95	21.95	NA	NA	NA	NA	NA
Nieto	48(8)	NTO-1240a	F	63.55	58.30	29.20	NA	NA	NA	NA	NA
Nieto	48(9)	NTO-961a	F	35.25	57.65	21.92	NA	NA	NA	NA	NA
Nieto	48(10)	NTO-912b	BP	56.50	54.20	21.55	NA	NA	NA	NA	NA
Nieto	48(11)	NTO-685a	BP	29.60	51.28	17.77	NA	NA	NA	NA	NA
Nieto	48(12)	NTO-918b	BP	42.58	57.10	19.49	NA	NA	NA	NA	NA
Nieto	48(13)	NTO-273a	MP	31.56	48.00	20.00	NA	NA	NA	NA	NA
Nieto	48(14)	NTO-705b	F	35.65	25.50	11.65	NA	NA	NA	NA	NA
Nieto	48(15)	NTO-845a	MF	27.95	25.95	5.72	NA	NA	NA	NA	NA
Nieto	48(16)	NTO-1046a	MBP?	85.25	59.70	29.02	NA	NA	NA	NA	NA

Table 25. Continued.

Figure No.	BC	BW	MBT	BLG	Nipple	Raw Mat	Break
48(1)	NA	NA	NA	Yes	NA	Quartz	Manufactue
48(2)	NA	NA	NA	No	No	Green Chert	Manufactue
48(3)	0.00	28.40	11.32	No	Yes	Quartz	Manufactue
48(4)	NA	NA	NA	NA	NA	Quartz	Manufactue
48(5)	NA	NA	NA	No	NA	Quartz	Manufactue
48(6)	NA	NA	NA	NA	NA	Quartz	Manufactue
48(7)	NA	NA	NA	No	No	Quartz	Manufactue
48(8)	NA	NA	NA	No	No	Quartz	Manufactue
48(9)	NA	NA	NA	No	No	Quartz	Manufactue
48(10)	NA	NA	NA	No		Quartz	Manufactue
48(11)	NA	NA	NA	No	No	Quartz	Manufactue
48(12)	NA	NA	NA	No	No	Quartz	Manufactue
48(13)	NA	NA	NA	No	NA	Quartz	Manufactue
48(14)	NA	NA	NA	NA	NA	Quartz	Manufactue
48(15)	NA	NA	NA	Yes	NA	Quartz	Manufactue
48(16)	NA	NA	NA	No	No	Quartz	Manufactue

Table 26. Technological Attributes and Metric Data of Cores from Nieto.

Site	Figure No.	Cat. No	Length/Height	Width	Thickness	Raw Mat
Nieto	53(22)	NTO-1245a	181.50	93.60	61.15	Quartz
Nieto	53(23)	NTO-86a	100.60	75.91	38.82	Quartz
Nieto	53(24)	NTO-1145a	80.05	66.07	42.50	Quartz
Nieto	53(25)	NTO-693a	61.98	67.30	39.80	Quartz
Nieto	53(26)	NTO-1244a	76.26	65.35	30.27	Quartz
Nieto	53(27)	NTO-1243a	58.80	46.63	22.44	Quartz
Nieto	53(28)	NTO-1089d	59.50	94.94	37.15	Quartz
Nieto	53(29)	NTO-691a	63.12	65.75	46.45	Quartz
Nieto	53(30)	NTO-705a	49.16	30.04	19.15	Quartz
Nieto	53(31)	NTO-1045a	77.50	77.67	20.65	Quartz

Table 27. Technological Attributes and Metric Data of Non-Bifacial Artifacts from Nieto.

Site	Figure No.	Cat. No	Length/Height	Width	Thickness	Raw Mat	Tool Type
Nieto	54(33)	NTO-1048d	46.50	37.25	10.20	Quartz	Spurred Tool
Nieto	54(34)	NTO-1151a	31.21	26.35	9.52	Quartz	Spurred Tool
Nieto	54(35)	NTO-1047a	26.60	31.55	8.90	Quartz	Spurred Tool
Nieto	54(36)	NTO-1215a	47.00	25.35	11.55	Quartz	Spurred Tool
Nieto	54(37)	NTO-880a	33.58	14.00	5.35	Quartz	Spurred Tool
Nieto	54(38)	NTO-1160d	31.46	14.45	5.66	Quartz	Spurred Tool
Nieto	54(39)	2002 1	43.75	26.78	17.46	Quartz	Spurred Tool
Nieto	54(40)	NTO-1125c	28.60	23.53	12.47	Quartz	Spurred Tool
Nieto	54(41)	NTO-1044a	65.90	37.08	21.55	Quartz	Spurred Tool
Nieto	54(42)	NTO-1227a	50.10	28.10	15.45	Quartz	Spurred Tool
Nieto	54(43)	NTO-1033c	23.53	35.45	8.85	Quartz	Spurred Tool
Nieto	54(44)	NTIO-889a	23.20	28.15	11.30	Quartz	Spurred Tool
Nieto	54(45)	NTO-1160c	33.70	31.55	12.72	Quartz	Spurred Tool
Nieto	54(46)	NTO-875a	32.42	27.55	17.95	Quartz	Spurred Tool
Nieto	54(47)	NTO-1022c	19.56	38.84	11.67	Quartz	Spurred Tool
Nieto	54(48)	NTO-90a	71.77	94.40	26.80	Quartz	Denticulate Scraper
Nieto	54(48)	NTO-289a	71.77	94.40	26.80	Quartz	Denticulate Scraper
Nieto	54(49)	NTO-616a	50.85	47.47	27.25	Quartz	Denticulate Scraper
Nieto	54(50)	NTO-1160b	56.25	52.46	22.39	Quartz	Denticulate Scraper
Nieto	54(51)	NTO-686a	57.90	35.05	27.00	Quartz	Denticulate Scraper
Nieto	54(52)	NTO-849a	64.90	58.53	29.60	Quartz	Denticulate Scraper
Nieto	54(53)	NTO-1177a	66.10	38.30	21.00	Quartz	Spokeshave
Nieto	54(54)	NTO-1106a	49.40	35.00	14.50	Quartz	Spokeshave
Nieto	54(55)	NTO-1231a	86.10	41.55	37.95	Quartz	Spokeshave
Nieto	54(56)	NTO-692a	86.74	51.55	34.16	Quartz	Plane
Nieto	54(57)	NTO-1061a	83.20	61.10	28.42	Quartz	Plane
Nieto	54(58)	NTO-687a	63.40	40.20	25.35	Quartz	Plane
Nieto	54(59)	NTO-689a	84.30	48.64	15.10	Quartz	Plane
Nieto	54(60)	NTO-1125e	64.90	47.55	41.80	Quartz	Plane
Nieto	54(61)	2002 4	89.45	60.00	32.95	Quartz	Plane
Nieto	54(62)	NTO-682a	84.90	59.70	21.00	Quartz	Plane
Nieto	54(63)	NTO-828a	75.15	49.65	31.46	Quartz	Scraping Tool
Nieto	54(64)	NTO-943f	61.76	46.48	11.95	Quartz	Scraping Tool
Nieto	54(65)	NTO-986a	46.30	36.17	21.48	Quartz	Scraping Tool
Nieto	54(66)	NTO-616b	42.70	20.95	9.55	Quartz	Scraping Tool
Nieto	54(67)	NTO-1136a	50.60	29.16	13.45	Quartz	Scraping Tool
Nieto	54(68)	NTO-938a	54.77	49.90	24.20	Quartz	Scraping Tool
Nieto	54(69)	NTO-1128g	44.67	30.73	13.68	Quartz	Scraping Tool
Nieto	54(70)	NTO-697a	69.58	41.52	18.76	Quartz	Scraping Tool
Nieto	54(71)	NTO-1072a	57.17	30.73	25.80	Quartz	Scraping Tool
Nieto	54(72)	NTO-75a	48.25	43.35	19.46	Quartz	Scraping Tool
Nieto	54(73)	NTO-982d	59.86	28.90	21.43	Quartz	Scraping Tool
Nieto	54(74)	NTO-728a	26.73	35.86	11.50	Quartz	Scraping Tool
Nieto	54(75)	NTO-12a	34.00	30.20	13.12	Quartz	Scraping Tool
Nieto	54(76)	2002 3	106.45	60.45	29.55	Quartz	Retouched Flake
Nieto	54(77)	NT0-683a	101.58	40.15	16.75	Quartz	Retouched Flake
Nieto	54(78)	NTO-877a	57.55	82.15	19.65	Quartz	Flake Blank
Nieto	54(79)	NTO-949b	68.21	90.65	23.06	Quartz	Flake Blank
Nieto	54(80)	NTO-940c	103.44	55.64	18.90	Quartz	Flake Blank

Table 28a. Description of Upper Zone Sediments from TP1, Cueva de Los Vampiros, North-East Profile (Refer to Figure 59a)*.

Stratigraphic Unit	Munsell Color	Description
1	7.5 YR 3/3	Organic layer. No cultural material. Roots.
2	7.5 YR 3/2	Dark brown clay. No rocks or cultural material.
3	7.5 YR 6/2-5/2	Gray sediments with eroded and fragmented shells. No rocks.
4	10 YR 7/4	Ash, shell, charcoal, and clay.
5	7.5 YR 6/4-5/4	Brown earth. Bone concentration, charcoal, and shell. Distributed in bands.
6	10 YR 7/4	Ash and charcoal. No ceramic.
7	7.5 YR 5/2	Gray sediments with charcoal and shells. No rocks or ceramic.
8	7.5 YR 6/4	Gray sediments with charcoal. Very compact. No rocks or ceramic.
9	7.5 YR 5/4 10 YR 4/2	Hearths. Compacted sections with loose sediments.
10	10 YR 7/4-6/4	Ash, shell, charcoal, and clay.
H1	10 YR 7/1 10 YR 7/2	Post hole
H2	10 YR 6/3-5/3	Post hole
H3	10 YR 5/3	Post hole
H4	10 YR 5/2	Post hole
H5	10 YR 5/4	Post hole
H6	10 YR 5/3	Disturbance. Krotovina with large rock.
H7	10 YR 5/4	Post hole
H8	10 YR 5/3-5/4	Post hole
H9	10 YR 6/3	Post hole
H10	10 YR 5/3	Disturbance. Ash, shells appear mixed up.
H11	10 YR 7/4	Post hole
H12	10 YR 7/4	Post hole
I- IX	7.5 YR 7/2	Ash floor

* Tabulated by Diana Carvajal

Table 28b. (Cont.), South-West Profile (Refer to Figure 59b)*.

Stratigraphic Unit	Munsell Color	Description
1	10 YR 4/4	Powdery dust. No charcoal or cultural material.
2	7.5 YR 5/3-5/4,10 YR 4/2	Possible hearth. Dark, soft sediments.
3	10 YR 6/2-5/2	Disturbed sediments with shell. Ceramics with fragmented and eroded shells. Roots.
4	10 YR 5/2-4/2	Fine sediments with shell. No rocks or ceramic.
5	10 YR 6/2-5/2	Fine and soft sediments with charcoal. Charcoal with very fine sediments.
6	10 YR 4/2	Pit. Disturbed ash lens.
7	10 YR 4/2	Possible pit. Bands of brown earth with bones, charcoal, and shells.
8	10 YR 8/2-7/2	Ash, charcoal, and clay.
9	10 YR 5/1-5/2	No cultural material. Charcoal. Fine sediments Very compact.
10	10 YR 7/4	Ash and charcoal
11	10 YR 7/3	Gray compacted sediments with charcoal
12	10 YR 7/4-6/4	Ash, charcoal, clay, ns shells
13	7.5 YR 6/4-5/4	Brown earth. Concentration of bone, charcoal, and shell.
14	7.5 YR 3/3	No rocks or cultural material. Roots, organics
15	7.5 YR 3/2	Dark brown clay. No rocks or cultural material.
16	7.5 YR 6/2-5/2	Gray sediments with eroded shells, no rocks.
H1	10 YR 4/2-4/3	Post hole
H2	10 YR 6/2-5/2	Post hole
H3	10 YR 6/2-6/3	Disturbance
H4	10 YR 6/2	Post hole
H5	10 YR 6/2-6/3	Post hole
H6	10 YR 5/2	Post hole
H7	10 YR 6/2-5/2	Post hole
H8	10 YR 6/2-6/3	Post hole
H9	10 YR 6/2-6/3	Post hole
H10	10 YR 6/3	Disturbance
H11	10 YR 5/3	Post hole
H12	10 YR 6/3	Post hole
H14	10 YR 7/3	Disturbance. Mixed sediments, very heterogeneous
H15	10 YR 5/3	Disturbance
H16	10 YR 6/2-5/2	Disturbance
H17	10 YR 5/2-4/2	Disturbance
H18	10 YR 6/2-5/2	Disturbance
H19	10 YR 4/2	Disturbance
H20	2.5 YR 6/3	Very compact earth
I-IX	7.5 YR 7/2	Ash floor
C	10 YR 7/2-6/2-5/2	Disturbed ash

* Tabulated by Diana Carvajal

Table 28c. Description of Lower Zone Sediments from TP1, Cueva de Los Vampiros (Cont.), All Profiles (Refer to Figure 59a, b).

Stratigraphic Unit	Munsell Color	Cultural Association	Description
1	7.5 YR 3/2 Dark Brown	Sterile	Compacted (cemented), dark clayey rubble with numerous rounded, large stones and pebbles. Rocks are whitish and are not roof fall. This deposit appears to have penetrated the old sediments.
2	10 YR 4/4 Dark Yellowish Brown	Preceramic	Soft, light brown sandy loam with pebbles and hardly no roof fall fragments. Color not uniform but texture is more or less the same throughout. To the north, it is very thin and discontinuous. It appears to have been washed out by the above rubble layer. Color is slightly mixed with layer 3.
3	10YR 5/4-6/4 Yellowish Brown	Sterile	Olive golden, loose, sandy with rounded pebbles. Does not extend across profile, small pockets under Unit 2. Artifacts were found just above, at the interface between with Units 2.
4	7.5 YR 4/3 Brown 10 YR 6/4 Light Yellowish Brown	Sterile	Light Purple Brown. Sandy loam with rounded pebbles and platy, lighter colored laminas composed of an indurated conglomerate of and rounded pebbles.
5	5 YR 5/3 Reddish Brown 7.5 YR 6/3 Light Brown	Sterile	Light purple sand. Loose sandy deposit containing visible quartz particles. This sand is found in the space between tightly packed concretions of various sizes composed of cemented sand, pebbles, and rocks.
6	10 YR 5/4 Yellowish Brown	Preceramic	Pocket of yellow sediments in Krotovina (kv).
7	7.5 YR 3/4 Dark Brown	Preceramic	Hard, indurated top section of Unit 2. Mottled with charcoal and ash from overlying occupations. It is probably an anthropogenic feature (chemical, physical, i.e., trampling, fish processing). Post holes are visible.
8	7.5 YR 4/4 Brown	Preceramic	Lighter colored section of Unit 2.
9	10 YR 7/3 Very Pale Brown	Preceramic	All of SE corner is mixed with ash giving brown loam a floury texture. Small ash pockets are visible throughout.
10	5 YR 4/2 Dark Reddish Gray	Preceramic	Loose darker soil with many small rootlets coming out of wall. Insect holes (pupae) are also visible (nest?). Sandier with many pebbles and small hardened dirt concretions.
11	7.5 YR 4/4 Brown	Sterile	Platy deposit south of large rock. Same as Unit 4 without the small pebbles.

Table 28c. (Cont.), All Profiles (Refer to Figure 59).

Stratigraphic Unit	Munsell Color	Cultural Association	Description
12	7.5 YR 3/2 top Drk Brown 5 YR 3/3 bottom Drk Reddish Brown	Sterile	Loose krotovina fill.
13	7.5 YR 6/3 Light Brown	Sterile	Cemented floor. Made of small rounded pebbles and sand.
14	5 YR 4/2 Drk Reddish Gray	Sterile	Sandy deposit with small rocks.
15	5 YR 5/2 Reddish Gray	Sterile	Sandy deposit with small rocks.
16	5 YR 5/3 Reddish Brown	Sterile	Sandy deposit with small rocks.
17	7.5 YR 5/3 Brown	Preceramic	Possibly another insect nest (?). Visible pupas, loose sandy loam with many small pebbles and charcoal.
18	7.5 YR 3/3 Drk Brown	Preceramic?	Loose krotovina fill (layered horizontally). Very fine sandy deposits. Note: This fill in not composed of the overlying ashy Ceramic-age deposits. This supports the idea that the top of units 1 and 2 were eroded/deflated.

Table 29. Geo-chemical Analysis of Sediments from Unit 2, TP1, Cueva de Los Vampiros.

% Sand	% Silt	% Clay	% Organics	pH	Phosphorous Ug/ml	Potassium Ug/ml	Calcium Meg/100 ml	Magnesium Meg/100 ml	Aluminum Meg/100 ml
60	28	12	1.34	6.8	210	755	0.24	1.32	0.2

Table 30. Description of Sediments from TP2, East Wall Profile (Refer to Figure 60).

Stratigraphic Unit	Munsell Color	Cultural Association	Description
1	10 YR 4/2 Dark Grayish Brown	Ceramic Period	Disturbed overburden
2	10 YR 4/2 Dark Grayish Brown	Ceramic Period	Clayey loam containing many large clam shells
3	10 YR 5/2 Grayish Brown	Ceramic Period	Intermediate zone containing very little shells
4	10 YR 6/2 Light Brownish Gray	Ceramic Period	Ashy deposit with small mussel shells
5	10 YR 6/2 Light Brownish Gray	Ceramic Period	Layer of oyster shells
6	7.5 YR 4/2 Brown	Sterile	Unconsolidated rubble composed of round boulders and fine silt
7	5 YR 3/3 Dark Reddish Brown	Sterile?	Sand and small pebbles
8	7.5 YR 3/2 Dark Brown	Preceramic	Sandy loam
9	7.5 YR 3/3 Dark Brown	Sterile	Compacted deposit of large boulders interspaced with sand. Water laid

Table 31. Radiocarbon Dates from Cueva de Los Vampiros.

Strat Zone	Lab No.	^{14}C B.P.	Cal B.P. (2 sigma)	$^{13}C/^{12}C$	Material	Method
UPPER ZONE						
TP1	SI-5681*	2090 ± 55	(2299-2169)	-25 o/oo	Charcoal	Conventional
TP1	SI-6257*	1665 ± 45	2030	-3.1 o/oo	Shell	Conventional
TP1	SI-5682*	2820 ± 65	(2922-2890)	-25 o/oo	Charcoal	Conventional
TP1	SI-5683*	1730 ± 60	(1689-1615)	-25 o/oo	Charcoal	Conventional
TP1	SI-6258*	2025 ± 55	2365	-4.3 o/oo	Shell	Conventional
TP1	Beta-27589*	1990 ± 90	2350	-3.4 o/oo	Shell	Conventional
TP1	SI-5680*	2210 ± 70	(2301-2159)	-25 o/oo	Charcoal	Conventional
TP1	SI-6260*	1540 ± 60	1900	-3.3 o/oo	Shell	Conventional
TP1	SI-6261*	2130 ± 60	2490	-3.1 o/oo	Shell	Conventional
TP1	SI-5684*	1855 ± 55	1818	-25 o/oo	Charcoal	Conventional
TP1	Beta-27590*	1900 ± 80	2290	-1.4 o/oo	Shell	Conventional
TP1	SI-6262*	2295 ± 55	2625	-5 o/oo	Shell	Conventional
TP1	SI-6263*	1795 ± 45	2160	-3.1 o/oo	Shell	Conventional
TP1	Beta-27588*	1620 ± 80	1980	-2.8 o/oo	Shell	Conventional
TP1	SI-5685*	2350 ± 40	(2464-2328)	-25 o/oo	Charcoal	Conventional
TP1	SI-6264*	2110 ± 50	2450	-4.6 o/oo	Shell	Conventional
TP1	SI-5687*	3100 ± 60	(3342-3273)	-25 o/oo	Charcoal	Conventional
TP1	Beta-27591*	2840 ± 70		-3.1 o/oo	Shell	Conventional
TP1	SI-5688*	1875 ± 45	1822	-25 o/oo	Charcoal	Conventional
TP1	SI-6265*	2140 ± 75	2500	-3.1 o/oo	Shell	Conventional
TP1	Beta-5870*	3800 ± 120	(4219-4152)	-25 o/oo	Charcoal	Conventional
TP1	Beta-27592*	2540 ± 90		-3.4 o/oo	Shell	Conventional
TP1	SI-5686*	1265 ± 75	(1229-1180)	-25 o/oo	Charcoal	Conventional
TP1	SI-6259*	1675 ± 40			Shell	Conventional
TP2	SI-6266*	1460 ± 65	1820	-3.1 o/oo	Shell	Conventional
TP2	SI-6266A*	2255 ± 55	2610	-3.1 o/oo	Shell	Conventional
LOWER ZONE						
TP1	Beta-5101*	8560 ± 160	(10,146-9146)		Charcoal	Conventional
TP1	Beta-166504	7690 ± 40	(8550-8400)	-24.9 o/oo	Charcoal	AMS
TP1	Beta-165620	8680 ± 40	(9730-9540)	-25.6 o/oo	Charcoal	AMS
TP1	Beta-166505	8970 ± 40	(10,210-10,130) (10,060-9950)	-17.4 o/oo	Charcoal	AMS
TP1	Beta-166506	9100 ± 40	(10,260-10,200)	-24.4 o/oo	Charcoal	AMS
TP1	Beta-167520	11,550 ± 140	(14,000-13,910) (13,900-13,150)	-18.3 o/oo	Bulk Soil Organics	AMS
TP1	Beta-166594	15,190 ± 60	(18,580-17,770)	-17.4 o/oo	Bulk Soil Organics	AMS

* Cooke 2002, pers. comm. (Pre-2002 dates from the Upper Zone are in approximate relative vertical position)

Table 32. Technological Attributes and Metric Data of Bifaces from Cueva de Los Vampiros, Aguadulce, and Corona Rockshelters.

Site	Figure No.	Cat. No	Integrity	Length	Width	Thickness	FLA	FWA	FLB	FWB	PFR
Vampiros	62e	VP163, 166A	DF	25.00	19.30	4.90	NA	NA	NA	NA	NA
Vampiros	62f	VP170A	MDP	40.40	45.43	6.80	5.10-+	18.85	NA	NA	Yes
Vampiros	62g	VP150A	DP	28.30	30.45	5.20	NA	NA	NA	NA	NA
Corona	65a	CL2 54 1	DP	17.72	25.75	4.45	NA	NA	NA	NA	NA
Aguadulce	65b	AG13 1346b 1	DP	38.06	37.30	5.05	NA	NA	NA	NA	NA

Table 32. Continued.

Figure No.	BC	BW	MBT	BLG	Nipple	Raw Mat
62e	NA	NA	NA	NA	NA	Banded Pink-White Chalcedony
62f	NA	NA	NA	No	NA	Yellow Jasper
62g	NA	NA	NA	No	NA	Red Jasper
65a	NA	NA	NA	No	NA	Red Jasper
65b	NA	NA	NA	No	NA	Red Jasper

Table 33. Technological Attributes and Metric Data of Non-Bifacial Artifacts from Vampiros.

Site	Figure No.	Cat. No	Length/ Height	Width	Thickness	Raw Mat
Vampiros	62a	VP132	31.27	11.68	9.44	Red Jasper
Vampiros	62d	VP17	41.35	43.50	10.06	Lustrous Orange-Brown Jasper
Vampiros	62o	VP169A	53.10	44.05	16.60	Banded Olive-Red Jasper
Vampiros	62p	VP172A	48.85	40.40	10.60	Red Jasper with Olive Brown Swirls
Vampiros	62q	VP161, 162A	41.31	28.40	12.55	Red Jasper
Vampiros	62r	VP174A	58.25	31.77	13.80	Coarse-Grained Red-Yellow Jasper
Vampiros	62s	VP171A	46.45	36.47	12.55	Mottled Red-Green Jasper
Vampiros	62t	VP85	55.60	31.26	8.10	Orange-Brown Jasper
Vampiros	62u	VP173A	74.60	33.14	14.20	Light Yellow-Green Jasper
Vampiros	62v	167A	31.05	23.30	11.00	Red Jasper (Very Patinated)

Table 34. Total Number of South American FPPs Tabulated from the Available Literature.

Country	Site	n	References
Colombia	Bahia Gloria	1	Correal Urrego 1983
Colombia	Manizales	1	Robledo 1954-55; Reichel-Dolmatoff 1965
Ecuador	El Inga (including Bonifaz collection)	47	Carluci 1963; Bell 1965, 2000; Mayer-Oakes 1986a
Ecuador	San Juan	6	Mayer-Oakes 1986a; Pearson 2000, personal notes
Ecuador	San Cayetano	5	Carluci 1963; Pearson 2000, personal notes
Ecuador	La Concha	1	Pearson 2000, personal notes
Peru	Ayacucho Valley	3?	MacNeish et al. 1980a
Peru	Piura-Alta	1	Chauchat and Quiñones 1979
Peru	La Cumbre	1	Ossa 1976
Peru	Q. Santa Maria	10	Briceño 1997, 1999
Chile	Fell's Cave	24	Emperaire and Laming-Emperaire 1963; Molina 1967; Bird 1988
Chile	Pali Aike	1	Bird 1988
Chile	Tagua Tagua	3	Nunez et al. 1994
Chile	Tres Arroyos	2	Jackson 1987
Chile	Cueva del Medio	2	Nami 1987a, b
Argentina	Cerro la China 1, 2	4	Politis 1991; Flegenheimer 1980
Argentina	Cerro el Sombrero (includes preforms)	109	Madrazo 1972; Flegenheimer 1999
Argentina	Sauce Chico	1	Politis 1991
Argentina	El Ceibo	1	Politis 1991
Argentina	Lobos	1	Eugenio 1983; Politis 1991
Argentina	San Cayetano	1	Politis 1991
Argentina	Piedra Museo	2	Miotti 1995
Argentina	Los Toldos	2	Bird 1969
Argentina	Abrigo Los Pinos	1	Mazzanti 1997
Argentina	Paso Otero 5	2	Martínez 2001, 2002 pers. comm.
Argentina	Collipili	1	Nami 1997
Argentina	Rio Tercero	2	Schobinger 1973
Argentina	La Crucesita	1	Schobinger 1973
Argentina	Rio Chico	1	Nami 1994, 1995
Uruguay	Alegre	2	Politis 1991
Uruguay	Rio Negro	56	Bosh et al. 1980; Suarez 2000
Uruguay	Las Veras	3	Bosh et al. 1980
Uruguay	Tacuarembo	2	Bosh et al. 1980
Uruguay	Rio Yi	1	Bosh et al. 1980
Uruguay	Canelones	2	Bosh et al. 1980
Uruguay	Baigorria	1	Bosh et al. 1980
Uruguay	Rincon del Bonete	2	Schobinger 1973; Bosh et al. 1980
Uruguay	Cerro Largo	1	Bosh et al. 1980
Uruguay	Valizas	3	Schobinger 1973; Bosh et al. 1980
Uruguay	Arroyo Pintos	1	Schobinger 1973
Uruguay	Fortaleza Sta. Teresa	2	Schobinger 1973
Uruguay	Los Pinos	2	Suarez 2001
Uruguay	Paso del Puerto	8	Nami 2001a
Uruguay	C. de los Burros	3	Nami 2001b
Venezuela	La Hundicion	2	Jaimes 1999
Venezuela	Los Planes	1	Jaimes 1999
Guyana	Cuyuni	1	Evans and Meggers 1960; Williams 1998
Surinam	Sipaliwini	1	Versteeg 1998
Brazil	Rio Claro	2	da Conceiçao 1986
Brazil	Rio Grde do Sul	1	Politis 1991
Brazil	Itapiranga	1	Schobinger 1973
TOTAL		335	

Table 35. Occurrence of Fluting on FPPs (Relative Percentage and Presence/Absence).

Fluted Faces	Central America	Northern South America	South America
0	0, (0.0%)	2, (18.18%)	59, (51.30%)
1	8, (66.66%)	4, (36.36%)	39, (33.91%)
2	4, (33.33%)	5, (45.45%)	17, (14.78%)
P/A	100%	81.81%	48.69%
Total n	12	11	115

Table 36. General Technological and Morphological Differences Between Lower Central American Lanceolate and Stemmed Fluted Points.

Variable	Fishtail	Lanceolate
Blank	Thin Flake	Thick Flake
Flaking Characteristics	Overlapping Transverse	Overshooting, Alternating
Reduction Pattern	Minimal, Bimarginal	Multi-Stage, Invasive
Cross Section	Flat	Bi-convex to Flattened
Blade Width	Larger	Narrower
Haft Width	Narrower	Larger
Tip Angle	Larger	Smaller
Pseudo-Fluting and Remnant of Flake Blank	Common	Rare

Table 37. Metric Data of Central and South American Fluted Points (Lanceolate, Fishtail, Restrepo).

Cat./Fig. No.	Country	Type	Site	Integrity	Length	Width	Thick	Min B. Width	Flute	Pseudo	References
9	Mexico	L	Los Grifos	C	42	22	5.5	20	2	N	García-Bárcena 1979
10(a)	Mexico	F	Los Grifos	C	70	35	8	19	1	Y	Santamaria 1981
10(b)	Mexico	F	Los Grifos	MDP	49	40	6	NA	?	Y	García-Bárcena 1979
1	Belize	F	Lamanai	C	90	51.77	6.85	20.3	2	Y	Pearson and Bostrom 1998
2	Belize	L	Ladyville	C	91.6	35.9	8.3	25	2	N	Hester at al. 1980a, b
15(2)	Belize	F	Site 100	C	73	47		19	1	?	MacNeish et al. 1980b
1	Guatemala	L	San Rafael	C	57	27	6.59	19.7	1	N	Coe 1960
10(a)	Guatemala	L?	Los Tapiales	BP	23	33	8	23	1	?	Gruhn and Bryan 1977
3	Guatemala	L	Chajbal	C	81	35		27	?	?	Brown 1980
88	Costa Rica	L	Hartman	C	58	32	5	22	1	Y	Swauger and Mayer-Oakes 1952
11-10(a)	Costa Rica	L	Arenal	C	80	32	8	23	2	Y	Sheets and McKee 1994
9-12-5-5	Costa Rica	L	Guard	BP	40.83	27.21	6.55	20.45	1	N	Personal Notes
2(e)	Costa Rica	L	Guard	C	63	27		20	1	N	Snarskis 1979
2	Costa Rica	L	Guard	C	64	25	6.2	19	2	N	Snarskis 1976
2(f)	Costa Rica	F	Guard	C	53	37		24	1	?	Snarskis 1979
3(b)	Costa Rica	L	Guard	MDP	81	38		25	1	?	Snarskis 1979
6(b)	Costa Rica	F	Guard	BP	13	22		17	1	?	Ranere and Cooke 1991
6(a)	Costa Rica	L	Guard	C	74	32		23	1	?	Ranere and Cooke 1991
4(3)	Colombia	R	Medellin	C	113	36	7	13	1	N	Ardila Calderon 1991
4(4)	Colombia	R	Restrepo	C	91	36	7	15	1	N	Ardila Calderon 1991

Table 37. Continued.

Cat./Fig. No.	Country	Type	Site	Integrity	Length	Width	Thick	Min B. Width	Flute	Pseudo	References
4(2)	Colombia	R	Cueva Murcielagos	C	51	34.6	7.5	14	2	N	Correal Urrego 1983
4(1)	Colombia	F	Bahia Gloria	MDP	58	40	6	NA	1	N	Correal Urrego 1983
6(15)	Colombia	F	Manizales	C	48	28		17	0	?	Ardila Calderon 1991
9	Colombia	R	Las Piletas	C	77	31		13	1?	?	Correal Urrego 1993
3(1)	Venezuela	F	Giosne Los Planes	C	51.5	21	8.3	18	2	Y	Jaimes 1999
7(1)	Venezuela	L	Sibara	C	65	33.7	7.5	22.8	2	N	Jaimes 1999
7(2)	Venezuela	L	Sibara	C	52.3	27.2	7	20.9	2	N	Jaimes 1999
7(3)	Venezuela	L	Sibara	MDP	42.4	26.5	7.4	NA	2	N	Jaimes 1999
6(3)	Venezuela	F	La Hundicion	BP	16.7	24	5.5	21.5	2	N	Jaimes 1999
6(4)	Venezuela	F	La Hundicion	C	27.6	28	5	17	2	?	Jaimes 1999
6(4)	Venezuela	F	Pedegral	C	46	29		20	?	?	Ardila Calderon 1991
4(a)	Guyana	F	Cuyuni	C	110	44	6	19	2	?	Williams 1998
2	Surinam	F	Sipaliwi	C	46	33		18	0	N	Versteeg 1998
34	Ecuador	F	El Inga	MBP	35	22	5	16.4	1	Y	Mayer-Oakes 1986a
35	Ecuador	F	El Inga	MBP	29	20	5	14.8	2	?	Mayer-Oakes 1986a
36	Ecuador	F	El Inga	MBP	36.5	27.4	6	20.9	1	Y	Mayer-Oakes 1986a
37	Ecuador	F	El Inga	MBP	50	40	5	19.6	1	N	Mayer-Oakes 1986a
38	Ecuador	F	El Inga	MBP	35	28	5	15.1	0	Y	Mayer-Oakes 1986a
39	Ecuador	F	El Inga	MBP	31	27.5	4.3	15.1	0	Y	Mayer-Oakes 1986a
40	Ecuador	F	El Inga	MBP	27.5	20.7	4.7	13.6	1	Y	Mayer-Oakes 1986a
41	Ecuador	F	El Inga	MBP	25.7	30.25	5.5	14.9	2	N	Mayer-Oakes 1986a
42	Ecuador	F	El Inga	BP	24.5	20.6	4.65	14.2	1	Y	Mayer-Oakes 1986a
43	Ecuador	F	El Inga	MBP	24.6	28.8	5.1	16.7	1	N	Mayer-Oakes 1986a
44	Ecuador	F	El Inga	BP	22.4	19.8	5.85	15.85	1	Y	Mayer-Oakes 1986a
45	Ecuador	F	El Inga	BP	20.85	20	5.5	17.1	0	Y	Mayer-Oakes 1986a
46	Ecuador	F	El Inga	BP	20.4	20.1	4.55	17.2	0	Y	Mayer-Oakes 1986a
47a	Ecuador	F	El Inga	BP	18	17.7	4.4	16	1	N	Mayer-Oakes 1986a

Table 37. Continued.

Cat./Fig. No.	Country	Type	Site	Integrity	Length	Width	Thick	Min B. Width	Flute	Pseudo	References
47f	Ecuador	F	El Inga	BP	16.2	16.9	4.1	16.65	0	Y	Mayer-Oakes 1986a
47k	Ecuador	F	El Inga	BP	18.8	16	4.4	12.5	0	Y	Mayer-Oakes 1986a
48a	Ecuador	F	El Inga	BP	15.1	17.8	3.6	13.7	0	Y	Mayer-Oakes 1986a
48f	Ecuador	F	El Inga	BP	15	17.95	4.1	14.8	0	Y	Mayer-Oakes 1986a
48k	Ecuador	F	El Inga	BP	12.5	14.4	3.5	14.5	0	Y	Mayer-Oakes 1986a
22a	Ecuador	F	El Inga	C	53	25	6	14	?	Y	Bell 2000
22b	Ecuador	F	El Inga	C	43.5	20	4	13	1	Y	Bell 2000
22c	Ecuador	F	El Inga	MBP	28	23	5	16	0	Y	Bell 2000
22d	Ecuador	F	El Inga	C	55	29	7	19	1	N	Bell 2000
22e	Ecuador	F	El Inga	MBP	38	36	6	17	2	N	Bell 2000
23a	Ecuador	F	El Inga	MBP		33	6	17	1	Y	Bell 2000
23b	Ecuador	F	El Inga	MBP		33	8	21	0	Y	Bell 2000
23c	Ecuador	F	El Inga	MBP		22	4	15	2	N	Bell 2000
23d	Ecuador	F	El Inga	C		19	3	13	0	Y	Bell 2000
23e	Ecuador	F	El Inga	BP		16	5	14	1	N	Bell 2000
23f	Ecuador	F	El Inga	BP		17	5	16	0	Y	Bell 2000
23g	Ecuador	F	El Inga	BP		16	5	14	0	?	Bell 2000
23h	Ecuador	F	El Inga	BP		17	6	16	?	?	Bell 2000
23i	Ecuador	F	El Inga	BP		16	5	15	0	Y	Bell 2000
23j	Ecuador	F	El Inga	BP		18	5	16	?	?	Bell 2000
23k	Ecuador	F	El Inga	BP		15	4	15	1	Y	Bell 2000
23l	Ecuador	F	El Inga	BP		16		15	1	?	Bell 2000
23m	Ecuador	F	El Inga	BP		20		20	0	?	Bell 2000
23n	Ecuador	F	El Inga	MBP		32		15	0	Y	Bell 2000
23o	Ecuador	F	El Inga	M		33			1	?	Bell 2000
23p	Ecuador	F	El Inga	MBP		19		17	0	Y	Bell 2000
ED31	Ecuador	F	San Juan	BP	24.05	23.75	5.45	18	0	Y	Personal notes
ED31	Ecuador	F	San Juan	BP	16.44	15.36	4.55	12.7	0	Y	Personal notes
ED31	Ecuador	F	San Juan	BP	23.8	18.94	4.14	13.87	0	Y	Personal notes
ED11	Ecuador	F	San Cayetano	MBP	37.3	29.58	7.22	15.05	0	Y	Personal notes

Table 37. Continued.

Cat./Fig. No.	Country	Type	Site	Integrity	Length	Width	Thick	Min B. Width	Flute	Pseudo	References
ED11	Ecuador	F	San Cayetano	C	34.03	21.75	3.45	12.26	0	Y	Personal notes
ED11	Ecuador	F	San Cayetano	BP	23.05	19	4.75	15.8	2	?	Personal notes
ED70	Ecuador	F	La Concha	MBP	24	35.85	5.6	18.43	1	N	Personal notes
3(a)	Ecuador	F	El Inga	MBP	22	24	5	17.2	1	?	Carluci 1963
3(b)	Ecuador	F	El Inga	BP		16	5	16	1	?	Carluci 1963
3(c)	Ecuador	F	San Cayetano	MBP	19	21	6	21	1	?	Carluci 1963
3(d)	Ecuador	F	San Cayetano	MBP					1	?	Carluci 1963
6	Ecuador	L	San Juan	MDP	43	28	8		1	N	Carluci 1963
1	Peru	F	Piura-Alta	C	60	32	6	13	0	N	Chauchat and Quiñones 1979
37	Peru	F	La Cumbre	MBP		29.9	5.9	17	1	N	Ossa 1976
41.1 1980a	Chile	F	Fell's Cave	MBP				21			Bird 1988
41.1 1980b	Chile	F	Fell's Cave	MBP				13			Bird 1988
41.1 1980c	Chile	F	Fell's Cave	MBP				17			Bird 1988
41.1 1980d	Chile	F	Fell's Cave	MBP				16			Bird 1988
41.1 1980e	Chile	F	Fell's Cave	BP				17			Bird 1988
41.1 1980f	Chile	F	Fell's Cave	MDP				NA			Bird 1988
41.1 1980g	Chile	F	Fell's Cave	DP							Bird 1988
41.1 1974	Chile	L	Fell's Cave	C					0	Y	Bird 1988
41.1 1979a	Chile	F	Fell's Cave	C	68	34.5	5.5	17.5			Politis 1991

Table 37. Continued.

Cat./Fig. No.	Country	Type	Site	Integrity	Length	Width	Thick	Min B. Width	Flute	Pseudo	References
41.1 1979b	Chile	F	Fell's Cave	C	57	30	7.3	16			Politis 1991
41.1 1979c	Chile	F	Fell's Cave	C	54	24	5	12			Politis 1991
41.1 1979d	Chile	F	Fell's Cave	C	47	26	4.5	14			Politis 1991
41.1 1979e	Chile	F	Fell's Cave	C	42	30	5.3	17			Politis 1991
41.1 1979f	Chile	F	Fell's Cave	C	36	20.5	5.3	12.5		Y	Politis 1991
41.1 1979g	Chile	F	Fell's Cave	C							Bird 1988
41.2 8303	Chile	F	Fell's Cave	C	50	31	8	17.3			Politis 1991
3564	Chile	F	Fell's Cave	C	52	26	6		0	N	Emperaire and Laming-Emperaire 1963
3551	Chile	F	Fell's Cave	C	56	30	5		0	Y	Emperaire and Laming-Emperaire 1963
3552	Chile	F	Fell's Cave	MBP		34	6		2	N	Emperaire and Laming-Emperaire 1963
3553	Chile	F	Fell's Cave	BP		25	5		1	?	Emperaire and Laming-Emperaire 1963
1341	Chile	F	Pali Aike	BP				15	0	?	Bird 1969
5(a)	Chile	F	Tagua Tagua	C	40				1	?	Nuñez et al. 1994
5(b)	Chile	F	Tagua Tagua	C	37				0	?	Nuñez et al. 1994
1(2)	Chile	F	Tres Arroyos	BP	30	22	8		0	?	Jackson 1987
1(3)	Chile	F	Tres Arroyos	DP	21	28	5		0	?	Jackson 1987

Table 37. Continued.

Cat./Fig. No.	Country	Type	Site	Integrity	Length	Width	Thick	Min B. Width	Flute	Pseudo	References
1	Chile	L	Pto. Saavedra	MBP	55	28	7.2	28	2	N	Jackson 1995
1(a)	Chile	L	Nochaco	C	56	22	5	22	1	N	Seguels y Campana 1975
1(b)	Chile	L	Nochaco	C	40	16	5.5	16	1	N	Seguels y Campana 1975
1(d)	Chile	L	Pilmaiquen	C	60	25	6	25	1	N	Seguels y Campana 1975
25/25 a-c	Argentina	F	Cueva del Medio	C	40.4	17.5	8	11	1	N	Politis 1991
26/29a	Argentina	F	Cueva del Medio	C	48	27	6	19	0	Y	Politis 1991
35-2-88	Argentina	F	Cerro la China 2	C	41	22	6	13	1	Y	Politis 1991
455	Argentina	F	Cerro la China 1	C	42	23	6	13	0	?	Politis 1991
35-1608	Argentina	F	Cerro la China 1	MBP					1	Y	Flegenheimer 1980
5	Argentina	F	Cerro el Sombrero	BP	24	23	7		2	?	Flegenheimer 1980
6	Argentina	F	Cerro el Sombrero	BP	25	24	6		1	?	Flegenheimer 1980
7	Argentina	F	Cerro el Sombrero	BP	17	18	6	17	1	?	Flegenheimer 1980
8	Argentina	F	Cerro el Sombrero	BP	20	17	7	16	0	?	Flegenheimer 1980
9	Argentina	F	Cerro el Sombrero	BP	16	16	7	14	0	?	Flegenheimer 1980
10	Argentina	F	Cerro el Sombrero	BP	19	19	6		0	?	Flegenheimer 1980
68-247	Argentina	F	Cerro el Sombrero	C	31	19	5.5		0	?	Madrazo 1972
68-249	Argentina	F	Cerro el Sombrero	BP		17	5.5		1	?	Madrazo 1972
68-225	Argentina	F	Cerro el Sombrero	BP	14	19	5		0	?	Madrazo 1972
68-240	Argentina	F	Cerro el Sombrero	BP	17	19	5		0	?	Madrazo 1972
S12/105/1	Argentina	F	Cerro el Sombrero	C	94	48	8	20	2	?	Flegenheimer 1989
S12/204/2	Argentina	F	Cerro el Sombrero	C				14	?	Y	Flegenheimer 1989
Table 2	Argentina	F	Sauce Chico	C	48	27	7	17.5	0	?	Politis 1991

Table 37. Continued.

Cat./Fig. No.	Country	Type	Site	Integrity	Length	Width	Thick	Min B. Width	Flute	Pseudo	References
Table 2	Argentina	F	Lobos	C	51.5	28	5	13	0	Y	Politis 1991 Eugenio 1983
Table 2	Argentina	F	San Cayetano	C	38.5	23	6	16	0	N	Politis 1991
1(a)	Argentina	F	Piedra Museo	MBP	56	55	5	24	2	?	Miotti 1995
8(7)	Argentina	F	Paso Otero 5	MBP	46.3	29.5	6.7		NA	Y	Martinez 1999, 2001
6(c)	Argentina	F	Neuquen	BP				16	2	?	Nami 1997
6	Argentina	F	Rio Tercero	C	37	24	6	14	?	?	Schobinger 1973
2057	Argentina	F	La Crucesita	C	78	40	5	14	0	N	Schobinger 1973
Table 2	Uruguay	F		C		38.5	7.6	18.5			Politis 1991
Table 2	Uruguay	F	Alegre	C	46	25	4	13	0	?	Politis 1991
Table 2	Uruguay	F	Alegre	C	35	21	5	14	1	?	Politis 1991
1	Uruguay	F	Rio Negro	C	71.5	42	5.5	23.5		Y	Bosh et al. 1980
2	Uruguay	F	Rio Negro	C	61	32	6.5	21.1		?	Bosh et al. 1980
3	Uruguay	F	Rio Negro	MBP	72	34	7.5	18.4	NA	?	Bosh et al. 1980
4	Uruguay	F	Rio Negro	C	55	22	5	14	1	?	Bosh et al. 1980
5	Uruguay	F	Rio Negro	C	39.5	21	5.5	16.3	0	?	Bosh et al. 1980
6	Uruguay	F	Rio Negro	C	31	29	6	14	0	?	Bosh et al. 1980
7	Uruguay	F	Rio Negro	C	32	22	5	14.5	2	?	Bosh et al. 1980
8	Uruguay	F	Las Veras	C	53.5	30	6.5	19	2	?	Bosh et al. 1980
9	Uruguay	F	Las Veras	C	39.9	23	7	19	2	?	Bosh et al. 1980
10	Uruguay	F	Las Veras	BP	20	22.5	5.5	20.8	2	?	Bosh et al. 1980
11	Uruguay	F	Tacuarembo	MBP	43.55	26	5.6	15.3	0	Y	Bosh et al. 1980
12	Uruguay	F	Rio Yi	MBP	49.8	35	5	17.2	2	?	Bosh et al. 1980
13	Uruguay	F	Rio Negro	MBP	31	29	6	15.4	1	?	Bosh et al. 1980
14	Uruguay	F	Rio Negro	C	90.65	45.6	8	19.8	1	?	Bosh et al. 1980
15	Uruguay	F	Baigorria	C	66.8	39.05	6.6	17.7	1	?	Bosh et al. 1980
16	Uruguay	F	Rincon del Bonete	C	62	31	6	17	2	Y	Bosh et al. 1980
17	Uruguay	F	Cerro Largo	C	63	26	5.5	16.5	0	Y	Bosh et al. 1980
18	Uruguay	F	Canelones	C	40	28	4.5	19.5	0	?	Bosh et al. 1980
19	Uruguay	F	Valizas	C	68	24	7	15	1	?	Bosh et al. 1980

Table 37. Continued.

Cat./Fig. No.	Country	Type	Site	Integrity	Length	Width	Thick	Min B. Width	Flute	Pseudo	References
20	Uruguay	F	Tapia	C	59	33	7.1	18.5	0	?	López et al. 2001
33	Uruguay	F	Canelones	C	49.2	37.8	6	15.7	0	Y	Bosh et al. 1980
3	Uruguay	F	Rincon del Bonete	C	35	19			0	?	Schobinger 1973
5	Uruguay	F	Valizas	C	65				0	?	Schobinger 1973
5	Uruguay	F	Valizas	C	55				0	?	Schobinger 1973
5	Uruguay	F	Arroyo Pintos	C	62	28	6	15	0	?	Schobinger 1973
4	Uruguay	F	Fortaleza Sta. Teresa	C	58	29	5.5		0	?	Schobinger 1973
4	Uruguay	F	Fortaleza Sta. Teresa	C	63	32			1	?	Schobinger 1973
1(a)	Uruguay	F	Rio Negro	C	37	20		12.5	0	?	Nami 2001
1(b)	Uruguay	F	Rio Negro	C	29	16		12.5	0	?	Nami 2001
1(a)	Uruguay	F	Los Pinos	MBP		27	6	15	?	?	Suarez 2001
1(b)	Uruguay	F	Los Pinos	MBP		31	6	16	?	?	Suarez 2001
1(b)	Uruguay	F	Rio Negro	C		27	6	16	1	?	Suarez 2000
1(c)	Uruguay	F	Rio Negro	C		28	6	16	2	Y	Suarez 2000
37	Brazil	F	Rio Grde do Sul	C	46	22	7	12.5	0	?	Politis 1991
60-66	Brazil	F	Itapiranga	C	48	26	7		1	?	Schobinger 1973
10	Brazil	F	Rio Claro	C	69.1	25.4		13.7	0	?	da Conceiçao 1966
11	Brazil	F	Rio Claro	C	54.6	27.25		17.1	1	?	da Conceiçao 1966

Table 38. Mean Dimensions and Thickness of Major Central and South American Point Types.

Mean Dimensions	Central American Clovis-like lanceolate	Northern South American Clovis-like lanceolate	Central American Fluted Stemmed	Northern South American Fluted Stemmed	South American Fell I FPPs
Min Base/Stem Width (mm, n)	22.02 (13)	21.85 (2)	18.85 (11)	16.86 (11)	16.02 (114)
Max Blade Width (mm, n)	31.29 (13)	29.13 (3)	38.43 (16)	32.05 (12)	25.44 (125)
Max Thickness (mm, n)	6.68 (8)	7.3 (3)	6.11 (12)	6.53 (8)	5.62 (114)

Table 39. Statistically Significant Differences (Table 38) Between Mean Dimensions and Thickness of Major Central and South American Point Types (.05 Level).

ANOVA Max Blade Width of Central American FPPs Versus Northern South America FPPs

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	279.0612	1	279.0612	4.6964	0.0396
Within Groups	1544.9355	26	59.4206		

Eta = .3911 Eta Squared = .1530

ANOVA Max Thick of Northern South American FPPs Versus South America FPPs

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	6.2173	1	6.2173	5.2552	0.0236
Within Groups	141.9680	120	1.1831		

Eta = .2048 Eta Squared = .0420

Table 39. (Cont.)

ANOVA Max Blade Width of Northern South American FPPs Versus South American FPPs

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	478.2301	1	478.2301	8.7175	0.0037
Within Groups	7405.9426	135	54.8588		

Eta = .2463 Eta Squared = .0607

Table 40. Mean Dimensions and Thickness of Central and Northern South American Point Types.

Mean Dimensions	Central American and Northern South American Clovis-like Lanceolate	Central American and Northern South American Fluted Stemmed	Restrepo
Min Base/Stem Width (mm, n)	22.00 (15)	18.77 (18)	13.75 (4)
Max Blade Width (mm, n)	30.89 (16)	35.91 (24)	34.4 (4)
Max Thickness (mm, n)	6.85 (11)	6.13 (17)	7.17 (3)

Table 41. Statistically Significant Differences (Table 40) Between Mean Dimensions and Thickness of Central and Northern South American Point Types (.05 Level).

ANOVA Max Base Width of C. A and N. S. A. Lanceolate Versus Restrepo Points

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	214.9342	1	214.9342	38.4964	0.0000
Within Groups	94.9150	17	5.5832		

Eta = .8329 Eta Squared = .6937

Table 41. (Cont).

ANOVA Max Base Width of C. A and N. S. A. Fluted Stemmed Versus Restrepo Points

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	82.5105	1	82.5105	25.8017	0.0001
Within Groups	63.9574	20	3.1979		

Eta = .7506 Eta Squared = .5633

ANOVA Max Base Width of C. A and N. S. A. Fluted Stemmed Versus Lanceolate Points

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	85.3014	1	85.3014	17.2413	0.0002
Within Groups	153.3724	31	4.9475		

Eta = .5978 Eta Squared = .3574

ANOVA Max Width of C. A and N. S. A. Fluted Stemmed Versus Lanceolate Points

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	242.2251	1	242.2251	4.2486	0.0462
Within Groups	2166.4901	38	57.0129		

Eta = .3171 Eta Squared = .1006

ANOVA Max Width of C. A and N. S. A. Lanceolate Versus Restrepo Points

Source	Sum of Squares	d.f.	Mean Square	F	Sig.
Between Groups	39.4665	1	39.4665	1.8511	.1904
Within Groups	383.7638	18	21.3202		

Eta = .3054 Eta Squared = .0933

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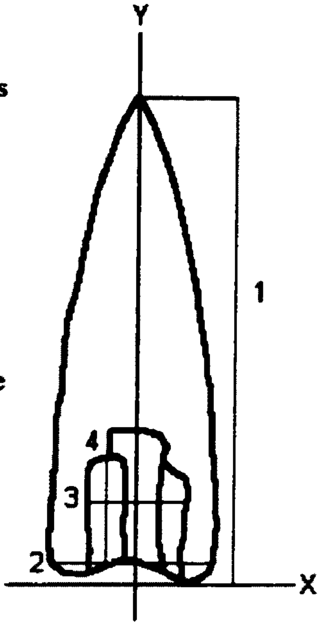
APPENDIX A

Methods
Quantitative data were measured using calipers with a degree of resolution of .00 millimeters. Hand lenses and microscopes were also used to examine flake scares, artifacts surfaces, and lateral edges for signs of abrasion and grinding.

1) Maximum Length
Based on a perpendicular Y-X axis. The Y line runs parallel and follows visible or inferred longitudinal symmetry from the tip to the base.

2) Maximum Width and Basal Width
Longest possible line running perpendicular to the Y axis. Depending on the shape of the points, this variable can often coincide with the width of the base.

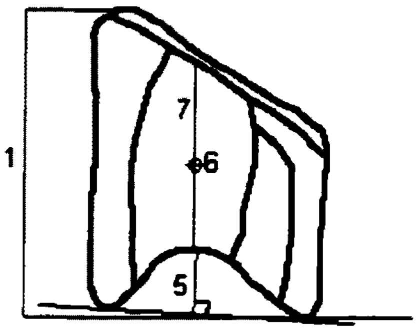
3) Total Maximum Flute Width
Longest perpendicular line to the Y axis running between the leftmost and rightmost arrises of a single or series of overlapping flutes or large basal thinning removals.



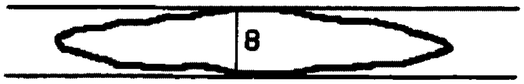
4) Maximum Flute Length
Longest parallel line to the Y axis running from the base of the point to the tip of the fluting/thinning scar.

5) Maximum Basal Concavity
To avoid subjective measurements due to inconsistencies in basal ear symmetry, this variable did not rely on the X-Y axis. Maximal concavity was derived from a perpendicular drawn from a straight line joining both ears.

6) Mid-Base Thickness
This measurement is taken midway up the fluted channel or basal thinning removals at equidistance from the lateral



7) Break Length
Following the Y axis, it is the distance between the upper arc of the basal concavity and the line of fracture.

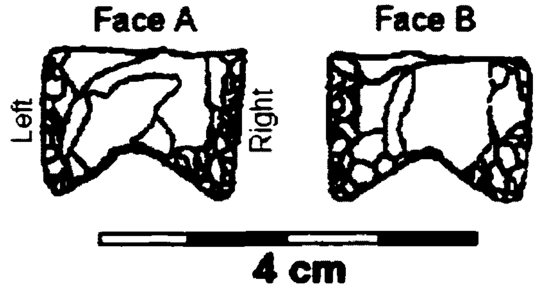


8) Maximum Thickness
Farthest, distance possible between two points perpendicular to the cross section. It is measured using the tips of the calipers.

Example and Explanation of Abbreviations
An example of the variables recorded for each fluted point and accompanying explanations is presented below.

Face A indicates the first side that was fluted. Left and Right margins are determined according to Face A (e.g., in the case of basal grinding).

Face B indicates the side with the last flute or basal thinning removal.



Abbreviations
Integrity:
F: Fragment
DP: Distal Portion
MP: Medial Portion
MDP: Medial-Distal Portion
MBP: Medial-Basal Portion
DBP: Distal Basal Portions
BP: Basal Portion
AC, C: Almost Complete to Complete

FLA, FLB: Flute Length (Side A and B)
FWA, FWB: Flute Width (Side A and B)

BLG: Basal and/or Lateral Grinding
BC: Basal Concavity
PFR: Post-Fluting Retouch
BW: Basal Width

MBT: Mid-Base Thickness
WEC: Working Edge Concavity (See Morrow 1996, 1997)

Note: A "+" sign at the end of a number indicates that the value was originally higher but it is impossible to determine by how much (e.g., broken points). The first "+" indicates that the distal portion is missing while the second "+" relates to the proximal section. Thus a broken base will have a flute which is X+mm long, while a medial section will have a flute which is X-+mm long.