Malcom Rogers: Geoarchaeologist

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Abstract

Malcolm Rogers trained in earth sciences and geology. He applied his knowledge and understanding of geology to all aspects of his archaeological research including studies of horizontal and vertical stratigraphy, descriptions of lithic material types, analysis of ceramic constituents, use of patination for relative dating, and interpretation of paleoenvironmental change. His entrenchment in "short" chronological concepts and the links he established between geology and culture history resulted in misdirection, but his descriptive legacy, pattern recognition, and many of the links he established between environment and culture were foundations for subsequent applications of cultural ecology models.

Introduction

Early in the development of their discipline, archaeologists tended to come from other fields, often bringing with them diverse methods and theory. Geoarchaeology is a subdiscipline that has evolved more recently; the term describes the integration of geology and archaeology. During the period when the bulk of Rogers' work was done, before 1945, there was a general separation between culture-historical concepts and elements of the environment. Models that embraced historical particularism saw geography and physical environment as elements exploited by cultures, but not as elements shaping or explaining cultures.

Rogers obtained his education in science at Syracuse University (1908–1914), gaining a broad training in geology, chemistry, chemical mineralogy, and assaying (Hanna 1982:165–166). With this background in geology and earth sciences, he employed geologic methodology and concepts of historical geology as tools for descriptive and deductive analysis in the development of regional culture-historical syntheses. Some of his most important geologic links that related to the paleoenvironment and chronological relationships and his links between environmental elements and cultures were flawed. His methodological and deductive use of geologic and environmental elements in building and comparing culture histories, however, set the foundation on which the next generation of archaeologists built cultural-ecological models.

While Warren (2009:203–204) implied that Elizabeth Campbell and Ernst Antevs practiced more of an early form of environmental archaeology than did Rogers, it seems that both camps integrated the geologic and environmental data into analysis to an unusually high extent. Rogers, however, formed an early premise related to a "short" chronology of approximately 4,000 years for human occupation. This colored some of his subsequent geological interpretations and forced him to deny and ignore certain aspects of the environmental data to accommodate his chronological model. Late in his career, as radiocarbon data were becoming integrated, he realized that some of his reconstructions in this regard were weak, and he used obfuscations, writing that "time epochs, climatic distinctions, and geological strata interpretations from Pluvial to recent times are not yet established with sufficient finality" (Rogers 1966:27).

Rogers did use his background in geology to integrate the natural environment and the cultural complexes he developed. At one point he stated, "if we but draw upon and correlate the findings of such sciences as geology, climatology, and botany," we can solve the mystery of early human presence in the

desert environments of today (Rogers 1933:118). His application and use of geological methods and concepts colored much of his interpretation and his culture history building.

Direct Applications of Geology

Some of Rogers' earliest works were direct applications of his geologic knowledge to the archaeological record. His mineralogical and chemical knowledge were reflected in "A Question of Scumming" (Rogers 1928), in which he explained some ceramic surface textures as chemical and not a purposefully added treatment. Later on he continued to use his knowledge of geology as applied to the mineralogical analysis of ceramics (Van Camp 1979; Waters 1982).

Another early project was Rogers' reconnaissance of the Mojave Sink region, which began as early as 1926 (Rogers 1929a:1). Much of this was a direct description of turquoise mineral resources and Native American mining. Rogers' account began with a footnote explaining that mining literature had led him to the project (Rogers 1929a:1). He then proceeded, as would a mining geologist, to describe the regional distribution of turquoise in the Mojave Desert and western Arizona, and he explained that there was prehistoric evidence for mining at nearly all the exposures. Much of the paper describes the extent and nature of prehistoric mining in the area northeast of Baker.

Rogers' labors in the Mojave Sink also delved into prehistoric occupation at Cronise Lakes (Rogers 1929a:8). While Warren (2009:203) suggested that much of this work was related to a strong influence of ethnology, Rogers was clearly trying to establish culture history. At the same time, he used his geologic skills to interpret the relationship between the ancient lake levels and cultural occupation. He noted wave-cut terraces along the northwest shore of East Cronise Lake and suggested that the inundation of this area was more recent than initial human occupation, this based on the presence of tufa deposits on ceramics (Rogers 1929a:10). Although not directly stated, his early experience at Cronise Lakes and the existence of a higher lake stand that inundated Late Prehistoric occupation and ceramics may have led Rogers to his enduring model of significant lake stands in the Mojave Desert during the "Little Pluvial" and his long struggle with chronology and environmental change.

Stratigraphy, Environment, and Time

Much of Rogers' investigations focused on the relationships between the culture-historical groups he was recognizing and both the environment and time. His early use of natural stratigraphic techniques deriving from his geologic background placed him in advance of many of his contemporaries in archaeology. His early work excavating coastal shell middens allowed him to establish chronological relationships between what evolved into his La Jolla Complex and more recent "Mission Indian" or Late Prehistoric occupation. He also used these coastal studies to look at relationships between groups and the environment and initially interpreted the presence of shell middens on elevated Pleistocene terraces as a reflection of the geologic uplift of older sites, suggesting great antiquity (Rogers 1929b:457). When he realized this antiquity was too great, Rogers used coastal subsidence to explain some of the changing relationships (Hanna 1982:214). His coastal excavation work led to his clear understanding that many of the coastal lagoons that are now silted in were once more productive sources of shellfish and a focus of coastal occupation (Rogers 1929b:457).

Most of Rogers' investigations emphasized surface survey and collection. Much of this work was in areas with limited soil accumulation and deflated soil conditions. This eventually led to his concept of "horizontal stratigraphy," "whose linear measurements extended over hundreds of square miles instead of a

few feet of vertical stratigraphy" (Rogers 1939:1). He described his horizontal stratigraphic method as "locating pure type sites and certain complementary phenomena of a physiographic nature" (Rogers 1939:1). Through this means, Rogers felt able to classify cultural sequences within multicomponent sites and develop a typological sequence.

An early example of this technique was at Lake Cahuilla, where he observed the correspondence of ancient shorelines and human occupation (Rogers 1933:121). He also saw changes in lake level as matching different occupations in time and eventually used change at Lake Cahuilla as an explanatory dynamo for Late Prehistoric population shifts in the region (Rogers 1945:194), again closely integrating geologic and environmental change with cultural change. Because of the limited time depth in Rogers' model and his lack of theoretical focus on culture change in and of itself, population migration was his tool for explaining culture change (Hanna 1982).

One of Rogers' most influential uses of his geologic knowledge and his concept of horizontal stratigraphy was in an analysis of the Lake Mojave basin and the relationship between human occupation and Pleistocene lake levels. Rogers (1939) was combating arguments by Campbell and Campbell (1937) and others (e.g., Antevs 1937) of direct associations between Pleistocene lake levels and human occupation. The full scope of the argument, politics, and geologic detail has been summarized in great detail by Warren (2004, 2005, 2009). The main point is that Rogers used his knowledge of geology to systematically and successfully attack ideas contrary to his chronological perspective.

Warren (2004:88) argued that Rogers' direct historical approach led him to his fixed "short" chronology. There can be little doubt that Rogers' (1929a) primary experience with the late prehistoric lakes in the Cronise Basin (and possibly Lake Cahuilla), along with historic floods in 1916 and 1938, suggested to him real alternatives involving a more recent past rather than Pleistocene occupation. These alternatives were more conservative at a time when the antiquity of human occupation in the New World was openly debated. Rogers' (1939) careful arguments and his background in geology allowed him to exploit weaknesses in the arguments of the Campbells and Antevs. Evidence of occupation on and not above the upper wave-cut terrace, issues with the elevation of the lake's outlet channel and occupation across it, along with brief historical fillings all helped Rogers to use his knowledge of geology to temporarily win the argument among amenable conservatives and delay further research on the subject.

Lithic Materials, Culture, and Typology

Rogers' primary goal was to establish culture history (Hanna 1982). With a nearly empty foundation in San Diego County to build upon, he selected building blocks for his culture models from his toolkit of geology along with other environmental elements and the typological patterns he saw in the archaeological record. Although perhaps unconsciously, Rogers' geologic background led him to integrate geology, ecology, and culture in his development of the La Jolla and San Dieguito concepts. While part of his distinction between these two "cultures" was typological and chronological, many of the underlying factors shaping the specifics of his model were geological, geographical, and ecological.

Figure 1 shows Rogers' initial distribution map for his Shell Midden People (later called La Jolla) and his Scraper-Maker Culture (later called San Dieguito). The essentially non-overlapping distribution of these "cultures" can be seen in part in Rogers' concept of horizontal stratigraphy, in which "pure type sites" were identified in areas of complementary physiography. Aspects of Rogers' culture construction shown in bold in Table 1 are those seen to be

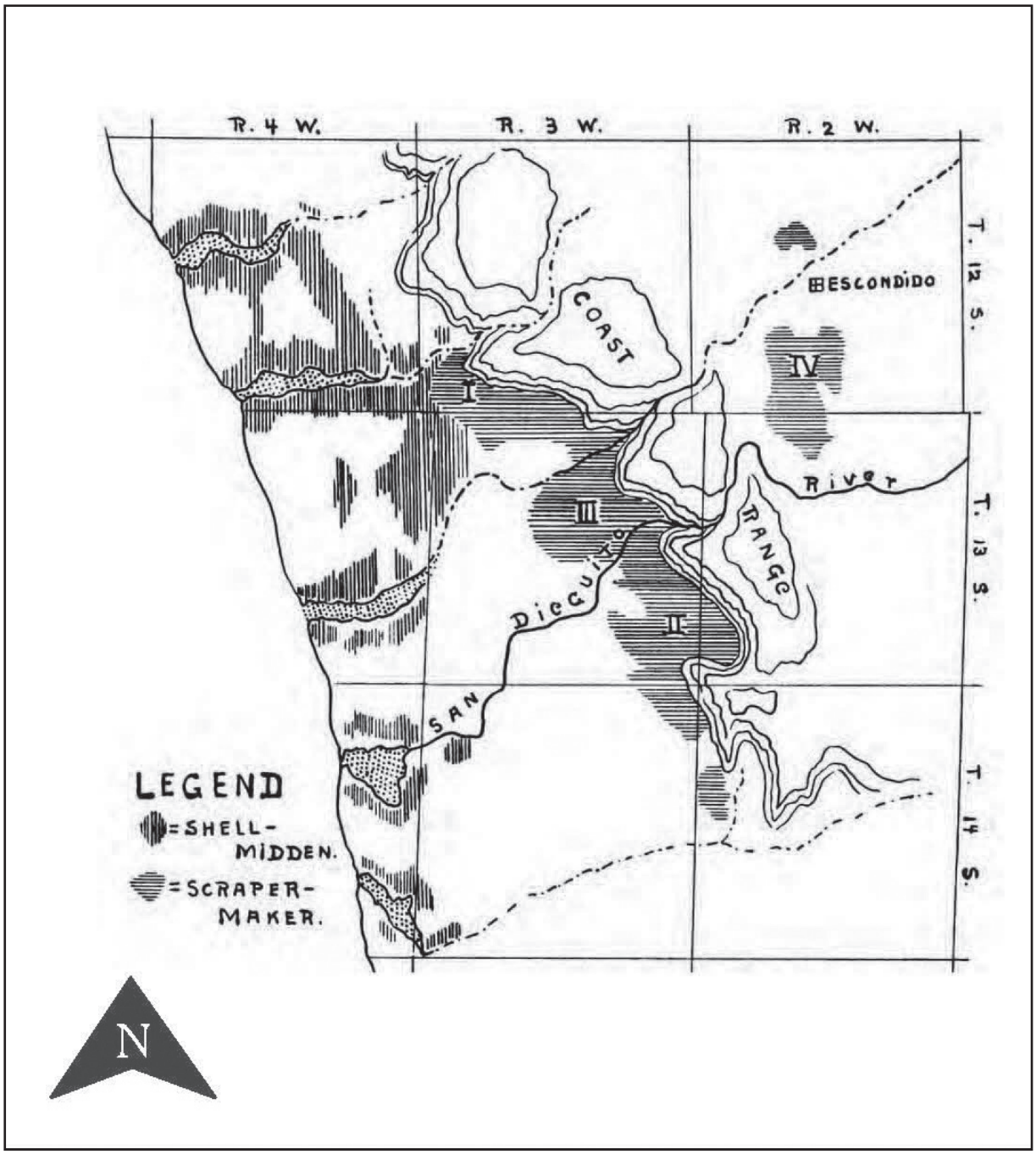

Figure 1. Rogers' initial culture zones (Rogers 1929b:455).

Table 1. Elements of the La Jolla/San Dieguito Models.

San Dieguito	La Jolla	Concept
Bedrock or Large Fragment Lithic Sources	**Well-Rounded Cobble Lithic Sources**	**Geology**
Fine-grained, Predominately Aphanitic Volanics	**Coarse-grained Quartzites and Coarse-grained Porphyritic Volcanics**	**Geology**
Excellent Concoidal Fracture	**Poor Concoidal Fracture**	**Geology**
Refined	**Primitive**	**Technological Complexity**
Later (More Evolved)	**Earlier (or Regressive)**	**Cultural Evolution**
Foothill	**Coastal**	**Geography**
Paleoarchaic	Archaic	Technology
Scrapers, **Large Bifaces**, Cresentics, No Significant Ground Stone	**Teshoa Flakes, Choppers, No Bifaces,** Manos and Metates	Typology
Hunting	**Gathering**	**Economy**
Large Mammals	**Shellfish/Small Seeds**	**Ecology**
Stratigraphically Lower	Stratigraphically Higher	Time (Post-1938)

Note: Bold text indicates that the attribute or attribute frequency is based on or affected by geology, geography, or ecology.

directly affected, at least in part, by the contrasting geologic and geographic aspects of the area in which these concepts were initially developed.

In a deconstruction of the La Jolla/San Dieguito concepts, many of the aspects that are critical to the model as an integrated unit are derived from the particular geology, geography, and ecology on which Rogers initially developed the models. This is in part why the models fell so neatly into subsequent cultural-ecological theoretical applications by the next-generation adherents of Rogers' models.

As indicated in Figure 2, Rogers' initial ideas of the distribution of these "cultures" directly correlate to contrasting geology. The largely marine sedimentary sequences of the coastal plain have significant components of well-rounded, coarse-grained quartzite and porphyritic volcanic cobbles. This region underlies Rogers' La Jolla complex. The distribution of the San Dieguito complex correlates nicely with areas underlain by fine-grained metavolcanic material from the Santiago Peak Volcanic formation. Some areas of San Dieguito occupation are underlain by granitic rocks, which largely lack lithic material for flaked stone tool manufacture, and the nearest sources of material available to these areas would be nearby fine-grained metavolcanic material. The relationship between lithic material and culture does not appear to be a random construction in Rogers' mind; he notes that "the conventional adherence to the use of specific types of stone in making implements … presents invaluable diagnostic criteria" (Rogers 1939:17).

With contrasting geologic links between "cultures" come a variety of consequences. La Jolla flaked lithic tools are described as "teshoa-flakes, and a great amount of split stone, but no chipped stone artifacts which may be recognized as finished implements, unless it be the teshoa-flakes" (Rogers 1929b:457). Well-rounded cobbles as a core type have technological implications for limiting and shaping the products produced from these cores. Even Rogers noted in relation to the Colorado Desert that "the potentialities

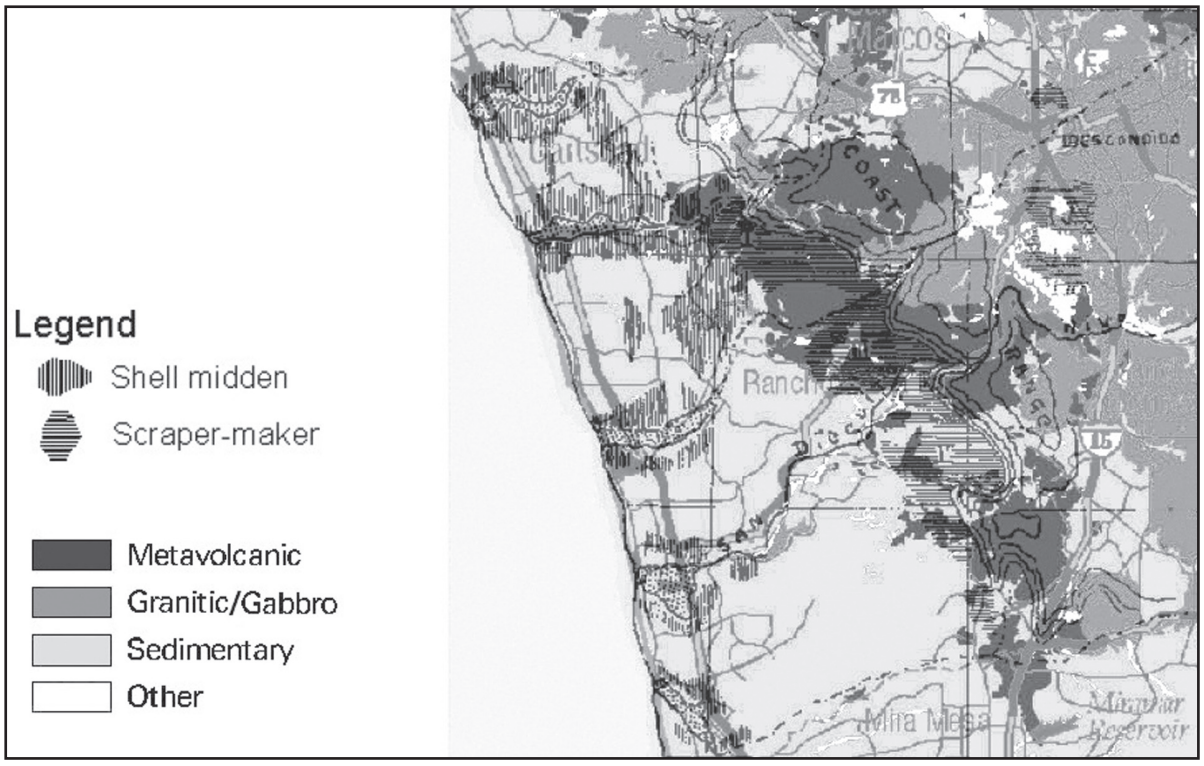

Figure 2. Correspondence between geology and culture (Rogers 1929b:455).

of river gravels as a source material … influence to a certain degree the purposes to which they were put" (Rogers 1939:16). He described the lithics of the San Diego coastal plain as dominated by volcanic porphyritic cobbles (Rogers 1929b:460). "These porphyries are short-grained and not amenable to long flaking. As they also lack the conchoidal fracture, it is practically impossible to employ a pressure-flaking technique" (Rogers 1929b:460).

It is important to note that Rogers' original published descriptions of the lithic materials used by the San Dieguito culture included both coastal cobbles and Santiago Peak volcanics (Rogers 1929b:460–461). In addition to the cobble material, Rogers noted:

> where the San Dieguito River cuts through this range several large bodies of latite and felsite are exposed, and it was from such material that the finest chipped work was fashioned. These rocks are fine-grained and uniform in texture, have a conchoidal fracture, and flake well [Rogers 1929b:461].

The application of his model to the tool typology that he established basically precluded the use of coarse-textured cobbles for the manufacture of two (bifaces and crescentics) out of the three elements of his typological triumvirate for the San Dieguito. This, followed by Rogers' use of the Harris site in Santiago Peak Volcanic terrain as a "type site," allowed most subsequent elaborations of La Jolla and San Dieguito models in San Diego County (excluding Rogers' Malpais or San Dieguito I concepts in the deserts) to virtually ignore the possible use of multiple lithic materials and essentially equate Santiago Peak Volcanic material with San Dieguito and Eocene-derived quartzite and porphyritic cobbles with La Jolla.

Rogers later cemented this geologic link:

> The San Dieguito trait of stubbornly adhering to the lithic material of their choice for artifact manufacture, no matter how intractable it proved, is again evidenced in the Southwestern Aspect. In this instance, however, they found in the felsite dikes of the Coastal Range an excellent medium [Rogers 1966:87].

The next generation of archaeologists elaborated on these concepts. James R. Moriarty (1987:51) stated that "mineral selectivity reflected in the artifact assemblage of the San Dieguito Complex, notably the preference for a local felsite, exhibited good fracture characteristics." In pointing out the difference between San Dieguito and La Jolla, he also stated that materials "change from felsite and more chert-like minerals (i.e., minerals with a distinctive and controllable conchoidal fracture) to the more local [meaning coastal cobble] rhyodacites, meta-quartzites, and diabases" with presumably poor conchoidal fracture (Moriarty 1966:21). Julian Hayden (1987:43) seemed to sum up the link by stating that "San Dieguito occupations may be said to be confined essentially to volcanic regions, since igneous rocks and their metamorphics provided the tool material of choice wherever found."

In one sense, part of the link between volcanics and large biface production is real, due to the need for large cores (Pigniolo 1996). At the same time, the artificiality of the complete, direct equation of contrasting lithic materials with culture groups and its implications have created a chain reaction affecting other critical aspects of the model. Their interrelationship and the feedback process have led to the enduring integrity of the La Jolla/San Dieguito model.

As previously stated, the core type/size and lithic qualities of the cobble material largely precluded the manufacture of large bifaces and crescentics, allowing these artifact types to be consistently linked with the San Dieguito even if found in a coastal context. Split cobble tools and large cobble-based retouched and utilized flakes made from coarse-textured lithic material could not be further modified through elaborate tertiary reduction and pressure flaking, as Rogers (1929b:460) noted. The lithic material qualities thus amplified the typological differences between the two "cultures."

Also critical was the difference in the technological quality and sophistication perceived for the contrasting cultures. The technological limitations of the well-rounded cobble cortex and the coarse texture of the material resulted in a "simplified" reduction strategy, with fewer stages. This, combined with the poorer concoidal fracture and coarse material texture, created the impression of a more "primitive" technology resulting from coastal cobble lithic reduction.

This contrasted sharply with the large potential core size, fine texture, and excellent concoidal fracture of many of the Santiago Peak volcanics. These material qualities allowed for large bifacial core reduction and multistage hard and pressure reduction, resulting in a more technologically elaborate tool assemblage.

Rogers then applied aspects of cultural evolution to the geology-based primitive/elaborate contrast perceived between his two cultures. This, for a long time, had him placing the La Jolla Complex as earlier in time than the San Dieguito, but when this cultural evolutionary expectation was foiled by the results of his stratigraphic excavations at the Harris site (Rogers 1966), the cultural evolutionary framework derived from the qualities of the lithic materials was not rejected but adjusted to identify the La Jolla Complex as "regressive" (Moriarty 1987).

A final aspect of geology that shaped Rogers' contrasting models of these cultures relates to biface frequency, which has so often been used as a critical attribute

for differentiation of La Jolla and San Dieguito sites in the San Diego area (Warren et al. 2008) and has fed expectations about economies that will be discussed below. As indicated in Figure 2, Rogers' initial San Dieguito distribution generally corresponds to the distribution of the Santiago Peak Volcanic formation. The use of the Harris site, located in close proximity to some of the largest quarries of high-quality volcanic material (Cook 1985), as a type site for the complex has helped to feed the expectations of San Dieguito Complex sites having high biface frequencies.

It has long been argued that the Harris site is not a typical habitation site (Ezell 1987). Although Vaughn (1981:137) contrasted the lithic assemblages from nearby quarry sites with those at the Harris site, resulting in the suggestion that the Harris site represented habitation activity, more recent reanalysis of the Harris site bifaces suggests that many, if not most, of the bifaces are unfinished or rejected items (Knell 2011). Warren et al. (2008) continued using Rogers' model to make a quantitative analysis of early western San Diego County sites. It seems both a testament to Rogers' model and its circular relationship with geology that all the San Dieguito sites that the Warren et al. (2008) study could identify after an additional 60 years of research since Rogers' 1929 publication fell within the same zone Rogers had mapped and correspond to the primary distribution zone of Santiago Peak Volcanics (Pigniolo 2005:253) (Figure 3). At the same time, Pigniolo (2005:253) identified a San Dieguito-like site in the eastern mountains of San Diego County, but the similarity of context was its close proximity to the primary lithic source used to make the bifaces.

If we see all these San Dieguito sites as Paleoarchaic biface production workshops in close proximity to prime lithic material localities, which are absent in most of the rest of San Diego County, then our perception of the San Dieguito model is altered. This affects three major factors: (1) biface frequency is amplified in contrast to typical habitation sites located away from lithic material sources (and in contrast to La Jolla assemblages) by the presence of large numbers (perhaps dominant numbers) of reduction rejects in the assemblages; (2) the absence of "true" San Dieguito sites outside Santiago Peak Volcanic terrain but the presence of typological elements (small scrapers, leaf-shaped bifaces, and crescentics) is explained by the differences (particularly in biface frequency) between workshops and typical habitation sites; and (3) the application to San Dieguito of a Great Plains-based economic model of mobile big-game hunting is weakened by the lower overall frequency of finished bifaces in the typical habitation assemblages.

In terms of geography, Rogers initially described the distribution of the San Dieguito as being in an area "which conforms in its occurrence to a well-defined zone on the San Dieguito plateau" (Rogers 1929b:457). The La Jolla site distribution was defined as "not only on the coast, but as far as four miles inland.… They are invariably located on mesa rims adjacent to sanded-in sloughs, which indent the local coast and extend inland often for several miles" (Rogers 1929b:456–457) (see Figure 1).

Rogers' La Jolla distribution corresponds to the coastal zone and a distinctive series of large, closely spaced coastal estuaries. Rogers' San Dieguito distribution corresponds generally to the foothill zone and is beyond the typical foraging range for shellfish. This geographic separation (coastal/foothill) between the cultures led in part to the contrasting economic models Rogers built when constructing the San Dieguito/La Jolla concepts.

As indicated in Figure 1, Rogers' (1929b) initial term for the La Jolla Complex was "Shell Midden People," which later evolved to "Littoral," before coastal sites in the La Jolla area were selected as type sites. The coastal geography, naming, and perceived economic focus were thus linked together. With shellfish pro-

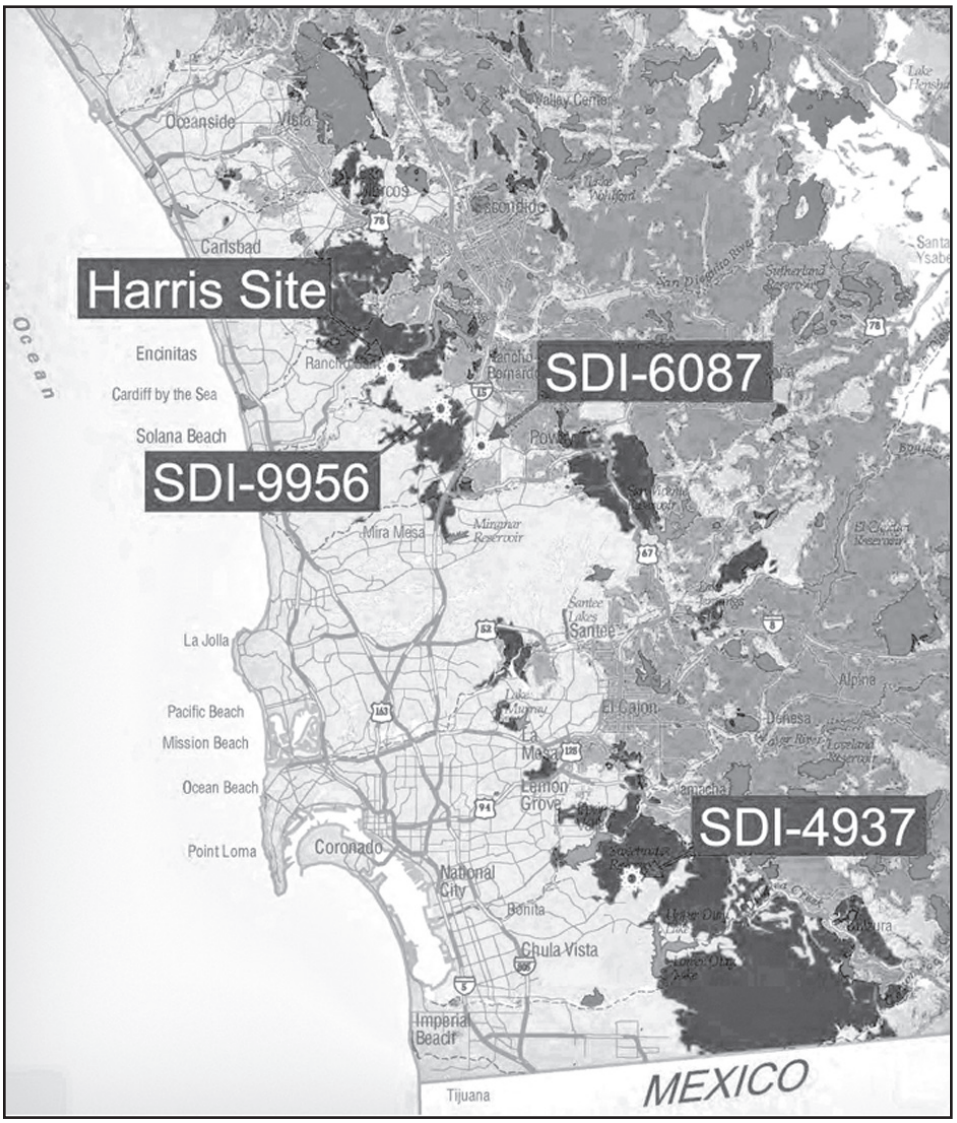

Figure 3. San Dieguito sites and geology (Warren et al. 2008).

curement as a dominant part of the coastal economy also came the Archaic technological addition of ground stone that suddenly made plant use visible in the archaeological record. These two elements, combined with few or no hunting-related tools needed in this coastal setting with its limited large sea or land mammal populations, spelled out a strong economic focus on gathering for the La Jolla Complex.

The San Dieguito distribution as Rogers mapped it was in the foothills, beyond the typical foraging zone for shellfish. An absence of shellfish procurement due to geography is the first economic contrast correlated with this culture. Without shellfish, but largely without any faunal remains, the economy was seen to focus on hunting. This was established by the presence of large, showy bifaces in the Paleoarchaic period assemblages and the frequency of bifaces, again many of which were production rejects. The lack or near lack of ground stone technology in the Paleoarchaic period assemblages, along with limited preservation, made all plant use invisible in the archaeological record. The

amplified presence of large bifaces along with frequent scrapers fed then current models of highly mobile hunters of big game (perhaps Pleistocene megafauna) derived from Clovis and Folsom sites. Thus, the idea of an economic focus on hunting was set.

The geographic and geologic specifics of where Rogers built this model amplified the economic contrast to one not seen elsewhere in the West. Just as Rogers' selection of Santiago Peak lithic reduction areas for the San Dieguito complex amplified the biface count and the strength of the perceived hunting focus in the economy, the selection of a study area that included a large sequence of closely spaced coastal lagoons, not seen elsewhere on the southern California coast, amplified the amount of shellfish use and the perception of a predominantly shellfish-based (gathering) economy. As mentioned, the lack of ground stone in San Dieguito assemblages and the technological shift to ground stone technology in La Jolla assemblages highlighted and made visible the use of seeds in the archaeological record, further accentuating the economic contrast.

Old ideas of economic continuity in the Desert West, such as Jennings' (1957) Desert Culture model, have been brought forward by evidence of continued lacustrine adaptation and the Paleoarchaic concept, in which Paleoindian economic models of mobile hunters have been rejected and replaced by Paleoarchaic hunter-gatherer models (Madsen 2007). It may be that Rogers was too good a geoarchaeologist and established too many links between geology, geography, and his culture concepts when building his culture models. When acknowledging that his San Dieguito/Amargosa model showed similarities to Jennings' Danger Cave site data, Rogers' major argument was about chronology and against Jennings' model of economic continuity (Rogers 1966:30–31). It may be that Rogers' selective integration of geology and environment with technological and chronological change to form his culture-history constructs provided so much perceived economic contrast and circular feedback that, along with his error in chronology, he made a critical error on the economic sequence as well. Just as Rogers' chronological error initially fit the conservative view on chronology at the time, his early big-game hunting model fit the models of Clovis and Folsom as later promulgated in Willey and Phillips' (1958) Lithic stage.

In the case of the San Dieguito and La Jolla complexes in San Diego County, Rogers used his knowledge of geology and geography too closely and too selectively as building-block tools for his culture models to meet an objective inductive goal of "finding" cultures. The implications of the core geologic and geographic links he placed together and the particular conditions of the San Diego area remain the foundations of these culture concepts, giving them coherence and durability among archaeologists, but artificiality in that they continue to fail to explain the typological data and are inapplicable in other environmental contexts. His application of San Dieguito and Amargosa concepts to assemblages as far away as Ventana Cave and Borax Lake (Rogers 1966) suggests that it might be better to view his final San Dieguito and Amargosa/La Jolla concepts as equating not with localized "cultures" but with the broader patterns of technological and chronological change we now more generally classify as Paleoarchaic and Archaic periods.

Conclusion

Rogers integrated his geologic background and training into his archaeological studies, developing culture history and regional syntheses. He can in many ways today be seen as a geoarchaeologist for his integration of the disciplines. His knowledge and skills in integrating geology and the environment into his archaeological work helped him to develop and test his culture-historical concepts in an era when few other tools were available. The strengths of his arguments and interpretation have had an enduring effect on archaeological interpretation in the region. Some basic errors in his linkages between geology, chronology,

ecology, and culture can be seen as enduring impediments to research progress in the region. At the same time, the links he established between geology, geography, ecology, and culture made many of his concepts amenable to further elaboration and development using cultural ecology models and theory, thus leading us a step forward in our understanding of the region's prehistory.

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