

A PALEOECOLOGICAL APPROACH TO THE ARCHAEOLOGY OF SOUTHERN MENDOZA

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ARCHAEOLOGICAL RECORD AND LONG-TERM PROCESSES

The present work supports the idea that the archaeological record constitutes a valid approach to understand the relationship between humans and environment. It not only constitutes a paleoecological record because of the recovery of biological evidences associated to human occupations but due to the fact that humans themselves are significant components of past ecosystems. In other words, the understanding of human occupations implies the comprehension of making decisions within a particular environmental context^[1,2]. If we accept humans as components of the ecosystem, there are several available theoretical and methodological backgrounds that allow the understanding of past systems, which range from ecological evolutionary approaches to landscape archaeology. Human paleoecology allows to explore and comprehend the variability of the archaeological record in terms of human strategies as well as to offer perspectives for the understanding of past processes. These approaches have also been denominated environmental archaeology^[2].

Although paleoecological studies have been originally based on non-human biological indicators, modern research programmes are starting to incorporate the human component within this system. Archaeological emphasis has varied from studies accentuating on systemic functional topics^[1] to others stressing the perception and construction of landscape^[2]. Many processes need to be understood in temporal scales without historical record or, eventually, when the temporal scale needed to generate those processes avoid their own perception. Here, the archaeological record as a paleoecological record provides a significant contribution.

The archaeology of Mendoza did not omitted the ecological component in the past^[3-5] but it was masked by a nature-culture dichotomy. In fact, the different theoretical backgrounds of paleoecological and archaeological studies avoided an explanatory integration of both approaches. The predominant historic-cultural emphasis mainly focused on the reconstruction of typological sequences and possible population “routes” as well as on ideas rather than in the understanding of human strategies. Therefore, the environment was simply a scenario where human populations acted. However, human ecology offers an opportunity for integration since the nucleus of the programme integrates the components from a systemic or evolutionary approach. Here, archaeological remains are analysed as an additional proxy record with the same value as other proxies usually employed in paleoenvironmental reconstructions.

The aim of the present work is to report preliminary results obtained from an ongoing pilot study in southern Mendoza (Figure 1) focused on the understanding of human occupation in relation to past environmental evolution. First, information on the environmental setting and expected human strategies is discussed. Second, aspects of human biogeography are assessed. To do that, an emphasis in the mode as the region was explored, colonised and occupied and how the environmental characteristics would have been related to those processes, is given. In addition, ongoing pilot studies on paleoenvironmental reconstruction of the area are presented. These multidisciplinary studies include several disciplines such as stratigraphy, sedimentology, palynology and malacology.

PAST AND PRESENT ENVIRONMENTAL STRUCTURE

The studied area, known as southern Mendoza, is located at 34°-37°S and 70°-67°W. The area has a heterogeneous environmental structure, including the Andean Cordillera, the eastern piedmont, eastern plains and the volcanic region of La Payunia (Figure 1). Rivers originate in the Andean Cordillera, while springs, small streams, lacustrine bodies and wetlands have been developed in the other sectors. The area has a mean annual rainfall of 250 mm with strong seasonal and interannual variations, as well as significant longitudinal variations. Two different rainfall patterns exist: (1) Predominant winter rainfalls in Cordillera and La Payunia and (2) summer rainfalls in the other sectors. According to its aridity index (precipitation/potential evapotranspiration) the region may be divided in humid (Cordillera) and arid (southern extreme of La Payunia)^[6]. Most of the eastern plains are characterised as semiarid. Three types of deserts exist^[7] in coincidence with the defined phytogeographic provinces of Monte, Patagonia and Puna.

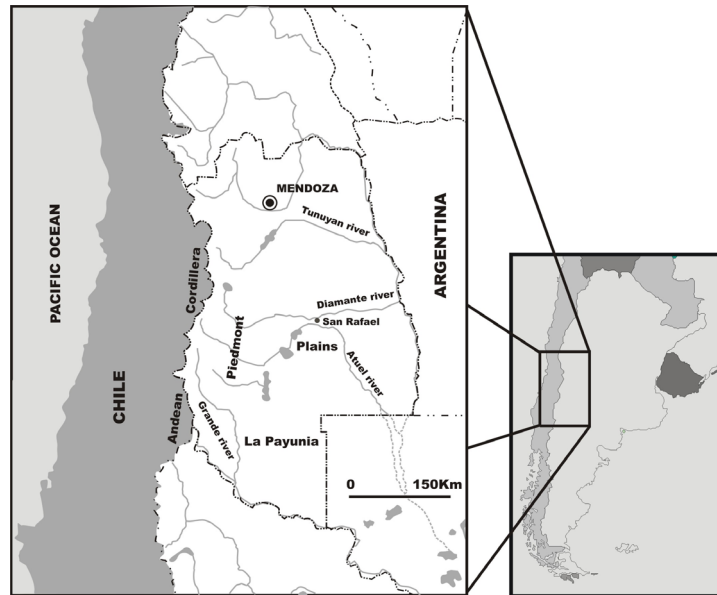


Figure 1. Study area

Paleoenvironments of southern Mendoza

The knowledge on the climatic and environmental conditions of the last 14,000 years in southern Mendoza is scarce and fragmentary. Historically, the paleoenvironmental reconstruction of the eastern Andean piedmont has been regionally extrapolated from localities situated at different environmental settings, and mainly referred to geologic and geomorphologic aspects^[8-10]. Recently, detailed lithostratigraphic and palynological studies coupled with radiocarbon (¹⁴C) and optical dating (OSL) of alluvial sequences have been initiated in several cliff sections (up to 18 m) within steep-sided valley gorges of tributaries of the Tunuyán river in the Uco Valley (northern Mendoza)^[11-14]. These preliminary results provided a baseline for the development of future studies, and suggested that paleoclimatic interpretations would be consistent with the model of Atlantic and Pacific anticyclones.

Similar alluvial sequences to those of the Uco Valley, have recently been identified along the headwaters of the Atuel river, in southern Mendoza. The sequences vary from 2-4 m (La Junta, Malargüe) to approximately 15 m (La Guevarina, San Rafael), and are composed of fine-laminated layers containing freshwater and terrestrial molluscs, which are indicative of different aquatic environments, from slow-running waters to fluvial habitats. The preliminary surveys performed in the area indicated the presence of six genera (*Biomphalaria*, *Heleobia*, *Lymnaea*, *Chilina*, and *Succinea*). The abundance of shells both in vertical and lateral section bring an unique opportunity to infer changes in temperature and humidity through the analysis of the stable isotope composition of carbonate shells ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$).

In addition, diatomite deposits and diatomaceous layers are present in particular stratigraphic levels and can be followed by several kilometres. At present, only La Guevarina section (Mid-Holocene) has been analysed in detail from a multidisciplinary approach including sedimentological, stratigraphical, palynological, and malacological (including $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) analyses. These preliminary results indicated the development of past lacustrine environments with episodic moments of higher water availability in the area^[15,16]. Additionally, two sections outcropping at the area of La Junta have been recently sampled for radiocarbon dating, palynological, and malacological analyses. The potentiality of the alluvial sequences outcropping in southern Mendoza coupled with the preliminary results obtained at present are encouraging. Sequences bring the opportunity to understand the paleoenvironmental changes that occurred during the late Holocene and Holocene, and how these changes would have been related to the human occupation in the area.

RADIOCARBON TRENDS AND PROBLEMS

The environmental diversity of southern Mendoza together with the available preliminary paleoenvironmental information allows us to hypothesize about the mode of occupation of this region. To do that, it is useful to extrapolate here the model of human occupation developed for Patagonia^[17-19]. It postulates the concepts of exploration, colonization and effective occupation. A basic assumption of this model is that the sites are optimally occupied according to the hierarchy of available spaces in each expansion, and this hierarchy is related to environmental productivity^[18]. However, many archaeological contexts are difficult to be included univocally in one of these classes, possibly due to the scarce available data^[19]. Moreover, this model may be useful for understanding human occupation at a regional scale but it fails in explaining local reorganizations or organizational changes preserved in the archaeological record.

As an initial approach, we focused on the chronology of events in different environments from southern Mendoza^[20-22]. Preliminary results suggested that water availability, spatial habitability and environmental productivity are key issues that may have influenced the effective colonization and occupation of the area. Middle and fluvial valleys recorded the first evidence of colonization towards the early Holocene. A latter effective occupation is recorded in environments from Cordillera and La Payunia for the last 2000 years. Although these environments were effectively occupied in the late Holocene, they were exploited ever since the mid-Holocene according to the evidence provided by obsidian artifacts originated in archaeological sites from the region, which source is the El Pehuenche stream^[23].

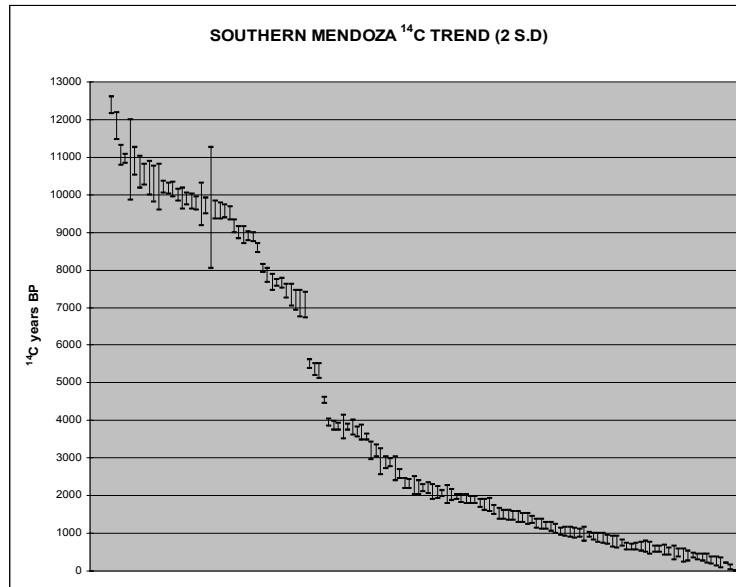


Figure 2. Radiocarbon trend in the archaeological record of southern Mendoza^[20,21].

Early occupations (11,000-8,000 ¹⁴C years BP)

Evidences of human occupations in the late Pleistocene and early Holocene in the area come from two sites located in the Atuel river valley: Gruta del Indio and Arroyo Malo-3. Gruta del Indio is characterized by an important diversity of extinct fauna accompanied by scarce lithic elements^[24-26], and constitute the unique evidence that characterised the paleoindian occupation known as Atuel IV. On the other hand, Arroyo Malo-3 is mainly composed of guanaco bones and a significantly higher density of lithic elements. In both sites, the relationship between human occupation and extinct fauna is still under discussion^[26-32]. An additional site, Casa de Piedra del Durazno, that also exhibits extinct fauna, was proposed until recently as related to the first humans^[24]. This faunistic assemblage shows a radiocarbon chronology even older than those actually recognized as the oldest occupations in the region^[21]. The strengthening of studies on this pre-human period may bring key information on the possible impact of the first humans on extinct fauna.

Mid-Holocene (8,000-4,000 ¹⁴C years BP)

To this chronology it has been hypothesised that arcaic hunter-gatherer groups with different technological traditions occupied the region^[24,33]. Yet the regional radiocarbon trend obtained for southern Mendoza (Figure 2) evidences a significant absence of dates for the mid-Holocene^[20]. This hiatus encompassed 3000 ¹⁴C years in the middle valley of the Grande river (Figure 1). The hiatus may be interpreted as absence of human occupation, or as demographic

changes at least in some sectors. Different explanations have been invoked to explain this absence of archaeological record: volcanisms, aridization, change in the regional pattern of space utilisation, and/or a possible archaeological sample strategy^[34]. Records of volcanic eruptions from Cordillera^[35], La Payunia^[36,37] and the middle basin of the Atuel river have been inferred for this period. The magnitude and extent of these eruptions may explain a short-term temporal abandon of the region by humans but fail in explaining processes at millennial scales such as those indicated by the radiocarbon trend. Therefore, it is necessary to explore other proprieties of the record during these four thousand years. A similar hiatus has been recorded in other parts of the world^[38,42], which evidences a complex situation that generate strong debates in the scientific community. It is needed to improve the knowledge on the processes of site formation, taphonomy, faunal turnovers, and stratigraphy in order to incorporate reliable data that may lead to a valid explanation for the absence of human occupation in this period.

Intensification

In the last years, a process of intensification in the cordilleran region of the Atuel river has been proposed^[31,32]. Such process consists in an imbalance between human demography and their resources under exploitation, and would have been initiated nearly 2000 years BP. Five predictions to test that process have been proposed^[32]: (1) a reduction in the relative mobility of groups, (2) an increase in the food processing, (3) an increase in the gathering of vegetables and in the exploitation of previously ignored resources, (4) colonisation of new habitats located in marginal environments, and (5) increase of long-distance exchange. All these predictions include a strong ecological evolutionary component. Although this proposal has been criticised by some authors^[27], it has allowed the generation of new hypothesis.

Another explanation for the intensification process focused on environmental changes rather than in demographic strengthening^[43]. When a population that is close to the environmental capacity of charge of the environment is subjected to environmental change, it would modify the abundance of resources under exploitation as an adaptive response. In order to clarify this process, it is needed to improve the archaeological definition of the term intensification, and to explore possible archaeological differences in other situations such as environmental changes.

RECENT ADVANCES AND NEW PROBLEMS

In the last years, we have initiated studies on different paleoecological aspects of the late Pleistocene and Holocene in southern Mendoza. As a continuation of previous studies on faunistic exploitations^[44], we have recently started a study on the role of birds in human subsistence. It is aimed to understand the cause of the deposition of bird remains and to evaluate its role in human subsistence through time. In addition, it will bring evidences to clarify the understanding of the intensification process at a regional scale through the analysis of taxonomic, economic anatomy and taphonomic traits^[45]. Also, we are carrying out archaeobotanic studies aimed to know the regional extent of the fossil record and to evaluate its role in the diet as well as their temporal trends^[46]. Taphonomic aspects of remains are key issues for the discrimination of depositional and post-depositional processes. These two projects (archaeofauna and archaeobotany) have allowed the exploration of the isotopic variability in order to infer dietary and mobility aspects of human populations^[47,48].

Paleoenvironmental reconstructions constitute another important issue to be developed. In order to evaluate many of the hypothesis proposed in the present work, it becomes fundamental to increase the knowledge on paleoenvironments from the region. Therefore, studies emphasizing geological aspects (stratigraphy, sedimentology, geomorphology) together with paleoecological studies (malacology, palynology) are being carried out in several sedimentary sequences outcropping in the region^[15,16,48].

PERSPECTIVES

The environment found by European colonizers, usually characterized as “natural” or “pristine”, was the result of 10,000 years of environmental evolution where human populations were a significant component. The archaeological record brings information in two main aspects: the human strategies within that paleoecosystem and the knowledge on natural processes such as volcanism and flooding. Human ecology offers a diversity of theoretical backgrounds that propitiate the integration of this information. In the case of southern Mendoza, this perspective define new problems. The prehispanic history cannot be understood just as movements of populations or ideas, and even in those cases it would be required an explanation.

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