The Paso Otero 5 site (38° 12’ 08” SL /59° 06’ 58” WL) is located in the middle basin of the Quequén Grande River (Interserrana Bonaerense Area, Necochea District, Buenos Aires Province, Argentina). Analysis of the geology as well as the artifacts recovered from an area of 20 m$^2$ (excavated and supervised by Martínez [1997, 1999, 2001]) forms the basis of the reported cultural association.

The general stratigraphic sequence in the area is represented by sediments of the Luján Formation and its two members: the late-Pleistocene Guerrero Member (GM) and the early to middle Holocene Río Salado Member (RSM). The GM includes alluvial and aeolian facies and the RSM is a fluvial deposit representing an aggrading floodplain. Aeolian sediments of La Postrera Formation rest on top of the Luján Formation (Tonni and Fidalgo 1978; Johnson et al. 1998; Zárate et al. 1998).

Statigraphy and Geochronology of Paso Otero 5

The geoarchaeological field work at Paso Otero 5 was carried out in 1998 by the authors. The section exposed by the excavations as well as a cut bank exposure were described using standard soil and stratigraphic nomenclature and procedures. Samples for soil, sedimentological, and radiocarbon analyses were collected from the upper 5-10 cm of each buried A horizon. For each sample, dates on the "humate" (humic acid extraction or base soluble humic acids) and on the "soil residue" (humin) fractions were
run. The dates are expressed in uncorrected and corrected $^{14}$C ages but not calibrated radiocarbon years B.P. (Table 1). Among each pair of corrected dates, the oldest is assumed to be closer to the "true" age because in general contamination by younger carbon is more likely than contamination by older carbon (Holliday 1995; Martin and Johnson 1995; Wang et al. 1996).

The stratigraphy at Paso Otero 5 is generally representative of the upper Luján Formation with slight differences (Figure 1). The lower section exposes the green Guerrero Member (GM) (~230cm to 240cm + below the surface), that is a sandy loam subjected to some weathering in the form of oxidation, giving it a mottled appearance (hence Cgb6 horizon). This weathering probably is related to an overlying A horizon at the base of the RSM. This member traditionally has been interpreted as a result of lacustrine and paludal facies although diatomaceous deposits also are recorded in different parts of the basin (e.g. La Horqueta II site, see Zárate et al. 1998:139). The RSM here is similar to that at Paso Otero 1 (Johnson et al. 1998) and traceable for hundreds of meters along the cut banks of the river, consisting of a series of carbonate layers or "marls" each with a weakly developed soil (producing A-C or A-Bk profiles). The marls are very low density, likely due to a high content of volcanic ash and diatoms.

The buried soils in the RSM are indicative of six periods of landscape stability. Four of these soils are dated. The Ab6 horizon (Figure 1) separates the two members of the Luján Formation and is correlated with the regionally developed Puesto Callejón Viejo soil that separates the two members of the Luján Formation (Tonni and Fidalgo 1978). This soil is dated to ~9400 yr. B.P. (Table 1). This A horizon, resting on the GM, contains the archaeological deposit dated on bone at ca. 10,200-10,450 yr. B.P. The top
of this A horizon was dated to 9470 ±110 yr. B.P. The overlying sediments and buried soils span much of the early and middle Holocene. The Ab5 horizon dates to ca. 8800 yr. B.P.; the Ab4 to ca 7400 yr. B.P.; and the Ab3 to ca. 6600 yr. B.P. (Table 1). The Ab2 and Ab1 soils have not been dated. La Postrera Formation appears to be missing from the Paso Otero 5 sequence, although the high sand content of the modern A horizon may be related to La Postrera deposition.

The Archaeological Record

With the exception of a few items that where recorded near the contacts between the RSM-GM and the Ab6 soil (Figure 1), the assemblage was recorded almost exclusively within the paleosoil. The most remarkable artifact is a fish-tail projectile point (Figure 2). Although the stem and the tip of this artifact are partially missing due to fractures, the shoulders and the piece of what remains of the stem have diagnostic attributes indicating a fish-tail type (i.e., stem thickness and edge-grinding). No other type of projectile point on the Pampas has such attributes (Flegenheimer, personal communication 1997). It is made from a red chalcedony (silica micro-cryptocrystalline) frequently founded in early sites dating between 10,000-11,000 yr B.P. on the Pampas. Recent studies suggest that the quarries for this raw material are located in Uruguay, where fish-tail projectile points made from this rock are found in surface sites (Flegenheimer et al. 2000). Although fish-tail projectile points have been recorded at surface sites in the Interserrana Bonaerense Area (Flegenheimer and Bayón 1996; Politis 1991), the Paso Otero 5 specimen is the first recorded in a clear stratigraphic Pleistocene-Holocene sealed archaeological context and with megamammals bones
(Martínez 2000, 2001). Lithics have been recorded in close association with bone (see Figures in Martínez 2001).

Identified taxa are: Megatherium americanum (giant ground sloth), Equus neogaeus (extinct horse), Toxodon sp. (Toxodon), Glossotherium sp. (ground sloth), Hemiauchenia (extinct camelid), Glyptodon sp. (giant armadillo), Lama guanicoe (guanaco) and Xenarthra (Martínez 2001). A remarkable feature is the amount of burned bones. They are concentrated around a calcaneum (Megatherium americanum) and a megamammal vertebra (Xenarthra) (see Figures in Martínez 2001). The intensity of combustion, a mixed burning situation from not burned to calcined stages, and high degree of fragmentation cause by fire support the idea that bone was used as fuel (Martínez 1997, 1999, 2001)

Discussion and Conclusions

The stratigraphy, soils, and radiocarbon dates from Paso Otero 5 provide evidence of episodic floodplain sedimentation and stability in cycles of ca. 1000 years between ca. 6600 and 9400 yr. B.P. and probably throughout most of the rest of the Holocene. The soils and stratigraphy also indicate that little post-depositional alteration occurred of the archaeological deposit and the overlying sediments. The age of ca. 9400 yr. B.P. on the Ab6 provides a minimal age for the archaeological material contained in the soil and probably approximates the age of burial by the overlying sediments. Megamammal bone from the bed itself is dated to ca. 10,190 and ca. 10,440 yr. B.P. The dating of the bone and associated soil show that the human activity and burial of Ab6 both took place at around the Pleistocene-Holocene boundary. Humates from the same soil at Paso Otero 1, located on the opposite bank of the river to Paso Otero 5, dates to ca. 9950 yr. B.P. (Johnson et al. 1998:20). Thus, the lowest soil at each site,
Ab4 at PO1 (Ab3 in Johnson et al. 1998) and Ab6 at PO5, were buried at about the same time (a little less that 10,000 yr. B.P.).

Downstream 30 km at La Horqueta II site, a similar stratigraphic column was studied (Zárate et al. 1998). A radiocarbon date obtained from the organic matter of the upper part of the Puesto Callejón Viejo soil yielded an age of 9000 ±70 yr. B.P. (Beta 79439; Zárate et al. 1998:142-143; Figure 3, Table 2). Other chronological data obtained from gastropod shells of La Horqueta II which samples were taken from 5 cm above the base of the RSM almost in contact with the soil, yielded older ages of 9340 ±110 yr. B.P. (Beta 84180) and 9820 ± 100 yr. B.P. (1972 AECV). The older ages of the gastropods may be due to reservoir effect, calculated in the Arroyo Tapalqué basin (200 km northwest) at ca. 1100 ± 300 yr. B.P. (Figini et al. 1996). The buried soils were not subject to this age offset “because the carbon uptake of terrestrial vegetation appeared to be dominated by photosynthesis” (Zárate et al. 1998:142-143; Figini et al. 1996).

The soils provide a general impression of environmental conditions along the Río Quequén during the past 10,000 years. The deposits probably represent episodic sedimentation in the backswamp portion of a floodplain. Thus the site was in a very low energy setting hydrologically. The iron oxidation and mottling of the Ab6 soil indicate that it was subjected to a fluctuating water table. Following burial, however, and throughout much of the Holocene, the soils probably formed under conditions of a high water table, indicated by the relatively high content of organic matter and the absence of leaching of the carbonates

Radiocarbon data from bones have been difficult to obtain. From 11 processed samples, only two have been successful. The study of diagenetic parameters in bones
(porosity, crystallinity (IRSF), diagenetic carbonate content (C/P), calcite, protein content (%N) and histology) for Paso Otero1, 3, and 5 indicates a pattern of differential bone preservation due to hydrolysis, microorganism action, and probably, time (Gutiérrez 1998; Gutiérrez et al. 2001). The conditions of the Ab6 paleosetting (soil subjected to a fluctuating water table) are in agreement with the results obtained by the diagenetic study.

Bones of at least five extinct megamammals are present at Paso Otero 5. Their taphonomy is integral to understanding integrity and site formation processes (HERE WE SHOULD REPLACE A WORD, INTEGRAL-INTEGRITY, REDUNDANCY, AND ALSO THESE PHRASE DOES NO SAY TOO MUCH... COULD IT BE MORE CLEAR???). The bone is weathered subaerially, with some elements exhibiting exfoliation and deep desiccation cracks. Carnivore modification occurs on other bones. Given the size and amount of available edible tissues of these animals, the idea of a simultaneous procurement is difficult to support. Martínez (1999, 2001) has proposed that the site was not formed through a single event but rather by several hunting/scavenging tasks, suggesting that the same place in the landscape was reoccupied by the hunters. This interpretation is in agreement with the types of natural modification to the bone. Cultural modification is present in the form of helical fractures, radial intersecting fracture fronts, and blow marks (Martínez 1999). As for the nature of the bone bed, its setting is a very low energy environment and the bones lack fluvial modification such as...........???. THEN.... DO WE ADD ROUNCING AND POLISHING OR NOT??

Stratigraphic and chronological information obtained from Paso Otero 5 have been useful to evaluate site formation processes and aspects related to the integrity of
the site. Further comparison with the other Paso Otero locality sites will allow the
construction of a model for the middle stream of the Río Quequén Grande.

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### Table 1: Radiocarbon data from Paso Otero 5 site. Organic Matter and Bone Analysis

<table>
<thead>
<tr>
<th>Ab3 (140-153)</th>
<th>Soil Bone</th>
<th>Base soluble humic acids</th>
<th>Soil residue</th>
<th>δ²¹²⁶⁺/₂¹²⁶⁺ C (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Uncorrected C14 age</td>
<td>Corrected C14 age</td>
<td>Uncorrected C14 age</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6,524 ± 127BP (DRI-3603)</td>
<td>6,629 ± 129 BP (DRI-3603)</td>
<td>-18,50 ± 0,05</td>
</tr>
<tr>
<td>Ab4 (166-172)</td>
<td></td>
<td>7,253 ± 84 BP (DRI-3601)</td>
<td>7,366 ± 86BP (DRI-3601)</td>
<td>-18,02 ± 0,05</td>
</tr>
<tr>
<td>Ab5 (186-197)</td>
<td></td>
<td>8,315 ± 89 BP (DRI-3605)</td>
<td>8,415 ± 91 BP (DRI-3605)</td>
<td>-18,79 ± 0,05</td>
</tr>
<tr>
<td>Ab6 (213-224)</td>
<td></td>
<td>8,767 ± 290 BP (DRI-3572)</td>
<td>8,863 ± 292 (DRI-3572)</td>
<td>-19,06 ± 0,05</td>
</tr>
</tbody>
</table>

Burnt Megamammal bone
Unit 1; Section SE; Level 2,55-2,60 (AA-19291)
10,190 ± 120 (δ¹³C = -20.6)

Burnt Megatherium sp. bone
Unit 1; Section SE; Level 2,55-2,60 (AA-39363)
10,440 ± 100 (δ¹³C = -19.8)