Supplementary Materials

Late Holocene triangular lithic projectile points, their morphometric variability and hafting systems in the Southern Pampean Hills (Córdoba, Argentina)

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FTIR analysis

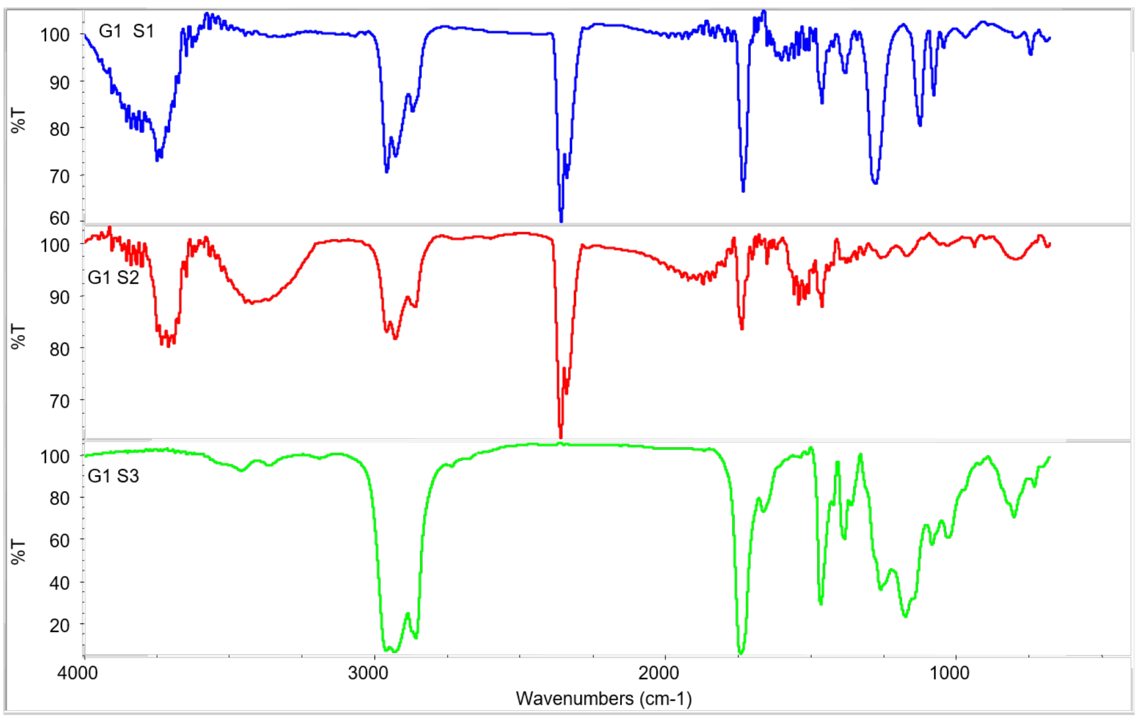

Figure 1. FTIR spectra of archaeological residues. In blue: Sample 1, Group 1. In red: Sample 2, Group 1. In green: Sample 3, Group 1.

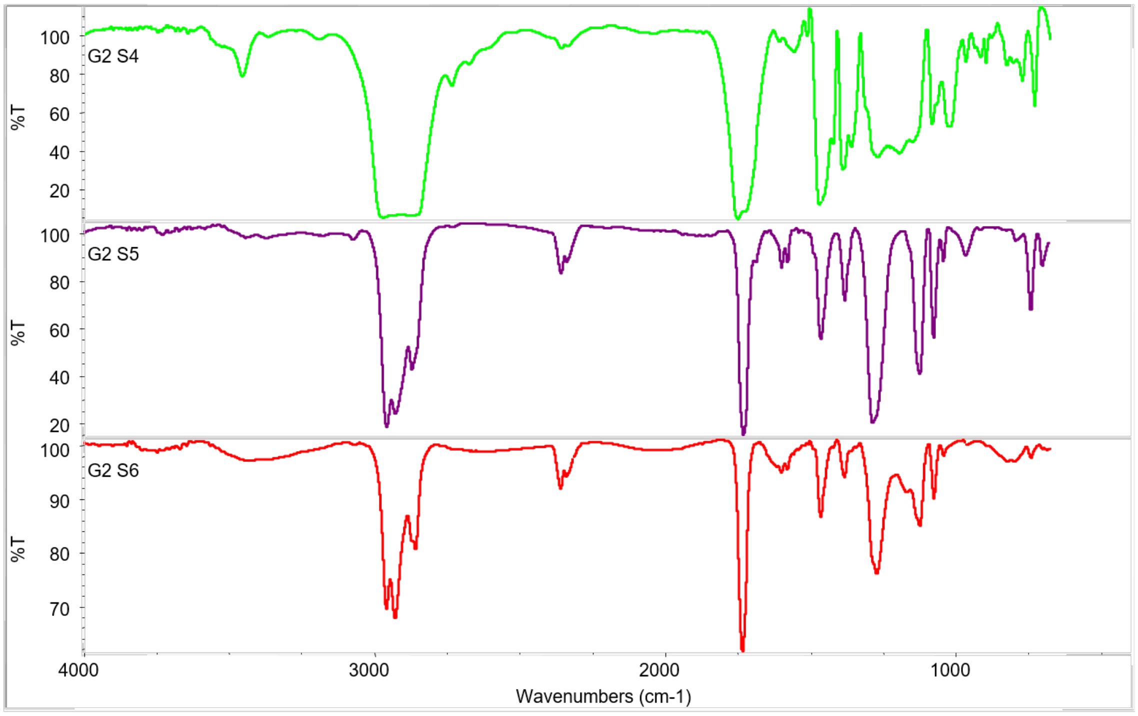

Figure 2. FTIR spectra of archaeological residues. In green: Sample 4, Group 2. In purple: Sample 5, Group 2. In red: Sample 6, Group 2.

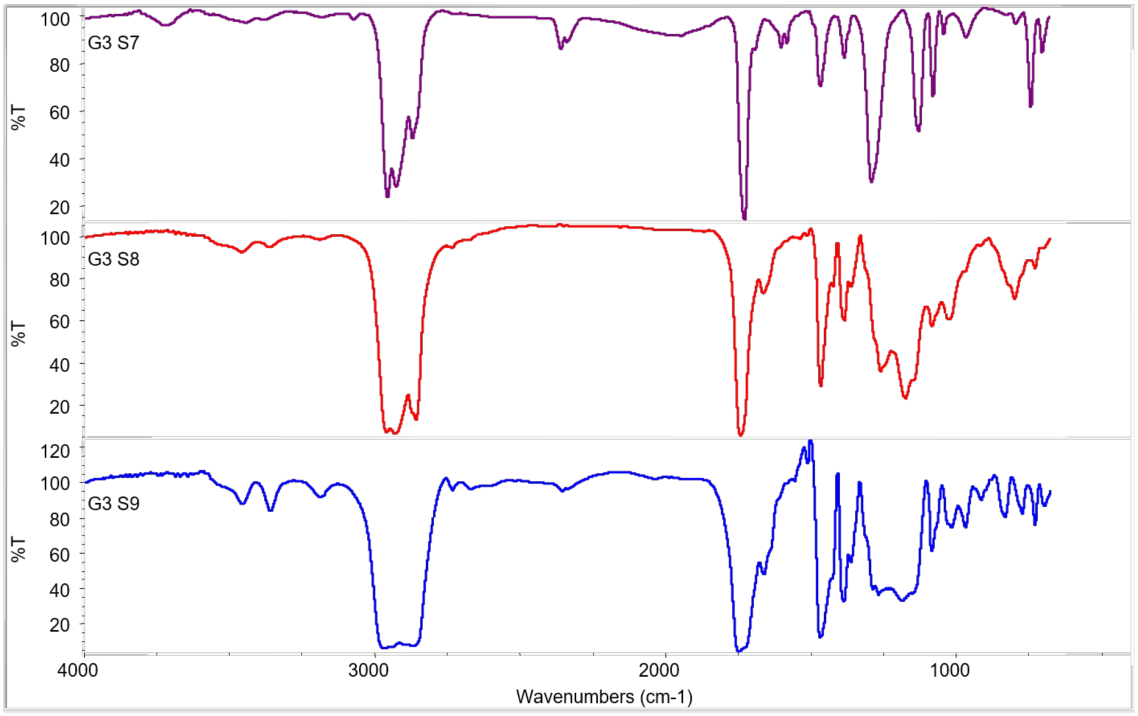

Figure 3. FTIR spectra of archaeological residues. In purple: Sample 7, Group 3. In red: Sample 8, Group 3. In blue: Sample 9, Group 3.

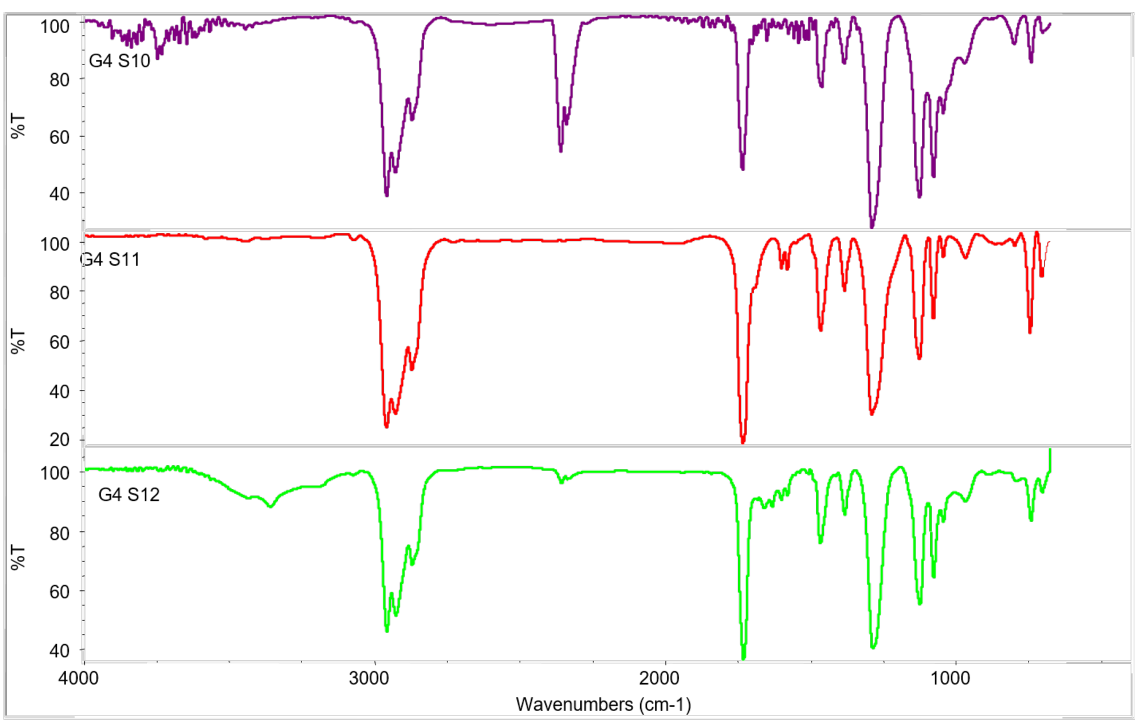

Figure 4. FTIR spectra of archaeological residues. In purple: Sample 10, Group 3. In red: Sample 11, Group 3. In green: Sample 12, Group 3.

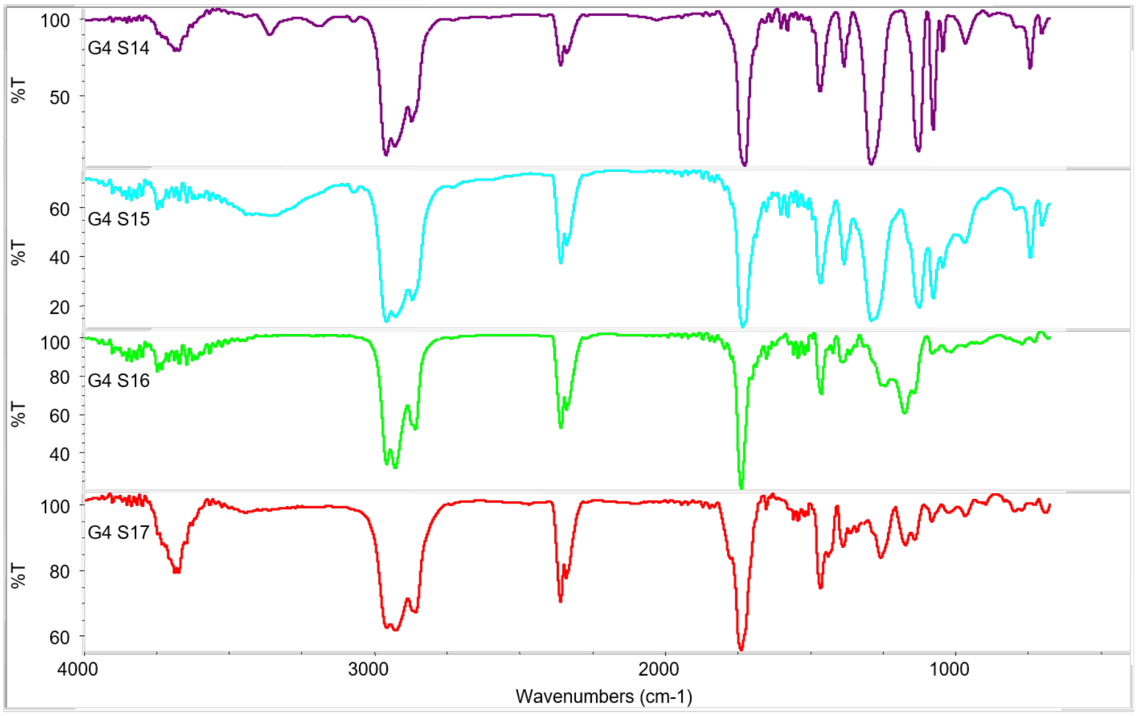

Figure 5. FTIR spectra of archaeological residues. In purple: Sample 14, Group 3. In light blue: Sample 15, Group 3. In green: Sample 16, Group 3. In red: Sample 17, Group 3.

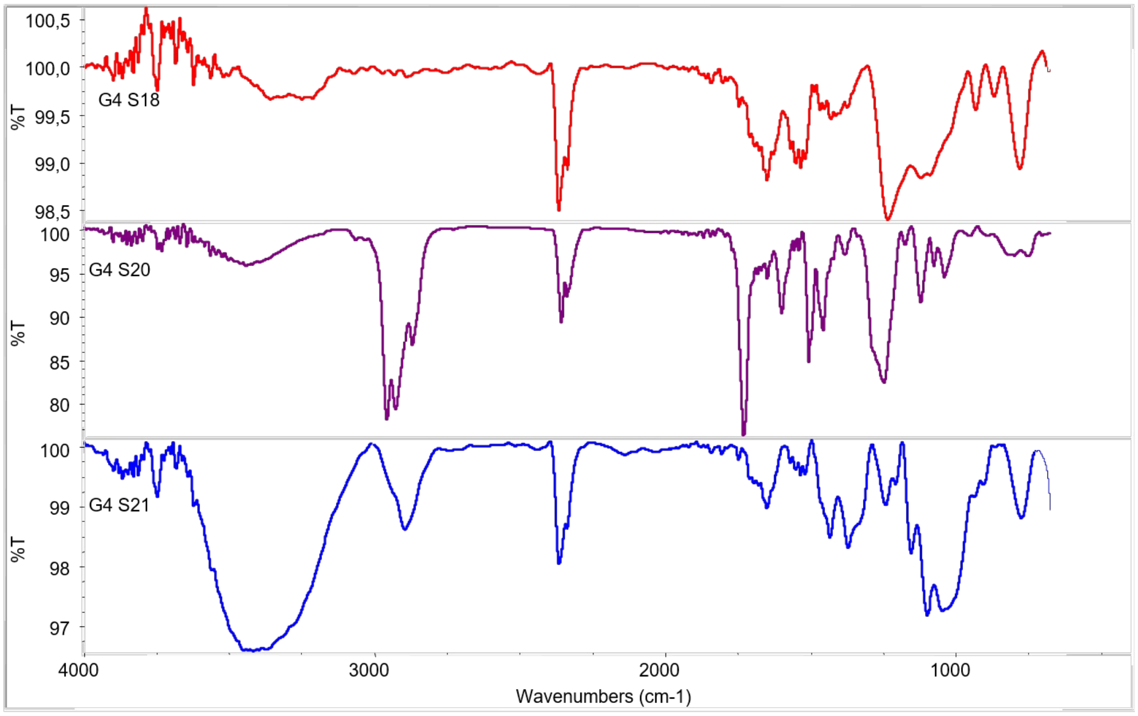

Figure 6. FTIR spectra of archaeological residues. In red: Sample 18, Group 3. In purple: Sample 20, Group 3. In blue: Sample 21, Group 3.

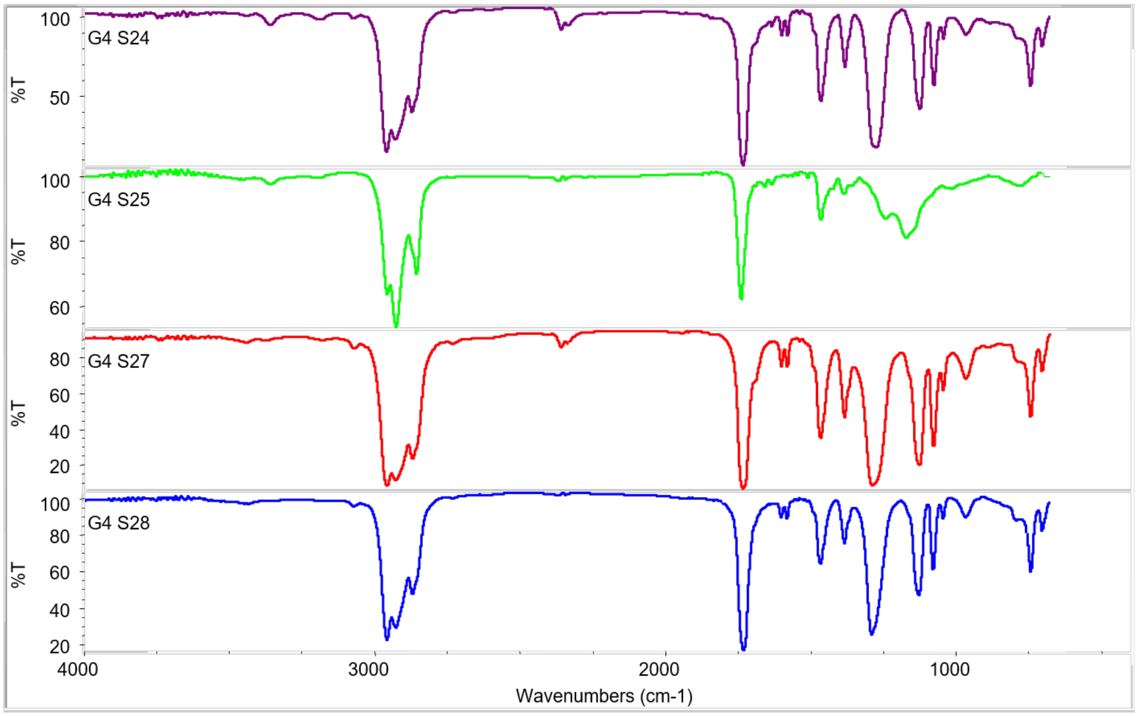

Figure 7. FTIR spectra of archaeological residues. In purple: Sample 24, Group 3. In light green: Sample 25, Group 3. In red: Sample 27, Group 3. In blue: Sample 28, Group 3.

Supplementary content for:

2. Materials

The archaeological data in the Ongamira valley and their chronology

The Ongamira valley is located in Córdoba Province, a vast territory of 165,321 km² with registered human occupations since *ca*. 10000 BP. For that period and space, excluding the Ongamira radiocarbon dates, we have registered only 132 radiocarbon dates related to archaeological contexts (Cattáneo et al., 2019; Izeta and Aguilar, 2020). A very low quantity compared with the number of known archaeological sites for the province, which in 2015, reached 1936 (Cattáneo et al., 2015). This number shows that only 4.08% of the known archaeological sites have absolute dates. It is also clear that in this situation there are few persistent occupation sites with over one dating per component. Therefore, there is no statistical robustness when defining the different archaeological occupations at the different sites in the region.

Since the 1940s, Ongamira valley has been one of the key regions for the development of explanatory models linked to the process of human occupation in South America (e.g. González, 1960; Schobinger, 1959; Willey and Phillips, 1958). During the 1950s, researchers reported at least five different sites at the valley (Menghin and González, 1954). Most of these studies were based on relative timelines or a unique radiocarbon information (González, 1960; Vogel and Lerman, 1969). However, they mostly focused their publications on the Deodoro Roca Rockshelter (González, 1943; Menghin and González, 1954; Montes, 1943).

During the next 50 years those models were used as no new archaeological work was made at the region, a situation that prevailed until recently (Cattáneo et al., 2013). In 2010, we resumed investigations in the valley, new archaeological excavations and a radiocarbon dating program has been settled focusing on the chronology of seven of the most important 60 sites identified in the valley (Izeta et al., 2021). During this decade it has been possible to provide greater chronological precision to many activities related to feeding practices, use of space associated with rock-shelters, palaeoenvironmental changes and the incorporation of new technologies into daily practices (Robledo, 2021).

DRR and ONP1, two of the main studied sites in the region, have been the origin of the archaeological materials studied in this paper. Due to the relevance of the provenience of each analyzed projectile point from those sites we are going to present a summary of the excavations that involves some of the methodology, stratigraphy and chronology as well.

Deodoro Roca Rockshelter (DDR) – Alero Deodoro Roca (ADR)

This rockshelter is located on the Saldán Formation (Zárate, 2016). It is an amphitheatre-shaped formation with faces to the south and east. It is about 100m long. Montes (1943) divided the rockshelter into two sectors (A and B) from a small semi-permanent waterfall. This causes a small stream that drains into the Ongamira River network, located about 1200 masl. Because all the samples in our work proceeded from sector B we focused in the description of that spot.

Deodoro Roca Rockshelter – Sector B

Sector B is located in the northern area of the rockshelter. In the 1950s, Menghin and González (1954) excavated several areas with controlled methodologies. For that intervention, they used a grid comprising 220 squares (4m^2 each) from where they excavated 31. Artificial levels, 0.20m depth, allowed interpreting the stratigraphic sequence and its cultural content resulting in the outline of four cultural horizons (Cattáneo et al., 2013; Cattáneo and Izeta, 2016a; Laguens and Bonnín, 2009; Menghin and González, 1954). Since 2010, excavation has resumed using the Harris Matrix (Harris, 1989) in sectors not affected by previous interventions. During fieldwork, the original grid system was identified. This allowed us to relate the material culture recovered in the 1950s to those from modern excavations. These excavations cover an area of ~24m^2 and ~3.80m deep in its deepest part. In this new area, 149 SU were interpreted (Figure 8) (Cattáneo and Izeta, 2016b). Sector B comprises 14 radiocarbon dates, associated with combustion units (structured and unstructured hearths) and, in one case, the burial of an infant (González et al., 2016).Within a depth of less than a meter at the center of Sector B, we registered 19 combustion areas, more than twelve thousand gastropod shells, five thousand charcoal fragments, seventeen thousand animal bone fragments and more than ten thousand lithic remains. Most of this record was studied in Doctoral Dissertations or published separately (Aguilar, 2019; Caminoa, 2016; Cattáneo and Izeta, 2016c; Conte, 2018; Costa, 2015; Mignino et al., 2016; Robledo, 2021, 2016). This enabled us to characterize the site as a persistent place used by hunter-gatherers throughout the Holocene.

Because archaeological work involves adopting a series of decisions that will determine the methodological approach to be implemented, both in the field and in cabinet. For this reason, we defined standard parameters that would allow comparing archaeological interventions in different archaeological sites in the valley. Hence, we planned, from the outset, a standardized registry that would allow not only recovering as many elements of the material culture as possible, but also providing data that would serve as input to interpret the various human occupations at the valley (Cattáneo and Izeta, 2016c).

During fieldwork planning, we used different resources for the registry of excavations. First, we kept a general record of daily activities, written on paper and in other formats. These were field diaries, where fieldwork directors made general annotations on researchers' work, weather, advance in excavation, general ideas of the material culture recovered, general procedures, among others. (Izeta et al., 2017). Second, we recorded SU using similar record sheets as used by the MoLAS (Museum of London Archaeological Service) (Brigham et al., 1994).

We based the registry of SU on a description and interpretation model of the deposition sequences of the stratigraphy of archaeological sites. This mode of describing the stratigraphic sequence is the so-called "Harris Matrix" (Harris, 1989), a method based on a systematic and objective description of archaeological stratigraphy. Here we attempted to define SU, facies, interfaces and features. This description was then plotted using/with diagrams that showed the relationships between the various components (Figures 8 and 9).

As a result, we developed a sequence that considers superposition, interventions and a temporal succession of the series studied. This is a first relative chronological model based on sequence diagrams devised from the definition of the stratigraphy (Dye and Buck, 2015). All data was collected during fieldwork seasons starting in April 2010. During excavations, a Total Station was used to register the tridimensional positions of archaeological objects. In addition, natural and cultural features were recorded using this instrument. Fire hearths, post-holes and bioturbation areas were then added to the Harris Matrix of each site.

To develop the radiocarbon dating program for the Ongamira valley, we considered the provenance of the samples and the possibility offered by each for the construction of an occupation sequence in the area.

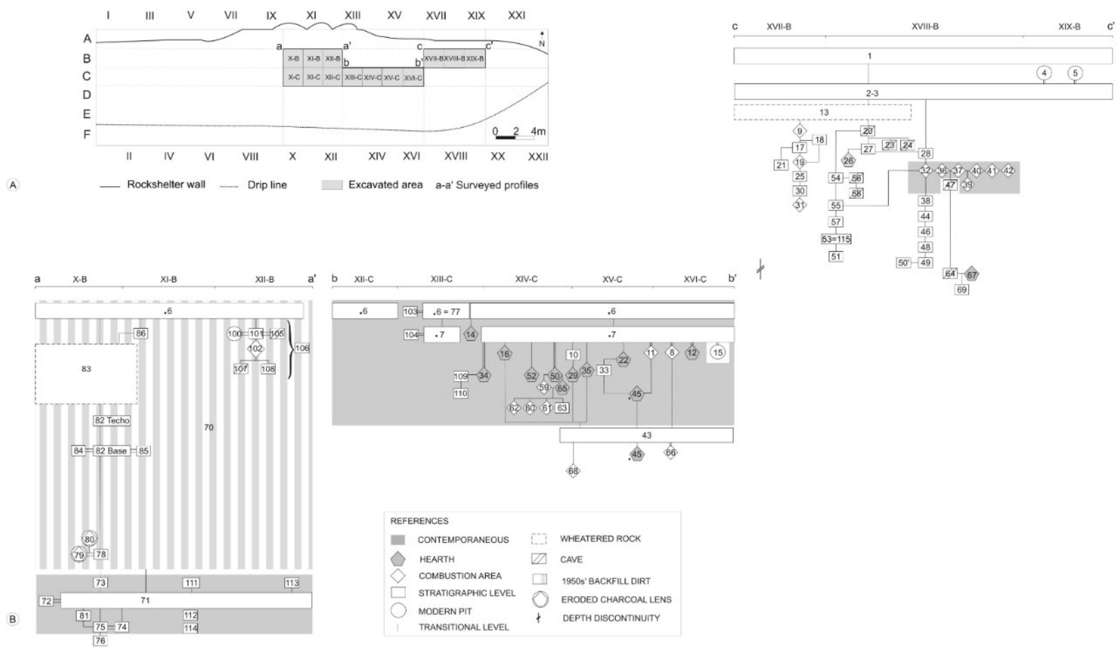

Figure 8. Deodoro Roca Rockshelter, Sector B, Harris Matrix. a) Plan of Sector B. The areas intervened since 2010 are highlighted in grey; b) Scheme Sector B north profile (modified from Cattáneo et al. 2016 and Izeta et al. 2021).

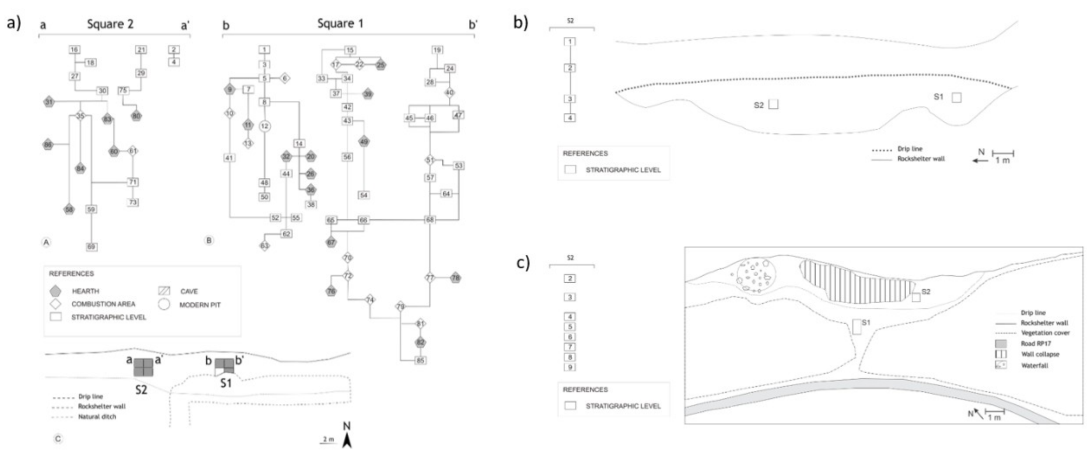

Figure 9. a) Ongamira Natural Park 1- Parque Natural Ongamira 1, Square 1; Harris Matrix. Ongamira Natural Park 1 - Parque Natural Ongamira 1, Square 2; Harris Matrix. b) Ongamira Natural Park 4 -

Parque Natural Ongamira 4; Harris Matrix. c) Ongamira Natural Park 5 - Parque Natural Ongamira 5. Modified from Robledo (2020) and Izeta et al. (2021).

Samples 1, 2 and 3

The first two samples, numbers 1 and 2 correspond to a surface sampling in DRR. Number 3 was recovered from OPN1 surface. We considered to include these projectile points particularly to compare measurements and the FTIR analysis even if we do not have a radiocarbon chronology for them. The decision to include these in our set and results was made after the morphological characterization and the observation that they were similar to those that were recovered from excavations. Also, because this type of projectile point was not founded outside the radiocarbon range that was considered in our work in our area of study.

Sample 4 and 5

The systematic excavation of several sites aimed at completing the local chronological sequence. ADR Sector B was established in the sequence, the one to be completed, since the SU corresponding to the end of the Late Holocene had been removed in previous excavations. The most modern date for the site held a value of 1915 ± 45 BP (MTC-15148) without association with ceramic technology (Cattáneo *et al.* 2013). Particularly associated to this date was recovered the Sample 4 and 5 which was founded in the same SU, identified as 32, next to the dated sample of bone in the XVIII-B square (sample 4) and in XIX-B square (sample 5).

The latter was considered to correspond to small charred branches to avoid the "old wood" effect (e.g. Schiffer, 1986) and attempt to achieve a "secure archaeological context" (Boaretto, 2009; Marconetto et al., 2014).

The selected samples come from undisturbed archaeological contexts. This was important in the upper section of the site as it featured many mammalian caves with fossorial habits. For example, in one of the caves, the skull and bones of the appendicular skeleton of a skunk (*Conepatus chinga*) were retrieved. Because of this, all micro faunal remains were taphonomically analysed to understand the process of site formation (Mignino et al., 2018). Considering this, a sample of this upper part was selected from an undisturbed sector, showing a large amount of archaeological material *in situ*, particularly a quartz straight base triangular projectile point. This sample comes from the stratigraphic unit SU32 located in the square XVIII-B (Figure 2). The result yielded a date of 1915 ± 45 BP (MTC15148, camelid metapodial) where the sample 4 was found.

Sample 6

The projectile point was recovered in the north-western sector of square 1 in the SU 14 (Robledo, 2020, p. 236) (Figure 9). This unit is associated with a Late Holocene occupation with a radiocarbon dating on SU 35 (square 2) of 1905 ± 20 BP (YU-7746, charcoal) (Izeta et al., 2021). SU35 is considered as a sedimentary matrix of dark colouration composed of thermo-altered bone remains in different degrees of fragmentation, disperse charcoal fragments, lithics material and ceramic materials.

The projectile point was recovered in the north-western sector of square 1 in the stratigraphic unit number 14 of ONP 1. SU14, is described as a sandy-silty soil with scattered archaeological remains (mainly flakes of quartz and animal bone remains), and it was located above a combustion area (Robledo, 2020, p. 236). Considering matrix composition and location we interpret SU 14 it is equal to SU 35. A slightly depth difference between both SU can be explained as the result of the low grade sloping observed during excavation.

Samples 7, 8 and 9

These three samples were recovered from the same chronological unit identified as SU 6/7, squares XIV-C and XV-C. These two mentioned SU were interpreted separately at the beginning of the excavation but later, also during excavations, were interpreted as only one deposit but the nomenclature were preserved. Then SU 6/7 corresponds to a sediment of black coloration, mainly composed of silts and clays with gravel-size material from the rockshelter walls. In some sectors, there is heavily fragmented land-snail shell, whereas in others we can find many whole snail shells, especially under bone remains, scattered charcoal and small lens-shaped hearths. These lenses were defined as other features: SU8, SU11, SU12, SU34 and SU50. Moreover, these SU showed combustion features and land-snail shell concentrations (SU8 and SU11). The radiocarbon date obtained for SU 6/7 was 2944±44 BP (YU-2291, charcoal). SU 34, as seen previously, developed between squares XIII-C and XIV-C. It corresponds to the aggregation of small combustion areas. It also contains bone remains (some burned), whole land-snail shells and many quartz flakes. For this unit, an absolute date of 2952±21 BP (YU-2290, charcoal) was obtained. This SU is contained in the SU 6/7 matrix. SU 50 was defined as a combustion feature containing remains of ash and entire land-snail shells. It was surrounded by part of the rock structure and sparse thermo-altered skeletal remains. It is contained in SU 6/7. This hearth was dated to 2942 ± 25 BP (YU-2293, charcoal).

For all the mentioned above this group chronology was estimated in ca. 3000YBP.

Samples 10 to 29

The projectile points in this group belongs to the back dirt fill left after the 1950 excavation by Menghin and González (1954). The back dirt fill was identified for us as SU 70. Sediments were removed using a shovel, and screening all the sediments to empty the squares X to XII- in lines B and C (Figure 8). It clearly differs from non-excavated areas because it does not have structure, is friable, and is homogeneous in color due to the mixture of all the different stratigraphic units. This landfill had a large amount of archaeological objects. All the material was recovered and bagged respecting the squares provenience, although we assume that they are mixed since, as we already said, they come from the filling from the pit of the entire area excavated in the 1950s. After removing the fill, a unit was reached without intervention named SU 71.

To control the old excavation chronology, we took several charcoal samples from the original north profile at square X-B.

There is an ash lens featuring charcoal and bones dated to 3969 ± 23 BP (YU-2288, charcoal), which is consider the oldest chronological limit for the SU70.

Given that there are remnants of the edges of the excavated squares, it has been possible to determine the level of intervention in a vertical direction, so the antiquity of SU 70 was established considering four radiocarbon dates (NSF-Arizona AMS Laboratory) obtained from the northern profile of the X-B square. From top to bottom we selected four charcoal samples. The first one coincides with the collapse of part of the rockshelter wall, thus this event is sealing the lower occupations of this part of the sector. This stratigraphic unit was named SU82 (Figure 2). A date of 3390±37 BP was obtained (AA93736, charcoal) at the top of this SU. On the other hand, a date of 3515±37 BP (AA93737, charcoal) was established from the SU82 base.

Several centimetres below SU 82 a charcoal sample was retrieved from the base of the stratigraphic unit (SU80) yielding a date of 3984 ± 38 BP (AA93738, charcoal). This date roughly coincides with the last intervention did by Menghin and González in 1950.

We continue to excavate and in the SU74, a bucket-shaped unit in which a large amount of charcoal and bone remains was found we collected a charcoal sample. A date of 4562±39 BP (AA93739, charcoal) was obtained in this unit.

All of the above made us confident in assigning the whole back-dirt filling to a lapse comprised between ca. 1900 BP to ca. 4500 BP. The ending date of this block coincides with the absence of pottery which its emergence at a local level it is dated around 1900 BP. In sum, the presence of triangular points with straight base, the lack of ceramics in the whole back-dirt fill and the profiles radiocarbon dates as independent variables show us a probable temporal assignation of this assemblage.

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