

## STRATEGY FOR RADIOCARBON CHRONOLOGICAL ASSESSMENT OF CERAMIC STYLES: AN EXAMPLE FROM PREHISPANIC NORTHWESTERN ARGENTINA

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**ABSTRACT.** This study argues that to properly set the duration of a particular pottery style using radiocarbon it is necessary to have a long series of data, but also to critically evaluate its reliability. This study presents a methodological strategy to establish the temporal position of the Famabalasto Negro Grabado (Famabalasto Black Incised) pottery style, which has a problematic chronological allocation in northwest Argentine archaeology. This article considers as a starting point the different hypotheses referring to the chronology of this ceramic style. All available  $^{14}\text{C}$  dates and the information of the archaeological contexts were used to evaluate the different degrees of certainty in the *sample-event association* and differentiate the association degrees among the dated events and the set of recovered ceramics. For this, a quadripartite scale of *date-pottery association* is proposed. This treatment of the information allows to rank the more reliable data. Anomalous data are detected and discussed, and as a result, the period of production of this style at a regional level can be dated to the early 14th century and mid-16th/early 17th century. This analysis presents a methodology that can be applied to different archaeological situations.

### INTRODUCTION

Before the use of radiocarbon dating, the construction of archaeological chronologies was based largely on stylistic classification of pottery and with stratigraphic position of the materials. With the introduction of archaeometric dating techniques, the stylistic chronology became less important, although the classification entities remained in use.

This study seeks to contribute to both aspects, but, as opposed to previous considerations, we focus on the problem of defining the chronology of a ceramic style starting from its association with  $^{14}\text{C}$  dating. For this, we will take as a case study the Famabalasto Negro Grabado<sup>1</sup> pottery (hereafter FNG) from the Northwest Argentine (NOA)<sup>2</sup> archaeology, generally assigned to the regional Late period (about AD 1000–1500). Our proposal implies that in order to properly set the duration of a particular pottery style with  $^{14}\text{C}$ , it is necessary to have a long series of data, but also to critically evaluate the information.

In the 1970s and 1980s, H T Waterbolk published a series of articles concerning the archaeological interpretation of  $^{14}\text{C}$  data (Waterbolk 1971, 1983). Among his recommendations, Waterbolk provided suggestions for the handling of large sets of dates as a means for determining the duration of cultural phases. For this, he emphasized the importance of analyzing every date, considering aspects like the possibility of contamination in the dated material, the error introduced between the age of death and the age of use of some organic materials, and the degree of certainty in the association between the dated organic sample and the archaeological material purported to be dated. The importance of making graphics adapted to the data sets was also emphasized, appealing to a good presentation of the essential data for its correct interpretation. As pointed out by Bayliss (2009), it is unfortunate that this did not have a greater impact on the archaeological community, at least the British archaeologists, when it was time to select samples for dating. In Argentina, although diffusion of this proposal existed (Carbonari 1994), it did not have enough impact among archaeologists.

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1. English translation: Famabalasto Black Incised.

2. NOA is a geographical region of Argentina that comprises various political entities and is characterized by its mountainous physiographic conformation and intermontane valleys with a climate classified as semiarid to arid.

Our methodological approach was inspired by Waterbolk (1971, 1983), but the schemes of degrees of association that we propose do not correspond exactly with those of Waterbolk. The methodological adaptation is original for the addressed problem. Often, when regional  $^{14}\text{C}$  information was summarized in previous studies, a simple list or tables of dates were used for establishing general trends, without making explicit the critical analysis of the associations. The ranking exercise of the  $^{14}\text{C}$  data appears an interesting way to proceed, accepting the challenge of revising our own data and the data provided by different investigation teams throughout publications with different standards for presentation of information.

### ARCHAEOLOGICAL BACKGROUND

The region from Lake Titicaca to the northwest of Argentina was, between the 10th and 15th centuries AD, a place for the development and consolidation of political systems tending to demographic centralization, with processes of social and technological change related to the management of natural resources and trade routes, and with inherent social conflict. According to the usual chronological schemes for Argentinean archaeology, this lapse is termed the Late period or Regional Development period, and is roughly equivalent to the Late Intermediate period known in the Peruvian, Chilean, and Bolivian archaeology.

This period is characterized by strong growth and concentration of population and the emergence of societies with controlled territories, large agricultural areas with irrigation systems, the development of new technologies, and the emergence of regional ceramic styles. The spatial extent of the social organizations varies, but the minimum unit was given by a settlement in high placement or *pukara*, where it exercised control over the surrounding agricultural area, water resources and pastures, and peasant dwellings distributed in the lowlands.

During the 15th century AD, the region was dominated by the Inca Empire and by the mid-16th century, by the Spanish, although rebellions and alliances between local groups against the invaders lasted more than a century. In the Yocavil Valley area, there are at least 15 settlements of *pukara* type and late chronological assignment, most of these exceeding 20 ha between the developed areas. Almost all of the samples studied here come from this kind of archaeological site, because this is where the research has focused so far.

### THE PROBLEM OF STUDY

The definition of ceramic styles and their location in space and time, necessary elements for the elaboration of regional archaeological sequences, is a subject in which there has been a progressive development, although with interruptions as long as decades, from the beginnings of the archaeological practice in Northwest Argentine archaeology. From the 1950s until the mid-1970s, the subject was central to the archaeology of the region.

The distribution of the major ceramic styles in the regional space was also a very important element—but not the only one—for the identification of extensive territories or areas of influence of different societies. In this way, for the Late period great ambits such as Belén, Santa María, Sanagasta, Averías, and Humahuaca were delimited, generally named after some especially representative place (e.g. a town or valley), and after the decorated ceramic style most abundant in every ambit. In any case, it is well known that these societies made multiple potteries, throughout the centuries in which they endured as integrated systems, in which stylistic varieties, regional as well as temporal, can be identified. Some ceramic styles were made throughout the entire Late period, continuing their use in the Inca and Early Colonial periods, while others had a shorter duration.

The ceramic that we now recognize as FNG was one of various minor styles made during the “late era” (a broad designation that includes the Late period, the Inca expansion moments, and the early days of the Spanish contact, i.e. about AD 1000–1660) by the societies of NW Argentina (Figure 1). It was made and circulated with more intensity in the Yocavil Valley and nearby areas, where towns or installations of the Santa María and Belén societies existed.

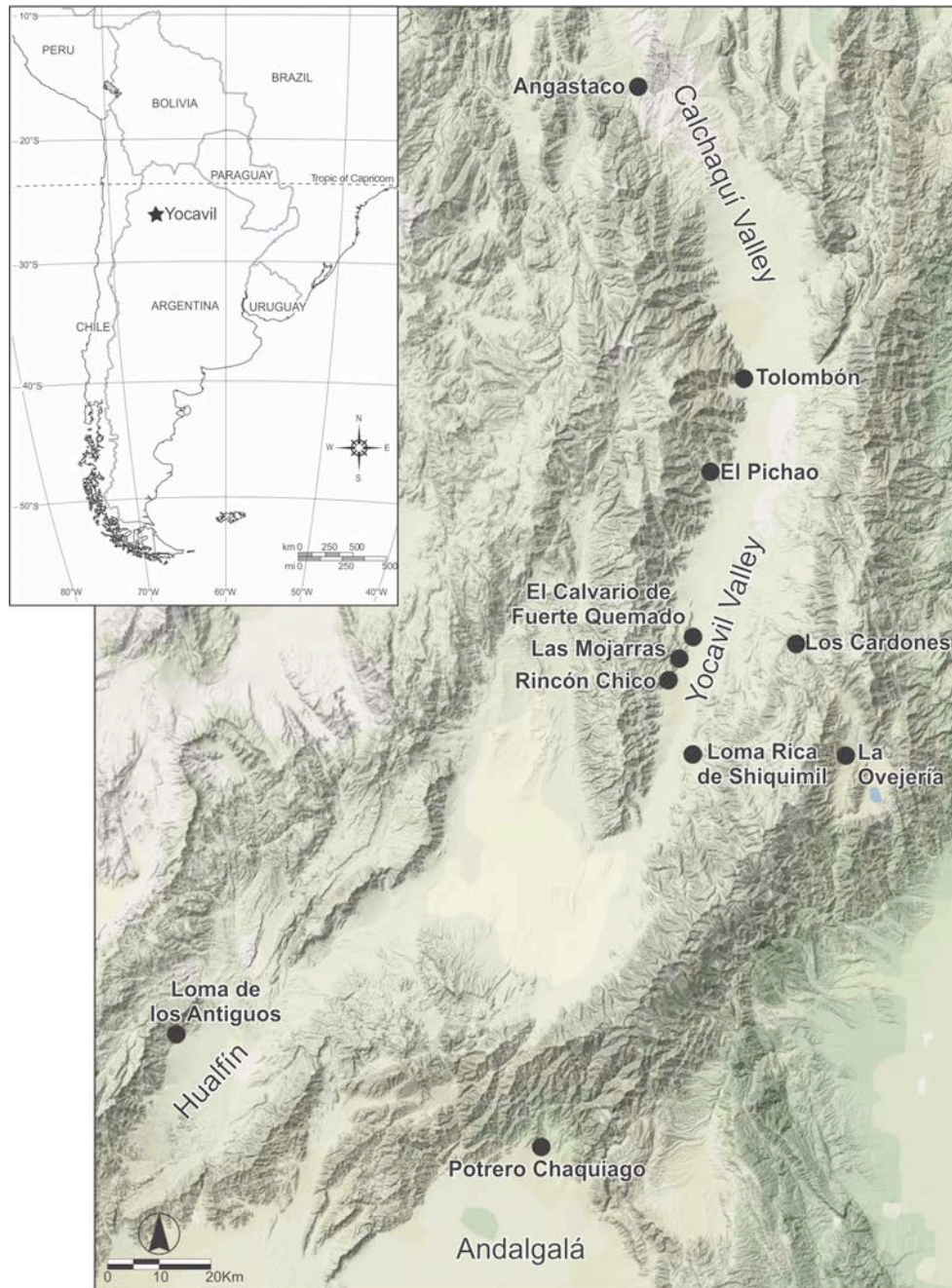


Figure 1 Archaeological sites in Yocavil Valley and surrounding areas with locations of the <sup>14</sup>C dates analyzed

FNG is a thin-walled pottery, with dark and heterogeneous coloration, polished surfaces, and incised designs in the majority of the pieces. These designs were filled with white mineral pigments that enhanced them. The FNG aesthetic presents interesting parallels with the late bronze metallurgy with embossed designs: discs, oval bells, and elaborated axes. Within the varied morphologies identified, there is a predominance of bowls for the service of food and beverage (Palamarczuk 2011) (Figure 2).



Figure 2 Examples of FNG ceramic style from the archaeological site Famabalasto, Cajón Valley, Catamarca, Argentina, belonging to the Muñiz Barreto Collection, La Plata Museum, Argentina. Scale in cm. (a) MLP-Ar-5288 BMB; (b) MLP-Ar-5374 BMB; (c) MLP-Ar-5321 BMB; (d) MLP-Ar-5336 BMB.

In reviewing the research history, we recognized four hypotheses regarding the FNG chronology (Figure 3), with different levels of consensus in the archaeological community:

1. The FNG ceramics belong to times that include the ends of the Late period and the Inca expansion era in NW Argentina (Cigliano 1958; González 1992).
2. The FNG style is part of the heritage of the Santa Maria societies and provides evidence of the persistence of a kind of pottery that preceded their organization. They are late forms that began to be developed in the 9th century AD, from a horizon of gray and black pottery that had previously extended through NW Argentina during the 5th or 6th century AD (Ibarra Grasso 1967; Serrano 1967).
3. The FNG style began to be made in the area with the arrival of the Incas and it is included in the whole of the pottery called “Provincial Inca” (Calderari and Williams 1991).
4. The FNG style is a characteristic production of the Late period in Yocavil Valley that continued to be made and circulated during the Inca period and even during the moment of hispanic-indigenous contact (Early Colonial) (Tarragó 1995; Palamarczuk and Manasiewicz 2009).

The ideas about the chronology can be grouped into two basic positions. On one side is the vision



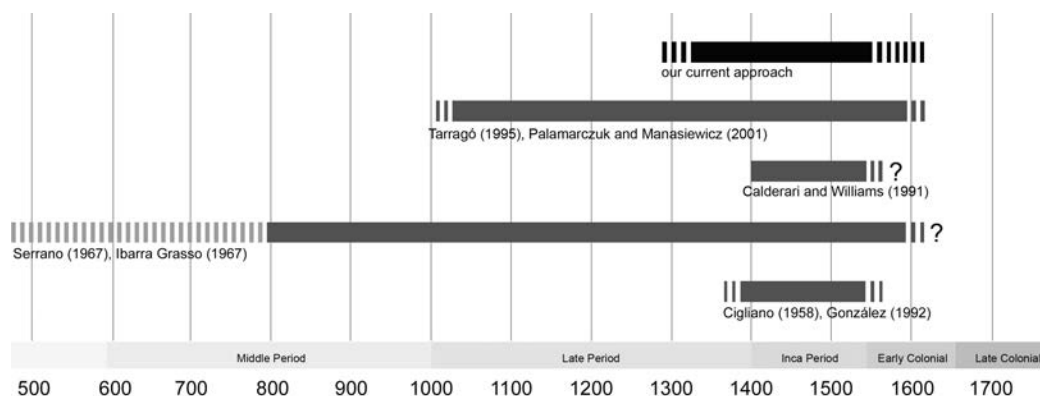


Figure 3 Representation of the chronological position of the FNG pottery style according to the authors cited in the text. Scale in calendar years.

that locates the beginnings of the style during the Incan expansion era. On the other side is the idea that the style originated before this expansion, during the local Late period. Given these different ideas, the style chronology appears as a problem whose resolution is essential if we want to locate its production in history and relate it to the discussions about the social and cultural process in the region. From a practical point of view, this ambiguity also reduces the utility of the FNG findings for inferring the age of the archaeological contexts where they are found. Given this current situation, the aim of our work was to achieve a chronological adjustment of the style using the available <sup>14</sup>C information, which was complemented with the study of the associations of funerary contexts, developed in another publication (Palamarczuk 2011). For this, we used published and unpublished studies as well as fieldwork.

## METHODS

For evaluating the <sup>14</sup>C chronology of the FNG style on a regional scale, we performed a comprehensive review of the literature considering published dates and details of associations of systematic archaeological excavations, taking into account the amount of FNG fragments and their proportion in relation to other styles, the total number of fragments according to the excavated areas, the degree of reassembling, and the sample integrity. All of these variables are related to the ceramic set. In total, 48 <sup>14</sup>C dates of published contexts with FNG pottery were considered. Although the majority are from the town of Rincón Chico (26), studied by our working team, 22 dates were collected in nine other archaeological localities, so the observed tendencies transcend the ambit of a single town, thus providing regional patterns for the style chronology.

The general methodology comprised the evaluation of the association between the <sup>14</sup>C dates, the events to be dated (i.e. the structures of combustion, floors, or tombs) and, at its time, the association between the ceramics sets and the dated contexts. When working with long series of dates, some authors had considered the necessity of making selections from them because the inaccuracies can alter the archaeological patterns of interest (Pettitt et al. 2003; Blockley and Pinhasi 2011; Nolan 2012). We maintain the necessity of using ranked information as a principle, which proves useful starting with the qualitative classification of the associations based on degrees of certainty suggested by Waterbolk (1983). This author considered a differentiation of four degrees for the association between <sup>14</sup>C samples and the archaeological object to be dated, but based on case studies and our experience we consider it necessary to differentiate two kinds of associations. First, there is the organic material dated and the archaeological context of recovery, or *sample-events association*

(S-E) (following Carbonari 1994). Second, there is the association between dates and fragments or ceramic vessels, *date-pottery association* (D-P) (Figure 4). In order to establish the quality of a  $^{14}\text{C}$  date applied to a specific context, both kinds of association must be evaluated in a complementary way. For example, the dating of a hearth on the floor of a room with scarce sherds may have a good S-E association but a poor D-P one.

| Association Sample-Event        | Association Date-Pottery          |
|---------------------------------|-----------------------------------|
| <b>A</b> Full certainty         |                                   |
| <b>B</b> High probability       | <b>I</b> High probability         |
| <b>C</b> Probability            | <b>II</b> Probability             |
| <b>D</b> Reasonable possibility | <b>III</b> Reasonable possibility |
|                                 | <b>IV</b> No association          |

Figure 4 Degrees of certainty in the associations

For the S-E association, we distinguished the cases according to the following criteria:

- A. Full certainty: when sample and events constitute the same archaeological object. For example, some artifacts of organic material or bones from a grave.<sup>3</sup>
- B. High probability: when a direct functional relation exists between the organic material (sample) and the diagnostic archaeological finds. For example, a hearth on the floor of a room, food remains inside a recipient, or carbonized remains inside a pipe.
- C. Probability: when there is not a demonstrable functional relation, but the quantity of organic material and the size of the fragments argue in favor of their association. For example, carbon concentration in an occupational floor or bone fragments in the same condition of conservation.
- D. Reasonable possibility: carbon particles of small size spread in the sedimentary matrix that contains the archaeological materials.

Other possibilities must be added to the options of this scale. For example, it is quite common not to find enough information to recognize the kind of feature, concentration, or origin of the dated samples in the bibliographical sources, so we classified them as indeterminate S-E association. Likewise, if the reference is vague and raises doubts, we add the sign (?) to the association degree. To rank the information in this way does not mean to directly reject some dates. On the contrary, it allows valuing all the available dates according to the necessary resolution for every temporal perspective and the research goal.

For the D-P association, we distinguish the cases according to this scale:

- I. High probability: When a direct functional relation exists between the ceramics (in this case FNG) and the dated events; for example, an urn containing a burial, a vessel with evidence of having been used over fire; also, vessels broken *in situ* in abrupt abandonment contexts.
- II. Probability: Vessels with a high degree of reassembly or grouping associated with an occupational floor. Large quantity of fragments without reassembly or grouping, but distributed in

3. Waterbolk (1983:58) placed within this level the example of “organic baking material in pottery.” We consider that it is a functional association (High Probability).

refuse and production areas.

- III. Reasonable possibility: Ceramic fragments dispersed in the sedimentary matrix, or even over an occupational floor, but in scarce quantity and low degree of reassembly or grouping.
- IV. No association: No associated ceramic, or an insignificant presence of it.

There is not a completely certain association between the <sup>14</sup>C dates and the ceramic because an indeterminate lapse of time exists between the making of the ceramics and their use. The perspective of the life history of the objects *sensu* Appadurai (1991) offers a necessary precaution, if we take into account that some objects could have had an extensive and changing useful life. In this sense, the major probability is constituted by the association between the skeletal remains of a child inside an urn or ceramic container, but we cannot be completely sure whether that vessel was made in a time close to the death of the individual. Regarding the ceramics in funerary dated contexts, some specific considerations according to the funerary local rules must be added, like the reopening of tombs or multiple burials, aspects that exceed this presentation.

For the purposes of our analysis, we consider the S-E association, but the D-P type of association gains special relevance and is the one that we use to organize the following exposition.

#### **ANALYSIS OF CASES**

To show the analysis made on the evaluation of every one of the 48 <sup>14</sup>C dates and their associations (Table 1), we present in detail examples for each of the date-pottery degrees of association. The evaluation of the contexts aims to include their contextualization in the local and regional ambit, the excavation techniques, the mode of obtainment and the dated organic sample's nature, the typology and the relative frequencies of the pottery sets (taking into account the chronological value for the different regional types), and the formation processes that affected the deposits, to the extent to which the published information allows.

##### **Grade I Association – High Probability**

In the case of the FNG pottery, there are no dated contexts with this degree of D-P association. These are the kind of contexts that should be selected to date in the future. In this case, it is expected that the contexts correspond to situations of funerary use, either as a lid of ceramic urns for a child's burial, or as an offering in individual burials of another kind.

##### **Grade II Association – Probability**

*El Calvario de Fuerte Quemado.* This is a town from the Late period, with more than 400 stone structures, including some that were modified as a consequence of the Inca expansion. Excavations were made in three Inca circular structures (named Superior, Medium, and Inferior towers). The Superior tower, 3.35 m in diameter, was stratigraphically excavated intramurally. A floor was discovered that was made with a layer of consolidated mud applied over a pavement of slab stone. There is a predominance of late local styles in the ceramic at all the levels of excavation, especially Santa María Bicolor and Coarse ware. Fragments of two FNG vessels were found in contact with the mud floor surface; thus, we consider that there is a high probability of an association with it. The Superior tower is the highest structure in this sector, from a topographical point of view, and for this reason it is improbable that the object's presence was a result of vertical migration by gravity from other spaces of use. We observed dispersed carbon spicules in the mass of consolidated mud of the floor. The totality of that sediment was dry sieved to recover the spicules, selecting only the little branches to perform a conventional dating, the result of which was  $340 \pm 50$  BP (LP 1903). Because

of its small dimensions, it was not possible to establish the carbonized vegetal species, but the small diameter of the selected branches guarantees that they are not long-lived specimens, ensuring a short time between death, combustion, and mixture on the floor. The carbon fragments were found dispersed but embedded and homogeneously distributed on the prepared mud floor, for which reason they are designated as having a C sample-events degree of association (Probable).

### **Grade III Association – Reasonable Possibility**

*Rincón Chico. Structure 214.* This late settlement has a minimum of 365 structures in the dense town sector. To date, for the whole settlement, there are 42  $^{14}\text{C}$  dates, of which 26 are from excavations where FNG fragments were recovered. The quantity of ceramic fragments recovered in the conglomerated sector was very low, either due to the small size of the excavation or because of formation processes. For our example, the case of structure 214 from sector X, located along a steep slope, is interesting. The area, stratigraphically excavated, was 16 m<sup>2</sup> (14% of the surface of the structure, which is 91 m<sup>2</sup>). At approximately 70 cm below the surface, a floor was located over which a series of lenses of ash and two small lenses of charcoal and ashes were spread, from which a date of  $830 \pm 60$  BP (LP 1414) with a grade B (High Probability) of sample-events association was obtained. The recovered artifacts included a polished stone axe, faunistic bone remains, and some obsidian and quartz flakes. The functional relation of the vessels is doubtful because they are represented by scarce or unique fragments, in a town sector with a significant slope and more enclosures at superior heights. As a consequence, we do not discard the migration of the fragments from higher spaces of use. The level of association among the scarce FNG fragments and the date is thus of Reasonable Possibility.

### **Grade IV Association – Nonexistent**

In this category we include cases cited as associations, but when subjected to our evaluation of stratigraphic information, frequency of findings, and review of typologies, we reinterpret as not associated with the dating.

### **Indeterminate Association (?)**

*Las Mojarras.* The only date in this late town corresponds to the mound LM 1-Augier, located in the low sector where rescue excavations were made. The evidence suggests that the place was part of a disposal and metallurgic production area. In a small trench of  $1.15 \times 1.5$  m, 22 arbitrary levels of 5 cm were excavated, recovering an abundant quantity of fragments of diverse styles, including FNG. A conventional date of  $400 \pm 60$  BP (LP 1310) was obtained from a significant, sharply delimited concentration (a possible fire hearth or dump) with burned cobs and corn seeds in an excellent state of conservation, that lay between the levels 17 and 22. The sterile archaeological levels begin at the level 22. The excavation revealed some structures made by fossorial mammals, which had contributed to a significant disturbance of the deposits, although the carbon concentration does not appear to have been affected by this process. We conclude that there exists a high probability of sample-events association in this case, increasing the reliability of the date because of the fact that it was made over plants of annual lifecycle. However, because of the complexity of the deposits and the excavation technique, the relationship is not known between this dated feature and the ceramic fragments recovered at different levels of the excavation, which show important vertical migration evidenced in the reassembly process. Therefore, we cannot establish any kind of relation between the dating and the FNG.



Table 1 Archaeological sites or localities with <sup>14</sup>C dates associated with the FNG ceramic style. Information taken from Cremonese and Williams (2007); Greco (2012); Pérez (2010); Palamarezuk (2011); Rivolta and Salazar (2006); Williams (1995, 2003, 2010); and Wynveldt (2009).

| Site/Locality                 | Sector/Structure        | Lab code    | <sup>14</sup> C yr BP | Sample origin  | Association |
|-------------------------------|-------------------------|-------------|-----------------------|--|-------------|
| Loma de Los Antiguos          | Recinto 11              | LP 976      | Modern                | Charcoal in a house floor                                  | C II        |
| Rincón Chico                  | RCh 15 - MM             | LP 1009     | Modern                | Combustion structure, metallurgical and ceramic production | B III       |
| Rincón Chico                  | RCh 15 - MM             | LP 1021     | 210 ± 60              | Combustion structure, metallurgical and ceramic production | B III       |
| Rincón Chico                  | RCh 1 - ML 39           | Beta 162380 | 240 ± 40              | Subadult bones in a funerary urn                           | A III       |
| Angastaco                     | Tambo                   | Beta 239859 | 300 ± 60              | ?  | ? ?         |
| Rincón Chico                  | RCh 1 - ML 7            | LP 1350     | 310 ± 60              | Concentrated charcoal in a house floor                     | C III       |
| Loma de Los Antiguos          | Recinto 31              | LP 1644     | 350 ± 50              | Human burial in a dwelling                                 | A III       |
| El Calvario de Fuerte Quemado | Torreón Superior        | LP 1903     | 340 ± 50              | Charcoal included in a prepared clayey silt floor          | C II        |
| Tolombón                      | T2A6c3n6 L1             | GX 29663    | 350 ± 60              | Charcoal from a hearth                                     | B II        |
| Las Mojarras                  | Las Mojarras 1 - Augier | LP 1310     | 400 ± 60              | Concentrated corn seeds, possible fire hearth or dump      | B ?         |
| Angastaco                     | Tambo                   | Beta 239860 | 420 ± 60              | ?  | ? ?         |
| Rincón Chico                  | RCh 14 - E1             | LP 1015     | 430 ± 60              | Fire pit in the floor of a dwelling                        | B II        |
| Tolombón                      | T2A6c3n7                | Beta 168672 | 440 ± 50              | Charcoal from hearth in a house floor                      | B II        |
| Tolombón                      | T2A6c6n9                | Beta 171426 | 440 ± 60              | Charcoal and ashes lens under the floor                    | B II        |
| Tolombón                      | Conoide Div. D RA       | n/d         | 440 ± 60              | Charcoal in a house floor?                                 | ? II        |
| Tolombón                      | T2A6c6n6                | Beta 171425 | 460 ± 60              | Charcoal from a hearth                                     | B II        |
| Los Cardones                  | R78 - level 1           | LP 1484     | 460 ± 60              | ?  | ? II        |
| Loma Rica de Shiquimil        | R27                     | LP 2212     | 460 ± 80              | Concentrated charcoal in a house floor                     | C III       |
| Potrero Chaquiago             | LS RIII CIV N9          | LP 319      | 480 ± 50              | Charred post on the floor                                  | B II        |
| Rincón Chico                  | RCh 15 - AN             | LP 2225     | 480 ± 50              | Combustion structure, metallurgical and ceramic production | B II        |
| La Ovejuna                    | ZCC cista 2             | LP 2222     | 480 ± 60              | Bones from human burial                                    | A II        |
| Rincón Chico                  | RCh 12 - E1             | Beta 130222 | 490 ± 50              | Fire pit in the floor of a dwelling                        | B II        |
| Rincón Chico                  | RCh 15 - MO             | LP 1713     | 500 ± 60              | Combustion structure, metallurgical and ceramic production | B II        |
| Tolombón                      | T2A6c3n6                | GX 29251    | 500 ± 60              | Charcoal from a hearth                                     | B II        |
| Rincón Chico                  | RCh 8 - E2              | LP 1624     | 520 ± 50              | Charcoal from small hearth in a house floor                | B II        |
| Angastaco                     | Tambo                   | Beta 203739 | 530 ± 40              | Charcoal accumulated in an area of discard                 | C III       |
| Rincón Chico                  | RCh 1 - E6              | LP 1638     | 550 ± 50              | Charcoal and ashes lens, ritual burning                    | B III       |
| Rincón Chico                  | RCh 13 - E1             | Beta 131674 | 560 ± 60              | Combustion structure, possible metallurgical production    | B III       |
| Potrero Chaquiago             | LS RIII C1 N6           | Beta 49616  | 560 ± 70              | Corn from a fire hearth                                    | B II        |
| Rincón Chico                  | RCh 15 - MO             | LP 728      | 570 ± 60              | Combustion structure, metallurgical and ceramic production | B II        |
| Rincón Chico                  | RCh 1 - E128            | LP 1622     | 570 ± 60              | Charcoal from hearth in a house floor                      | B III       |
| Los Cardones                  | R81 - Level 20-60       | LP 1573     | 570 ± 60              | Charcoal concentration, ritual burning                     | B II        |
| Angastaco                     | Tambo                   | Beta 239861 | 570 ± 70              | Charcoal   | ? ?         |
| Rincón Chico                  | RCh 15 - AN             | LP 2208     | 620 ± 70              | Combustion structure, metallurgical and ceramic production | B II        |
| Rincón Chico                  | RCh 15 - MO             | LP 1461     | 650 ± 60              | Combustion structure, metallurgical and ceramic production | B II        |
| Rincón Chico                  | RCh 15 - MO             | LP 401      | 660 ± 70              | Combustion structure, metallurgical and ceramic production | B II        |
| Rincón Chico                  | RCh 8 - E2              | LP 1491     | 660 ± 70              | Concentrated charcoal in a house floor                     | C II        |
| Rincón Chico                  | RCh 15 - E1             | LP 416      | 680 ± 110             | Fire pit in the floor of a dwelling                        | B III       |
| Rincón Chico                  | RCh 1 - E6              | LP 1636     | 690 ± 70              | Charcoal and ashes lens, ritual burning                    | B III       |
| Rincón Chico                  | RCh 1 - E161            | LP 771      | 720 ± 60              | Charcoal from hearth in a house floor                      | B III       |
| Tolombón                      | T2A6c3n10               | GX 29252    | 720 ± 60              | Charcoal and ashes lens under the floor                    | B II        |
| Rincón Chico                  | RCh 15 - E3             | LP 451      | 820 ± 80              | Charcoal from hearth in a house floor                      | B III       |
| Rincón Chico                  | RCh 1 - E214            | LP 1414     | 830 ± 60              | Charcoal from hearth in a house floor                      | B III       |
| Rincón Chico                  | RCh 15 - E2             | LP 459      | 830 ± 90              | Concentrated charcoal in a house floor                     | C III       |
| Rincón Chico                  | RCh 18 - E2             | LP 428      | 890 ± 100             | Concentrated charcoal in the sediment                      | D II        |
| Los Cardones                  | R78 L4                  | LP 1495     | 930 ± 70              | ?  | ? III       |
| Rincón Chico                  | RCh 18 - E2             | LP 471      | 1020 ± 90             | Dispersed charcoal in a house floor                        | C II        |
| Rincón Chico                  | RCh 15 - E1             | LP 529      | 1175 ± 70             | Concentrated charcoal around a fire pit (LP 416)           | C III       |

## RESULTS AND DISCUSSION

Figure 5 shows the probabilistic distributions of all the calibrated dates, with a colored gradient indicating the declining D-P certainty. It can be seen that the probabilities are distributed from the end of the 1st millennium AD to modern time. It also stands out that the majority of the dates with a good level of association are temporally located in the intermediate moments of that rank, whereas those that deviate from the whole in both extremes have a minor degree of association.

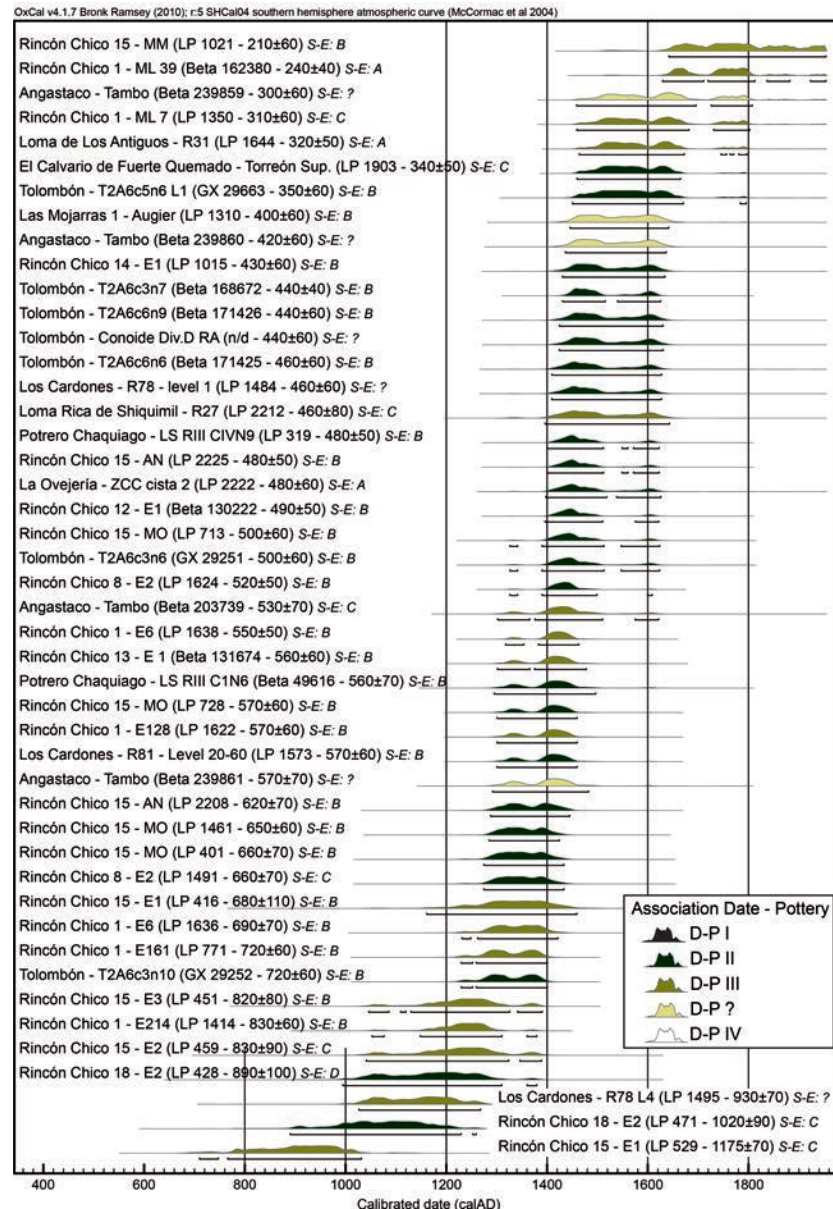


Figure 5  $^{14}\text{C}$  dates with different degrees of association respect to FNG ceramic style. Information taken from same sources cited in Table 1. Calibration was done using the curve SHCal04 (McCormac et al. 2004) and software OxCal v 4.1 (Bronk Ramsey 2009). Note that two other dates reported as “modern” are not shown here.

Our data ranking test leads to privileging data with better associations as much in the S-E as in the D-P association type, presented in Figure 6. There are 21 accepted dates, which means that less than 50% of the known dates were judged as satisfactory for making a chronological characterization of the style. We put aside 22 dates with dates with S-E degree D and indeterminate, D-P III and indeterminate, two others that were reported as modern, and three cases from Rincón Chico whose accuracy we marked as doubtful in previous works (Greco 2010; Palamarczuk 2011; Palamarczuk and Greco 2012).

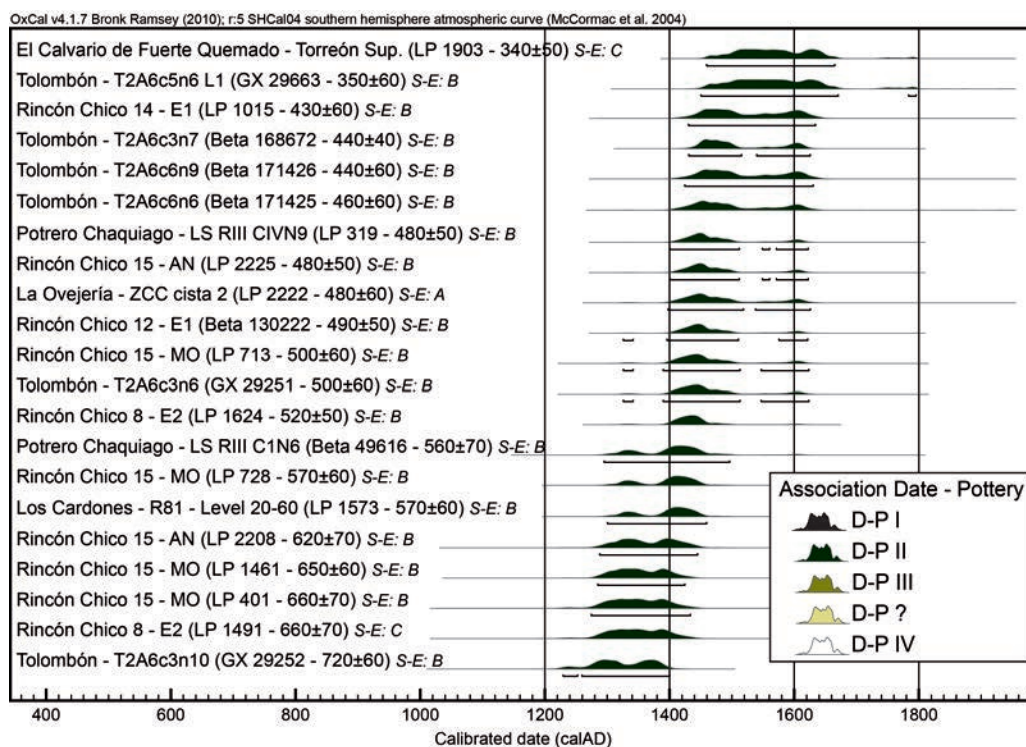


Figure 6 Selection of <sup>14</sup>C dates associated with FNG pottery

A detailed analysis of sample provenance (Palamarczuk 2011; Palamarczuk and Greco 2012) has shown the best associations. A great majority of the dates (76%) come from the great settlements of Rincón Chico ( $n = 10$ ) and Tolombón ( $n = 6$ ) in Yocavil Valley, where dating was conducted on charcoal from hearths and combustion features in households or craft production places. The remaining dates with good associations (23%) come from a greater diversity of archaeological settings located both in the same and neighboring valleys. These include a ritual area in Los Cardones ( $n = 1$ ), an Inca structure in El Calvario de Fuerte Quemado ( $n = 1$ ), a funeral area from Ovejería-ZCC ( $n = 1$ ) in Tafi Valley, and the Inca installation of Potrero Chaquiago ( $n = 2$ ) in Andalgalá. Taken together, this sample is a good basis for an overview of the chronology of the FNG style for the Yocavil region, which could be similar for surrounding areas if more data are added with further investigations.

The critical study of the available <sup>14</sup>C dates allows us to evaluate the initial statement about the chronology of the FNG style. If we consider the complete probability range of the calibrated dates from Figure 6, its validity as a regional manifestation would range from between the beginning of the 14th century and the middle of the 16th to beginning of the 17th centuries.

This same data is used to build a Bayesian statistics model to assess the duration of the phenomenon. We designed a uniform phase model with OxCal (Bronk Ramsey 2009) that considers all the  $^{14}\text{C}$  dates as belonging to the same phase and evaluated it first for the complete data set and then for a selection (Figure 7). We currently do not have enough *a priori* information to distinguish subphases, although in the future this model could be more complex with further information.

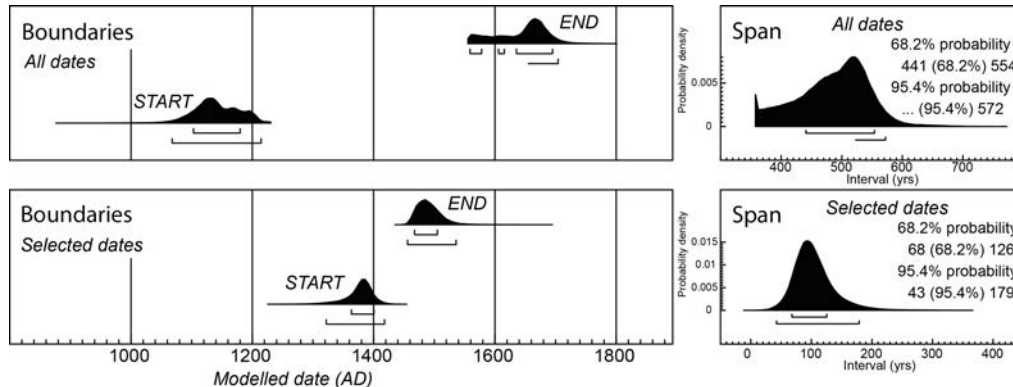


Figure 7 Modeled boundaries and span for a Bayesian single phase model considering the complete data set (upper graphics) and the selection (lower graphics), using the software OxCal v 4.2 (Bronk Ramsey 2009) and the calibration curve SHCal04 (McCormac et al. 2004).

Analysis of the complete data set results shows a location in time and duration of the FNG style similar to that previously indicated by Tarragó (1995) and Palamarczuk and Manasiewicz (2009). However, when analyzing only the group of  $^{14}\text{C}$  dates that have good S-E and D-P associations, the output model shows a timespan of less than 2 centuries, beginning in the middle of the 14th century and ending in the beginning of the 16th.

This means that FNG would be a local stylistic innovation phenomenon in an intermediate/final moment of the Late period, and its production seems to decline in the Early Colonial period or immediately after the fall of the Inca Empire. In any case, we recognize that given the probabilistic nature of the dating methods, to talk about specific dates is only possible as a heuristic resource. This range emerged from a cautious exercise in which, through different stages, the most reliable data are ranked considering dates with good degrees of sample-events and date-pottery association, and considering also the concordance between the results and the knowledge about the temporal validity of other ceramic styles linked in each case.

Finally, it should be noted that there exist other criteria that can be employed for the data selection but were not necessary in our case, including the possibility of the old-wood effect, very large standard deviations in the reported age, time of the dating (if they were made long ago they have a high risk of underestimated systematic errors), or more sophisticated classification series such as those presented by Pettitt et al. (2003), Blockley and Pinhasi (2011), or Nolan (2012).

## CONCLUSIONS

Returning to the methodological aspects of this work, we conclude that the establishment of good associations is fundamental to extract solid conclusions from the dates. The evaluation of a temporal trajectory using  $^{14}\text{C}$ , that is, the establishment of a chronology for objects, is only possible if the association between them is taken into account, for which a qualitative evaluation scheme of degrees of certainty between sample and event (S-E) and date and pottery (D-P) is a useful tool. The collection of samples for  $^{14}\text{C}$  dating of well-defined archaeological contexts is absolutely necessary



but not sufficient to obtain accurate <sup>14</sup>C ages to estimate the age of use of these materials. Managing a significant sample of dates, gathered through decades of investigation, allows us to detect those dates that deviate from the general tendencies.

A limitation to take into account when working with bibliographical information is the disparity of criteria when presenting the dates and their contexts. Also, we observe that in the future it would be beneficial to go forward with the practice of dating reliable contexts (Boaretto 2009), making field sampling designs that include contexts with good associations between dates and ceramic, such as single burials, offerings that could be linked to individuals, or organic adherences in vessels.

These results allow us to evaluate current hypotheses regarding the chronology of the FNG style, with different levels of acceptance in the archaeological community, and to offer an alternative. This, of course, may be improved when new dates with good associations are added. Nevertheless, more than a discussion regarding the chronology of the style, this article has placed the emphasis on how a methodological decision to consider either all or a selection of the available data significantly influences the interpretation of the social process under study.

Beyond the interesting information obtained for our problem of study, in particular the temporality of the pottery style Famabalasto Negro Grabado, the exhibited analysis method can be applied to different cases of study in other spatiotemporal situations.

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