

## ARCHAEOMETRIC AND TECHNOLOGICAL INVESTIGATIONS OF NURAGIC CERAMICS FROM SANT'IMBENIA (SARDINIA).

B. De Rosa<sup>1</sup>, P. Mameli<sup>1</sup>, G. Cultrone<sup>2</sup>, M. Rendeli<sup>3</sup>

<sup>1</sup> Dipartimento di Scienza della Natura e del Territorio, Università degli Studi di Sassari, Via Piandanna, 07100, Sassari (Italy); [bderosa@uniss.it](mailto:bderosa@uniss.it)

<sup>2</sup> Departamento de Mineralogía y Petrología, Universidad de Granada, Avda. Fuentenueva s/n, 18002, Granada (Spain).

<sup>3</sup> Dipartimento di Storia, Scienza dell'Uomo e della Formazione, Università degli Studi di Sassari, Viale Umberto 51, 07100, Sassari (Italy).

### Introduction

The Nuragic site of Sant'Imbenia at Alghero (North-Western Sardinia, Italy) was inhabited approximately from the 14<sup>th</sup> to the 6<sup>th</sup> century B.C.[1] (Fig.1).

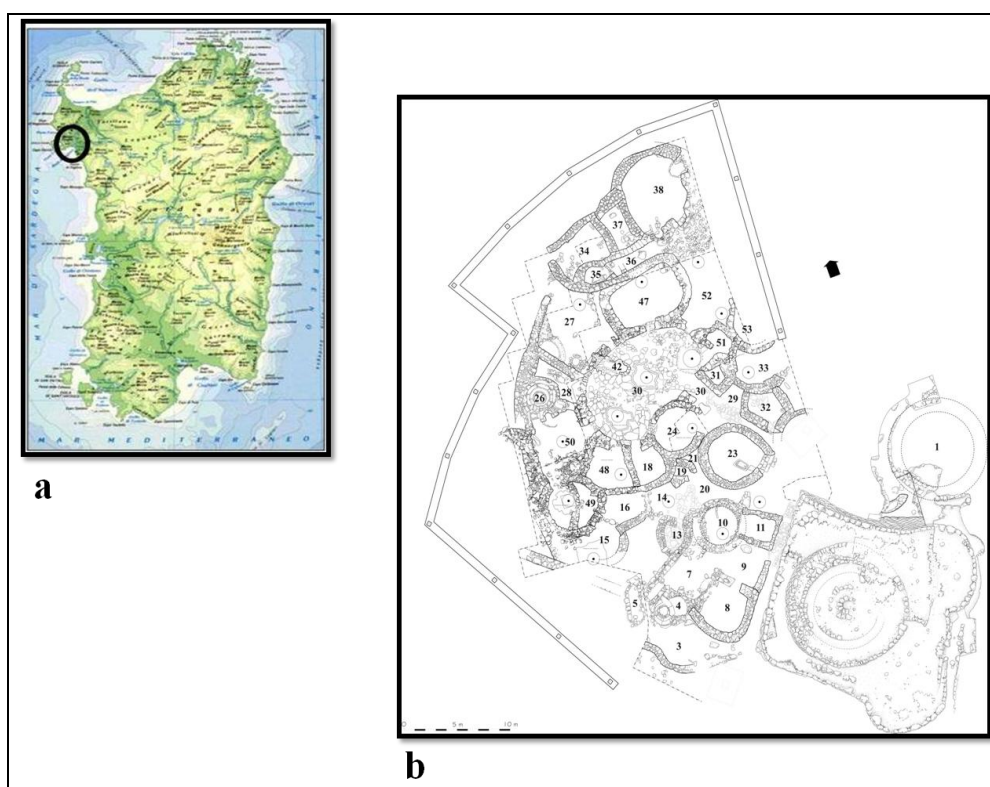


Figure 1. a) map of Sardinia in which the black circle indicates the location of the Nuragic area of Sant'Imbenia; b) map of the site before the archaeological excavation of 2010 (Graphic elaboration by L. Sanna and A. Demurtas)

Between the end of the Bronze Age and the beginning of the Iron Age merchants and some craftsmen arrived to Sant'Imbenia attracted by the prosperity of the area. Several types of goods were exchanged in Sant'Imbenia, along with experiences, ideas and news. Exchanges in technological knowledge and cultural ways of live were established; in fact, local ceramics, imported red-slip Phoenician wares, local imitations of Phoenician products and Greek, Euboean, Corinthian and Pithecusian drinking pots have all been found in this area [2][3][4][5].

## Materials and methodology

The analyzed pottery represents the typical repertory of the Nuragic production: bowls, askoi, jars [6][7] (Fig. 2).

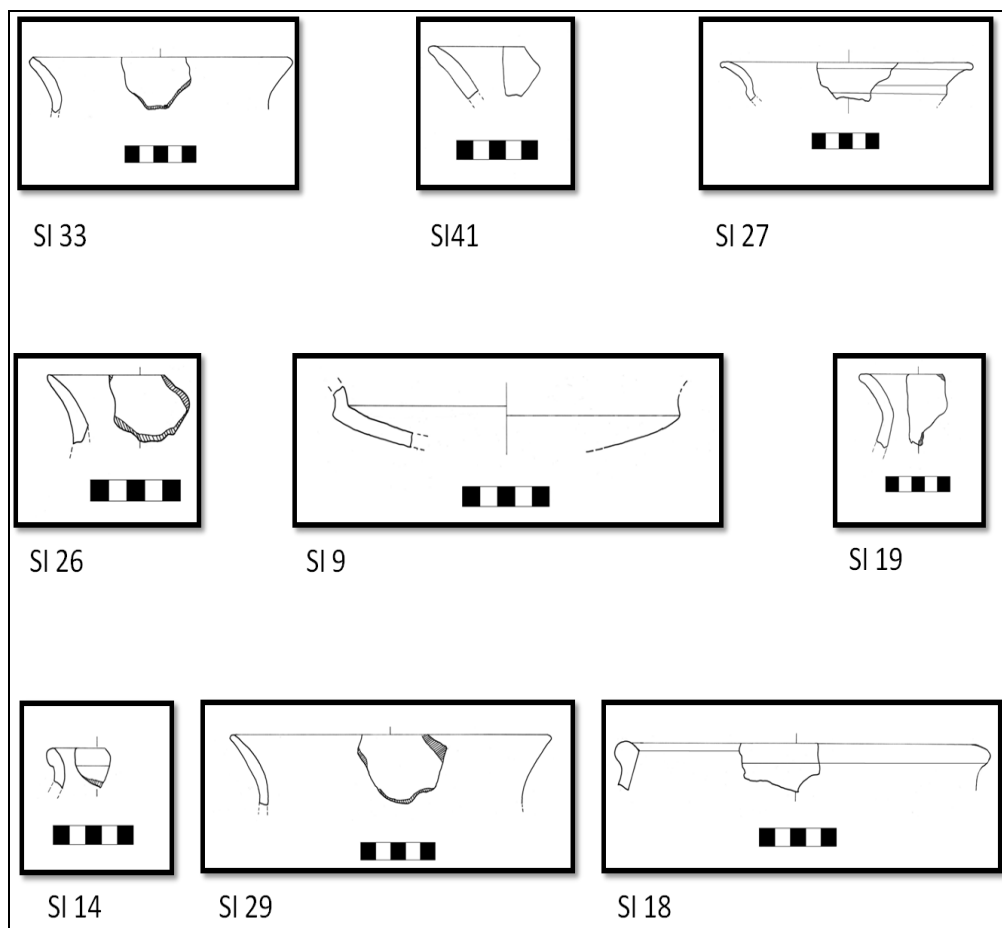


Figure 2: some examples of the studied pottery.

The samples have been observed under a stereomicroscope to identify the different superficial treatments. The mineral phases and ceramic textures were established by observing thin sections under a polarized optical microscope. The mineralogical composition was determined using XRD analysis; data interpretation was performed using the X Powder software [8]. Bulk chemical analyses were performed by means of the XRF technique.

## Results

The samples show different surface treatments: polishing, smoothing, burnishing or patinating.

After the mineralogical and petrographic analysis, the samples were divided into two groups: the first is characterized by low birefringence, a 15-20% grains content with a bimodal distribution and a porosity values range between 20-30%. We observed quartz, calcite, muscovite, rare feldspars and metamorphic and sedimentary rock fragments (phyllites and litharenites). Imprints of straw and other plant remains were also detected (Fig.3); the second has matrices with a black heart, medium birefringence, a 10-15% temper content and porosity values between 5 and 10%. Quartz, K-feldspar, muscovite, hematite and plagioclase were detected; also, there are fragments of volcanic rocks (pumice and ignimbrites) in relatively constant proportions and sizes and fragments of metamorphic and sedimentary rocks (Fig.3).

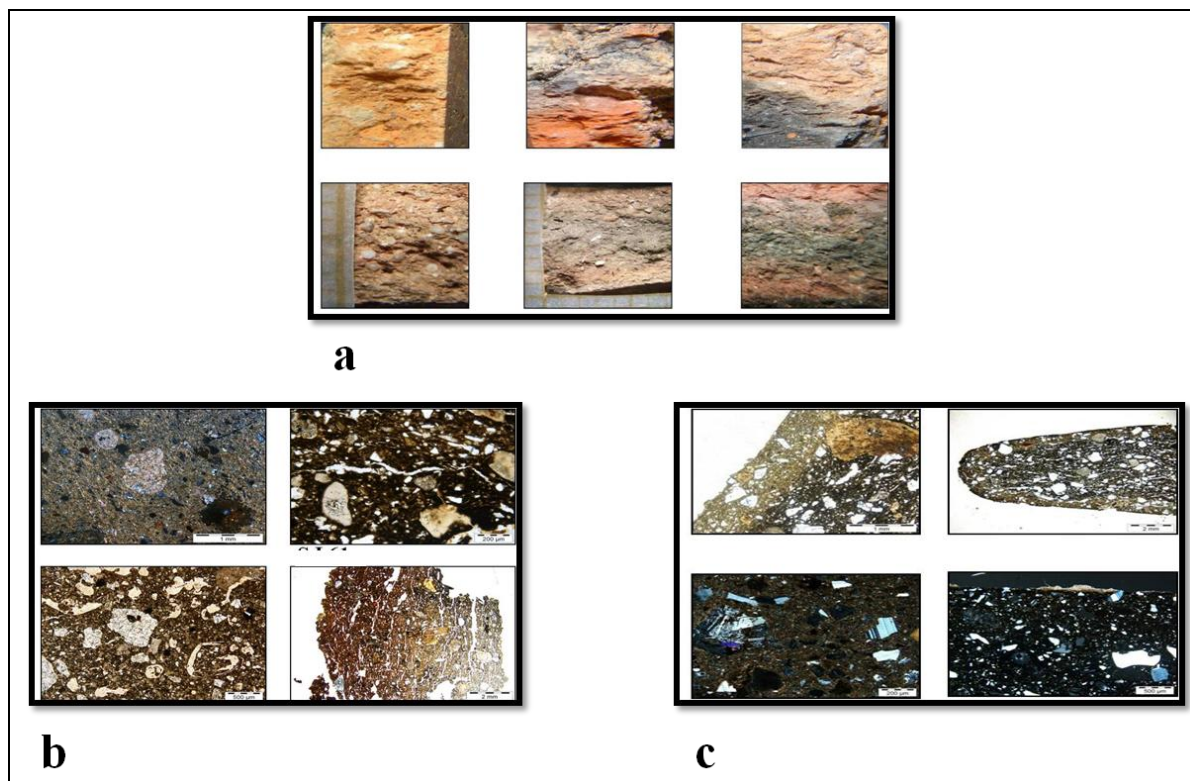


Figure 3. a) stereomicroscopic observation, 10X: the samples first, fourth and fifth belong to the group 1; the others to the group 2; b) MOP observation: samples of the group 1; c) MOP observation: samples of the group 2

XRD analyses confirmed the previous observations; all samples are rich in quartz and have varying muscovite and feldspar content. In the samples of the second group we also detected new silicate phases, gehlenite and diopside.

XRF analysis performed on a little number of samples showed differences especially for the amount of CaO; all are rich in Si and Fe elements.

### Conclusions

The study conducted on Nuragic ceramics revealed some differences between the two groups. The first group utilizes material rich in phyllites, quartz and feldspars, is characterized by rather friable mixtures due to the high amount of temper and a porosity level of 20-30%, the second group uses fragments of volcanic rocks, has a slightly lower porosity level (15-20%). Both groups are locally produced: the pumice and ignimbrites may come from the Tottubella area, about 15 km east of the site [6][9], and phyllites and litharenites from Lago di Baratz, about 7 km east [6][9]. The XRD analysis has allowed us to take some observations about the firing temperature; the samples of the first group were fired at temperatures of around 750-800°C, as the presence of calcite and muscovite suggest; the samples of the second group and were fired at temperatures of around or above 900°C, as attested by the presence of gehlenite and diopside, aspect who is possible to explain as a technological evolution.

We observed an evolution in the technology used to produce the ceramics, for example the treatment of the surface, which reduced surface permeability to the minimum. The surface often have a very thin red patina, bonded with the ceramic body, bright, non-porous and

partially vitrified: this aspect can be considered like imitations of Phoenician red-slip products imported into Sant'Imbenia.

*Key words:* Nuragic ceramics; Sardinia; mineralogy; texture; technology.

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