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## Geochemical study of beveled rim bowls from the Middle Syrian Euphrates sites

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## ABSTRACT

Among the pottery of the Middle Uruk period (or Late Chalcolithic 4) in Syria-Mesopotamia (3800–3450 BCE), it is perhaps the beveled rim bowls (BRBs) which are the most usually interpreted as a “reference pottery” of this period. The BRB is a type of very basic, hand and mass-made bowl characterised by the standardisation of its shape. Despite the thousands of BRBs found in the sites linked to the expansion of Southern Uruk culture, their function continues to be debated. It is also unclear if the production and distribution of BRBs was performed by the large centres controlled by an institution (regional or state) or not. We have studied BRBs from two nearby sites of the Southern Middle Euphrates in Syria (Tell Humeida and Tell Ramadi) using mineralogical (petrographic observations and X-ray diffraction) and chemical analyses combining X-ray Fluorescence, Inductively Coupled Plasma-Mass Spectrometry and Instrumental Neutron Activation Analysis to assess if BRBs were produced in a single centre in the Syrian Euphrates. We have compared results considering major, minor and trace elements, analytical methods and sites as a first step for full comparison of BRBs from sites of the whole of Mesopotamia. Results show a very good fit among samples from the Syrian Southern Middle Euphrates, and some points are considered on the use of specific elements to assess provenance and monitor trade.

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## 1. Introduction

The chemical analysis of archaeological pottery and raw materials in support of provenance research has grown rapidly over the past few decades. Pottery can be studied via geochemical techniques as if they were natural stony materials. They can be considered as sediments metamorphosed at high temperatures and low pressure due to the process of firing clay needed for their manufacture (Szilágyi et al., 2012). Compositional profiles of pottery and raw materials (clays and temper) are used to trace individual artefacts from their find spot to their origin. The composition of pottery is strongly related to the source of clay and the tempering. This is usually site specific and, although similar in style and appearance, in critical cases it is possible to distinguish between the products of different producers by determining the chemical composition (e.g. Rice, 1987; Pollard and Heron, 1996; Prudêncio, 2009; Eckert et al., 2015).

Several geochemical techniques can be used for the characterisation and comparison of pottery sets. The purpose of the study can be to obtain information on the manufacturing processes (e.g. selection of materials, shaping technologies, firing conditions), assessment of contents (Evershed, 1990) or assessing various kinds of exchanges. Chemical analysis, together with statistical data treatment, has been used extensively to supplement archaeological investigations when provenance studies or socioeconomic aspects are concerned (Tite, 2008). However, statistical analysis is only a helping tool when very large amounts of

data matrixes are available (in terms of variables and samples). Considering that the results obtained are an approximation of the reality, the attribution of one pot or composition group to one particular site is based on statistical probability and the results must be checked taking into account geochemical considerations, as well as other compositional features such as mineralogy (e.g. Eckert et al., 2015).

A number of different analytical techniques have been employed to characterise archaeological materials, i.e. X-ray Fluorescence (XRF), Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and Instrumental Neutron Activation Analysis (INAA), the latter being the most common and successful. However, the use of one or the other technique involves some constraints, because the sample preparation procedures, measurement conditions, calibration procedures and use of correction factors can determine the results. Thus, it is difficult to compare results from different studies when different analytical methods have been used. Moreover, it is important to keep in mind the elements used in geochemical analysis. Major elements may give us an idea of the type of mineral material which makes up the ceramics. Minor elements can indicate the variations between different sources of material and major mineral abundance (this usually varies depending on the geological source of raw materials). However, trace elements can be used to determine the provenance of the mineral components in the paste or to distinguish different ceramic groups, better differentiating diverse raw materials even within the same geological context.

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This work has a dual purpose: (i) the mineralogical characterisation of a special kind of pottery (the “beveled-rim bowl” or BRB) using X-Ray diffraction and comparison of geochemical analyses obtained using different instrumental techniques (XRF, ICP-MS and INAA) on several samples to assess the problems which arise from the comparison of results obtained with each technique; and (ii) to compare and correlate the composition of sets of samples of BRBs taken from two nearby Uruk archaeological sites located in the Syrian Euphrates, to assess if they were made in the same site or with the same raw materials. This type of multi-method study can be crucial from an archaeological point of view to know if the production and distribution of BRBs was performed by large centres controlled by an institution (regional, supra-regional or state) or was a local product.

## 2. Archaeological frame of the study

The contribution of the Middle and Late Uruk period (Late Chalcolithic 4–5) to the birth and diffusion of the first urbanism in the Syro-Mesopotamian basin has been essential. Habuba Kabira, in the northern Middle Euphrates, is the first new city with an orthogonal plan found to date (Margueron, 2002). This city shows a characteristic urbanism of southern Mesopotamia. The planning of the first cities is well characterised around 3300–3100 BCE and Habuba Kabira is a good example: a geometric plan (rectangular), a ranked road network, the existence of a power centre (political and religious power) and a complex defensive system (city wall with towers).

Several Uruk sites can be found in the Middle Syrian Euphrates valley, as a result of population movements which occurred during the so-called ‘Proto-urban period’. The reason behind such an expansive movement is still not clear, although it seems evident that commercial activity may have played an important role based on evidence from major studies (Butterlin, 2003).

The study of the material culture defined as “southern Mesopotamian-style Uruk” or “genuine Uruk” in the Syrian Euphrates valley (Sürenhagen, 1986) has led us to conclude that there were different types of settlements in Syria within a hierarchical system characterised by mass production of some commodities. Such is the case of the BRBs, an indicative Uruk-type pottery. The location and distribution of BRBs have been used to study the connections and disconnections of Uruk geography.

Algaze (1993) has proposed a functional typology of the Uruk sites in the Mesopotamia periphery: enclaves, cluster sites, stations and outposts. According to archaeological evidence, it seems coherent to establish the following organisational system of Uruk sites in Syria (Schwartz, 2001): Uruk colonies and Uruk-related sites. However, we suggest that settlements in this region can be organised into three different types, based upon their material culture, that is to say: colonies that were founded ex-novo by people from the South of Mesopotamia (with an intrusive culture and massive presence of BRB), commercial enclaves founded over pre-existing indigenous establishments (with an hybrid culture), and points of interchange frequented by merchants from Uruk (with dominance of the local culture) (Montero Fenollós, 2012).

Among genuine Middle and Late Uruk materials, the so-called beveled rim bowls are frequently highlighted (Fig. 1). The BRB is a type of basic, mass-produced pottery of truncated-conical shape with fairly constant dimensions present in a large number in Uruk colonies across the whole of Mesopotamia. Two propositions have been considered to assess the manufacturing technique of the BRBs: they were entirely hand-made or made using a mould dug into the ground (Kaalsbeek, 1980; Strommenger, 1980). As far as the function and use of BRBs are concerned, several hypotheses have been proposed: to measure rations to pay state workers, to prepare yogurt, to make leavened bread, to drink beer, for the salt trade and to make offerings, to name but a few (Le Brun, 1980). The question of the function of BRB is interesting as it illustrates the difficulties encountered by researchers when evaluating what the introduction of this mass produced pottery can



Fig. 1. Set of BRBs from Tell Humeida (Syria).

represent on a social, economic and also cultural level in the peripheral regions of the south of Mesopotamia. A further question about BRBs still remains unanswered: that regarding the production and distribution centres. Was there a local, regional or supra-regional centre (“archaic state”) for the manufacture and distribution of BRBs?

Geochemical techniques can be a useful way to shed new light on the trade of BRBs. In this study, geochemical analysis of BRB samples from two nearby Uruk sites located in the Syrian Middle Euphrates was carried out to determine if the raw materials used on the samples from both sites were the same. For this purpose, we intend to obtain a quantitative spectrum of all the chemical elements of this kind of pottery. The manufacturing technique and function are also being studied in a whole research project on the BRBs of Uruk. New data from these other analyses (still in progress) will be published shortly.

## 3. Sites studied

In a stretch of approximately 200 km of the Southern Middle Euphrates, bounded by the gorge of Khanuqa and Baghouz, two sites of the Uruk period have been excavated. From north to south, they are Tell Humeida and Tell Ramadi (Fig. 2). BRB samples of these two are the basis of this study.

Tell Humeida is located on the left bank of the Euphrates, 6 km from the entrance to the Khanuqa gorge. A Syrian-Spanish team conducted a small survey in 2011 in the western part of the main hill (Montero Fenollós, 2011). In this sector we documented two occupation periods: Byzantine and Uruk. Provisionally, three phases were distinguished in the Uruk period. In the most recent one, there is a fragment of “riemchen” mudbrick wall (UC.105), which was partially destroyed during the construction of the Byzantine wall. The middle phase is a level of massive waste with charcoal, animal bones and pottery (UE.1006). Among other characteristic types of Middle Uruk period pottery, both whole BRBs and fragments are abundant. This level has been dated by AMS analyses of charcoal samples providing  $4917 \pm 40$  yr (Ua 42144) and  $4811 \pm 34$  yr BP (Ua-42140), that correspond to 3780–3640 BCE cal and 3660–3520 BCE cal, respectively. We have studied 30 samples of BRBs from this site.

Tell Ramadi is a site located on the right bank of the Euphrates, 12 km away from ancient Mari (Geyer and Monchambert, 2003) and downstream from the inlet of the Khabur River. A French team conducted excavations in 1991 which allowed us to define a sequence from the Obaid to the Middle Bronze period. However, the Uruk occupation was certainly the most important given the large amounts of pottery (particularly BRBs) found in the three excavated sectors (Beyer, 1991). The preliminary typological study of pottery allowed us to date the site to the Middle Uruk period although no absolute ages have been reported. We have included 11 samples from this site in this study.

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