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Application of strontium isotope analysis to provenance studies of Early Bronze Age North-Mesopotamian Metallic Ware

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ABSTRACT

Sr isotopic analysis was carried out on Early Bronze Age (*c.* 2800–2200 BCE) North-Mesopotamian Metallic Ware and clay samples collected from south-eastern Anatolia and north-eastern Syria with a view to determining the provenance of this characteristic ceramic type, in particular of its non-calcareous variant. The non-calcareous and calcareous variants of North-Mesopotamian Metallic Ware, which have been defined in previous archaeometric studies, show a clear distinction in their Sr isotopic signatures. The non-calcareous group is characterised by high $^{87}Sr/^{86}Sr$ ratios, whereas the calcareous variant has much lower values. The Sr isotopic signature of the non-calcareous group shows similarities with clay samples from the Pütürge Massif area in south-east Anatolia. Combining the results of the present study with previous investigations, it is thought that the raw material used for the production of non-calcareous North-Mesopotamian Metallic Ware could have been originated from the southern part of the Pütürge Massif area. Furthermore, this study proves that Sr isotope analysis is a useful tool for the characterisation and identification of archaeological ceramic provenance.

1. Introduction

North-Mesopotamian Metallic Ware (NMMW; Fig. 1) is one of the most characteristic ceramic types of the Early Bronze Age in south-eastern Anatolia and northeastern Syria, dated to the period between the Syrian Early Bronze Age II and Early Bronze Age IV A, *c.* 2800–2200 BCE (Falb, 2009a; Falb et al., 2014; Kibaroğlu and Falb, 2013). It is related to the cultural group characterised by a heavily fortified type of settlement, the Kranzhügel settlements in the middle of northern Syria (see below; Fig. 2; Falb, 2009a). The main distribution of NMMW is located within an extensive area between the southern foothills of the Taurus Mountains in south-eastern Turkey and the region south of the Jebel 'Abd al-Aziz in northern Syria (Fig. 2; e.g. Falb, 2009a; Kühne, 1976; Pruß, 2000). NMMW is characterised by a very hard and dense fabric; as a result of the firing process at high temperatures, at around 1000–1100 °C, it is closely related to modern stone ware (Fitz, 1984; Kühne and Schneider, 1988; Schneider, 1989). The majority of the ware is greyish in colour, although the surface colours can vary from buff over reddish-brown to grey and black, and occasionally even bicoloured orange–grey surfaces can occur. The clay paste is very pure, virtually free of coarse inclusions (e.g. Falb, 2009a; Kühne, 1976; Kühne and Schneider, 1988). Archaeologically, NMMW is considered to be the product of a craft tradition common to a special cultural group, displaying a high level of technological skill by the potters (Falb et al., 2014).

Because of its archaeological significance for the Early Bronze Age in the Near East and its remarkable technological features, NMMW has been the subject of numerous archaeological and archaeometric studies (e.g. Broekmans et al., 2002, 2006, 2008; Falb, 2009a; Fitz, 1984; Kibaroğlu, 2008; Kibaroğlu et al., 2008; Kibaroğlu and Falb, 2013; Klenk, 1987; Kühne, 1976; Kühne and Schneider, 1988; Pruß, 2000; Schneider, 1989; Schneider and Daszkiewicz, 2001). In earlier archaeological studies, NMMW was thought to represent local production in the alluvial region of the Jazirah, between the Euphrates and the Tigris rivers, and the Mardin High in the north. However, archaeometric studies of examples of NMMW collected mainly from northeastern Syria have demonstrated that this pottery was produced from two very different clay types, which are clustered according to their calcium oxide (CaO) content into calcareous and non-calcareous chemical groups (Kühne and Schneider, 1988). The calcareous group is characterised on average by high concentrations of CaO (up to 20%), magnesium oxide MgO (5.2 wt%), Sr (320 ppm), Cr (203 ppm) and Ni (180 ppm). In

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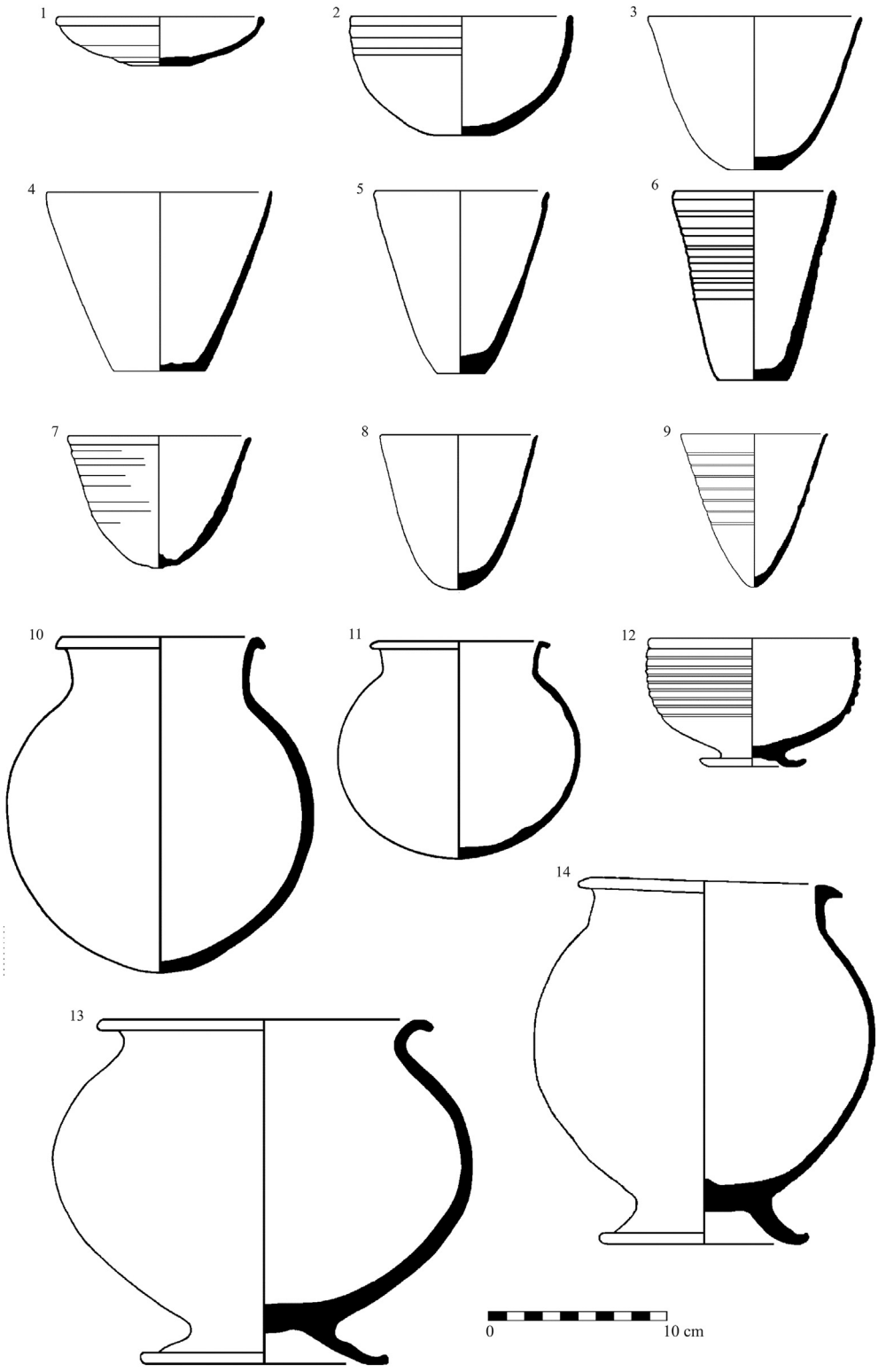

Fig. 1. Characteristic vessel types of NMMW from several sites in northeastern Syria and southeastern Anatolia. 1, Kurban Höyük (Algaze, 1990, plate 77R); 2, Tell Chuera (Kühne, 1976, Fig. 2); 3, Tell Chuera (Othmann and Pruß, 1995, 173, Fig. 86.123); 4, Tell Brak (Oates, 2001, 405, Fig. 394.82); 5, Tell Chuera (Othmann, 1995, 66, Fig. 25.45); 6, Harran (Prag, 1970, 82, Fig. 7.37); 7, Tell Qara Quzaq (Valdéz Pereiro, 1993, 131, Fig. 32.3); 8, Tell Qara Quzaq (Valdéz Pereiro, 1993, 131, Fig. 32.1); 9, Tell Shiyukh Tahtani (Falsone, 1998, 52, Fig. 7.9); 10, Tell Bi'a (Strommenger and Kohlmeyer, 1998, plate 128.4); 11, Tell Qara Quzaq (Valdéz Pereiro, 1993, 131, Fig. 33.9); 12, Tell Brak (Oates, 2001, 407, Fig. 395.104); 13, Tell Bi'a (Strommenger and Kohlmeyer, 1998, plate 97.3); 14, Tell Brak (Emberling and McDonald, 2001, 37, Fig. 13.4).

contrast, the non-calcareous group on average shows very low CaO (1.9%) and MgO (1.2%), low Sr (140 ppm) and Cr (103 ppm) and high Al_2O_3 (21.5%) contents compared with the calcareous group. The bulk of the samples collected from northeastern Syria in previous studies (e.g. Falb, 2009a, 2009b; Kibaroğlu, 2008) and the new ceramic samples from southeastern Anatolia (Kibaroğlu and Falb, 2013) belong to the non-calcareous group. In addition to these two major groups, Broekmans et al. (2002) have reported the presence of a third chemical group, distinguished within the samples from Tell Beydar (Nabada) in northeastern Syria (Fig. 2), labelled as an 'intermediate group', with about 8.5% CaO. A fourth, small, chemical group has also been distinguished by Klenk (1987) and assigned to the region of Lidar Höyük in southeastern Anatolia. In previous archaeometric studies it has been demonstrated that the calcareous group of NMMW has a close chemical affinity with clays from northeastern Syria and it has been suggested that the vessels of this group must have been produced from local clays in that area (Broekmans et al., 2002, 2006, 2008; Falb, 2009a; Kibaroğlu, 2008; Kühne and Schneider, 1988; Schneider and