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Earliest salt working in the world: From excavation to microscopy at the prehistoric sites of Ţolici and Lunca (Romania)

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ABSTRACT

Since the Early Neolithic, salt has played an important role in the social and economic development of populations. Consequently, the study and comprehension of salt management strategies have become a significant component of current archaeological research. This study is part of an interdisciplinary research program consisting of excavations and detailed analyses on two Early Neolithic salt working sites situated in the sub-Carpathian region of Romania, Lunca and Ţolici (county Neamţ). These remarkably well-preserved sites are characterised by stratified deposits several meters thick. Detailed stratigraphic descriptions were followed by optical microscopy analysis (soil micromorphology) and scanning electron microscopy (SEM) coupled with geochemical analysis (EDS). The aim of these analyses was to identify specific sedimentary, petrographic and chemical characteristics that could be linked to salt working process. The results enable us to describe the main site formation process over time and to detect chemical components of edible salt (Na and Cl) in Early Neolithic ashes. These new data consolidate previous interpretations of the operating procedures implemented from the Early Neolithic to the Bronze Age. Two techniques appear to have been preferentially adopted: pouring natural brine onto combustion structures during the Early Neolithic and evaporation in specific ceramic containers from the Chalcolithic onwards.

1. Introduction

Since the Early Neolithic, salt has played an important role in societies for the consumption and conservation of foodstuffs, livestock farming or for therapeutic purposes (Weller, 2015). The control of deposits and production sites, the mastery of extraction techniques and the transport of salt over long distances all contributed to the social and economic development of populations. Consequently, the study and comprehension of salt management strategies have become a significant component of current archaeological research, as shown by recent studies and collective works in Europe (Pétrequin et al., 2001; Alexianu et al., 2011; Biddulph et al., 2012; Nikolov and Bacvarov, 2012; Cassen and Weller, 2013; Harding, 2013; Alexianu et al., 2015; Brigand and Weller, 2015; Riddiford et al., 2016) as well as in Asia (Flad, 2011; Horiuchi et al., 2011; Kawashima, 2015), America (McKillop, 2005; Williams, 2015; Graham et al., 2017) or Africa (Alabi, 2000; Antonites, 2016).

Although common salt is an invisible item for archaeological research, some material evidence of production can be found in the form of wooden catchments or fittings, washing structures or stone tool for rock salt exploitation. Most often the evidence consists of accumulations of fired clay comprising debris from ancient heating installations and salt moulds (called briquetages). In the absence of briquetage, the existence of salt harvesting becomes more hypothetical because it is so often archeologically invisible. However, before the first use of fired-clay moulds, namely during the mid-5th millennium BCE in Europe, the earliest salt production seems to have been carried out without containers. In fact, there are other traditional techniques of salt making, which do not require use of fired clay or furnaces. This paper focuses on this non-briquetage production technique.

Since 2003, the Franco-Romanian research program "The

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prehistoric exploitation of salt springs in Moldova", aims to describe the different technical, socio-economic or ecological aspects of salt exploitation in this region in the north-east of Romania, from the early Neolithic until the end of the Chalcolithic (c.6000–3500 BCE). Several approaches contribute to this research: prospecting and recording salt springs and archaeological sites, spatial analyses of territorial dynamics, ethnographic investigations among riverine communities, archaeological excavations and paleo-environmental and geo-archaeological studies (see the compilation of studies in Alexianu et al., 2016; Brigand and Weller, 2018). The study zone is located along the Carpathian thrust on the Moldavian Plain (Fig. 1). On the north-south branch of this thrust, more than 200 salt springs and fifteen archaeological sites linked to salt exploitation were recorded during archaeological surveys (Weller et al., 2008a; Weller and Brigand, 2017). This dense concentration of sites is due to the upwelling of brine springs in sub-Carpathian Tertiary argillites rich in salt, through the numerous fault lines running through the massif.

The two sites of particular interest here are Hălăbutoaia, near Ţolici, and Poiana Slatinei, in Lunca (county Neamţ) (Figs. 1 and 2). The site of Poiana Slatinei was first excavated in 1984–1987 by a team led by Dumitroaia (1987). As these first excavations highlighted the potential of the site regarding the question of salt making since Neolithic times, we decided to re-excavate the site in 2004 in order to reach the bottom of the deposit, to record completely the stratigraphic profiles and to implement new methods of investigation such as archaeobotany and micromorphology (Weller et al., 2008b). The site of Hălăbutoaia was discovered during field survey in 2005, then excavated and studied by our team from 2007 onwards (Weller et al., 2008a, 2015; Danu et al., 2010). Both sites are located near salt springs which are still used today and currently represent the oldest known salt production sites in Europe (Weller and Dumitroaia, 2005; Weller et al., 2015). They occur as thick archaeological sedimentary accumulations, which are several metres high and comprise numerous lenticular layers of clay, ash and charcoal. The salinity of both mineral springs is very high, with extreme chlorine and sodium contents (Table 1).

The location of the sites near salt sources still in use today and the presence of thick stratified archaeological sedimentary accumulations, the upper part of which contain pottery generally used for making salt blocks (briquetages), give rise to the following working hypotheses: a) at Lunca, like at Ţolici, the whole sedimentary sequence, and not just the upper part, may be linked to salt making; b) the sedimentary changes in these sequences may reflect the evolution of exploitation techniques during the course of time. Therefore, a detailed study of these deposits was carried out, beginning with chrono-stratigraphic descriptions in the field, and followed by soil micromorphology and scanning electron microscopy (SEM) coupled with geochemical analysis (EDS). The aim of these analyses was to identify specific sedimentary and petrographic characteristics that could be linked to salt making process and perhaps to detect chemical components of edible salt (Na and Cl). Such combined use of soil micromorphology and SEM-EDS has already obtained pertinent results from salt working sites, as at the Iron Age and Roman coastal site of Essex (Macphail et al., 2012), or at Maya Marco Gonzalez, Belize (Macphail et al., 2017). Other workers employing SEM-EDS found traces of Na and Cl in pottery from the first millennium BCE (Flad et al., 2005) and, in Romania, identified salt in briquetage at the early 4th millennium sites of Ţolici and Cacica (Weller, 2000; Sandu et al., 2012; Tencariu et al., 2015). However, to our knowledge, no analysis of this type has yet been conducted on sedimentary deposits produced by the first exploitation of salt springs during the 6th millennium BCE. These

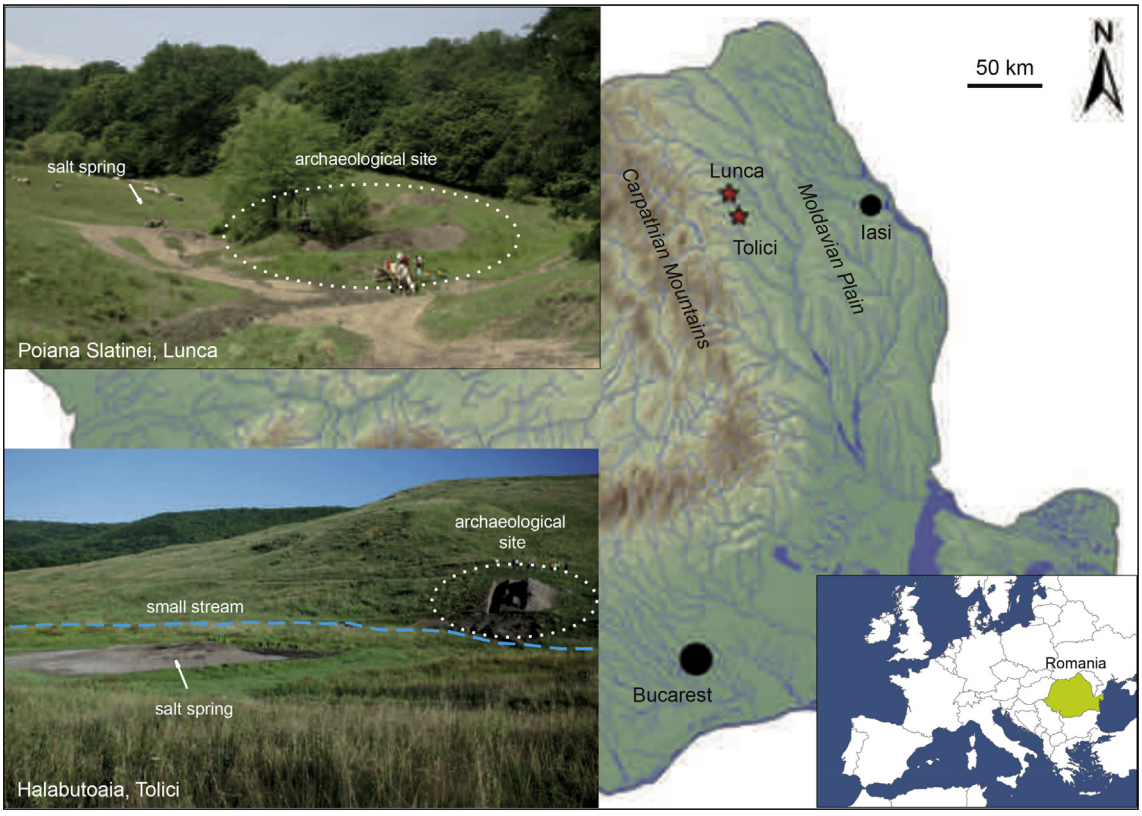

Fig. 1. Location of the archaeological sites.
The extension of the archaeological deposits is approximately indicated by white dotted ellipses.