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First evidence of heat treatment during the early Neolithic in northeastern Italy

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ABSTRACT

The site of La Vela sector VII (Trentino-Alto Adige – Italy), provides one of the few complete stratigraphic sequences, ranging from the Mesolithic to the middle Neolithic, in northwestern Italy. The site is located in the Adige valley, a way of communication between the Po plan and the Alps. This research focuses on the early Neolithic lithics ascribable to the Gaban facies, dated to 5000–4700 cal BC. Different rocks, coming from local exposures, have been exploited. The goal of the reduction sequence was the production of blades by pressure knapping technique. The technological study of the assemblage raised a particular interest for the presence of flint artifacts suggesting the usage of controlled heat treatment. The presence of this technique has been tested by an experimental approach based on Fourier-Transform infrared (FT-IR) spectroscopy. Complementary microstructural and analytical characterizations with low-vacuum scanning electron microscopy (LVSEM) observations combined with energy dispersive X-ray spectroscopy (EDXS) have been performed. The analyses confirm the presence of artifacts intentionally heat treated. The thermal treatment, achieved in order to increase the quality of the blade production, is the first evidence of this technique in northeastern Italy during the early Neolithic.

1. Introduction

The controlled heating of siliceous rocks, in order to ameliorate the knapping quality of the raw material, has been investigated since a comparatively long time, with early systematic works on the subject dating to the 1960s and 1970 (see among others Crabtree and Butler, 1964; Flenniken and Garrison, 1975). The heat treatment improves the fracture behavior of the materials with particular reference to fracture toughness (Domanski and Webb, 1992), thus increasing the knapper's control over the rock with a consequent improvement of the quality and efficiency of the lithic tool production.

The observation of colors changes (rubefaction, whitening) and the presence a greasy/glossy surfaces, caused by microstructural and crystallographic transformations of the artifacts, is a first macroscopic approach to infer the adoption of specific heat treatments (Crabtree and Butler, 1964; Inizan et al., 1995; Tiffagom, 1998; Tixier and Inizan, 2000). Unfortunately, the taphonomic processes can alter the aspect of artifacts causing the formation of other types of patination/modification and making it difficult to detect possible heat treatments (Crabtree and Butler, 1964; Boix Calbet, 2012; Schmidt et al., 2013a). The debate about the transformations of the rock's proprieties is still open (Domanski and Webb, 1992; Domanski et al., 1994; Schmidt et al., 2012), but several authors proposed different approaches to detect these modifications and verify the usage of the controlled heating in artifact manufacturing (Melcher and Zimmerman, 1977; Griffiths et al., 1986; Borradaile et al., 1993; Schmidt et al., 2013a).

The oldest evidence of heat treatment of flint materials has been proposed for the Middle Stone Age in South Africa (Brown et al., 2009; Mourre et al., 2010; Schmidt et al., 2013b). In Israel, the Upper Paleolithic assemblage from Manot cave was intentionally heated in antiquity (Weiner et al., 2015). Bordes (1969) highlighted the heat treatment in the French Solutrean as well as Tiffagom (1998) in Spain. Archaeological evidence of this technique has also been discovered in Poland for Mesolithic and Bronze Age assemblages (Domanski et al., 2009). In Southwest Germany, thermal pre-treatment has been suggested for several

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early Mesolithic inventories (Eriksen, 1997, 2006). During the early Neolithic, the use of pre-heated flint cores, in order to improve blade production, is attested in Spain (Perales Barrón et al., 2015). In France, during the Neolithic, the intentional heat treatment has been recognized in various archaeological records of the Chassey culture (Binder and Gassin, 1988; Lea, 2005; Léa et al., 2007; Schmidt et al., 2013a). In northern Italy, only macroscopic evidence of heat treatment has been suggested for the late Neolithic site of Botteghino (Mazzieri and Dal Santo, 2007) and for some Neolithic surface findings of Buttrio (Duches, 2009).

To the best of our knowledge, the few possible cases in Italy concerning heat treatment have not yet been proved by archaeometric investigations. In this framework, the Neolithic site of La Vela (Fig. 1A), a few kilometers north of Trento (Adige Valley, Italy), is raising a particular interest for the presence of flint artifacts probably produced after controlled heat treatments.

This study is part of a broader research on the early Neolithic of northeastern Italy. In this region, La Vela site (sector VII) provides one of the few complete stratigraphic sequences, ranging from the Mesolithic to the middle Neolithic, i.e., to the Square Mouth Pottery facies (Pedrotti et al., 1998).

In this research, a complete identification and attribution of raw materials has been conducted on the lithic assemblage. Furthermore, the technological analyses allowed recognition of the reduction sequence. On the basis of these results, particular attention has been paid to the usage of heat treatment. For this purpose, an experimental approach based on Fourier-Transform infrared (FT-IR) spectroscopy has been adopted. For the complementary microstructural and analytical characterization of the material samples, low-vacuum scanning electron microscopy (LVSEM) observations combined with energy dispersive X-ray spectroscopy (EDXS) analyses have been conducted.

2. Settings

2.1. Regional settings

The Adige valley (Fig. 1B), spanning from the Alps to the Veneto region, is connected with several lateral valleys (Non valley, Gresta valley, Valsugana, Fiemme valley) creating an extended network between the Po plain and the Alps. This region, as a whole, is part of the southwestern Alps and it is characterized by a remarkable geological uniformity. It is almost exclusively composed of carbonate rocks (limestone and dolomite) and a few volcanic ones (porphyry) (Cassinis and Perrotti, 2007; Tomasoni et al., 2009; Barbieri et al., 2013). The morphology of the valley was influenced by tectonic and glacial events and by the fluvial genesis of the Adige river (Fuganti et al., 2001). The river is 410 km long and is connected to a hydrographic basin of 12200 km^2. The Adige springs are near the Reschen pass, close to the border between Austria and Italy. The river crosses the Alps, from north to south, and it touches the Lessini and Baldo mountains before entering the Veneto plain. The Lessini mountains consist of calcareous formations, where intense karst activity is attested and where are located the most important flint crops of northeastern Italy (Barfield, 1990; Cavulli et al., 2002; Longo et al., 2004). The river activity has characterized the surroundings and influenced the progressive diffusion of the population into the mountain area. From the Holocene, after the climatic improvement and global stability, the valley underwent progressive forestation. This stable phase is characterized by aggradation events occurring in conjunction with pedogenesis and anthropic activity (Bassetti and Borsato, 2007; Angelucci and Bassetti, 2009).

2.2. Cultural settings

During the early Neolithic, northern Italy provides a mosaic of cultural facies: Gaban, Fiorano, Vhò, Isolino, Fagnigola, Samar

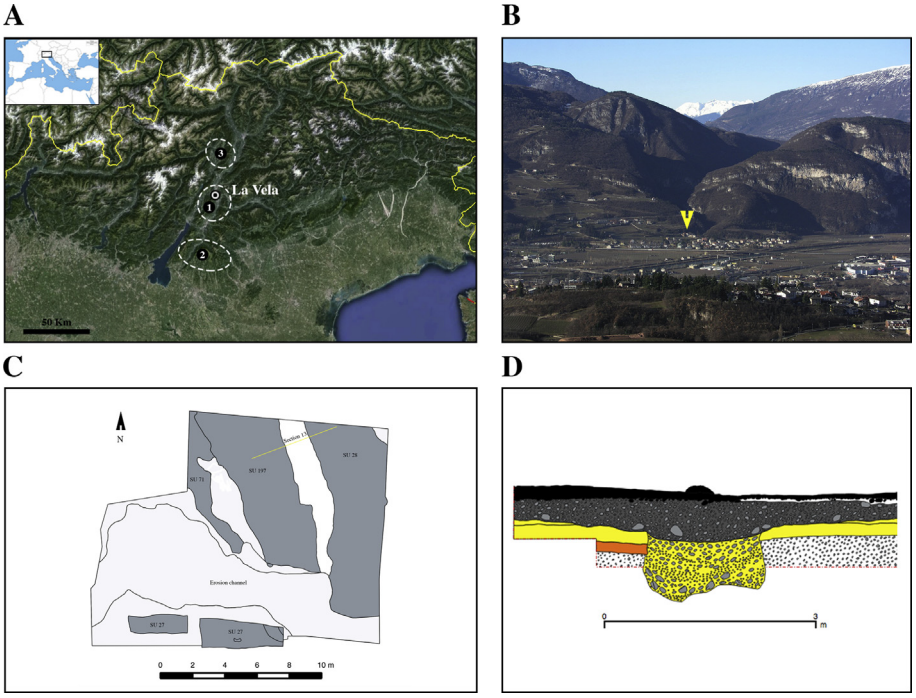

Fig. 1. La Vela VII: A) Location of the site and the raw materials provenance areas (1-Adige valley, 2-Bondone and Lessini mountains, 3-Non valley); B) Overview of the alluvial fan and site position inside the Adige valley (photo: D.E. Angelucci); C) Map of the site with the studied layers; D) Section 13: Stratigraphy of the site (from the bottom to the top: Orange: Mesolithic; Yellow: early Neolithic/Gaban facies; Grey: middle Neolithic/VBQI facies; Black: middle Neolithic/VBQII facies). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.).