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RAPID LATE PLEISTOCENE CLIMATE CHANGE RECONSTRUCTED FROM A LACUSTRINE OSTRACOD RECORD IN CENTRAL ITALY (LAKE TRASIMENO, UMBRIA): PRELIMINARY RESULTS

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ABSTRACT: An 8.59 m long sediment core was retrieved from Lake Trasimeno (central Italy) with the aim of performing a palaeoclimatic and palaeoenvironmental reconstruction. In this study we present, for the first time in central Italy, a quantitative palaeotemperatures reconstruction based on ostracod assemblages. The mean winter (January) and summer (July) palaeotemperatures were estimated from 44,000 to 9,000 cal yr BP by using the Mutual Ostracod Temperature Range (MOTR) method. Of the total of 19 ostracod species recovered, 13 of them were used as reliable palaeotemperature proxies on the base of their living temperature ranges.

KEYWORDS: Palaeotemperatures, palaeoclimatology, ostracoda, central Mediterranean, Quaternary

1. INTRODUCTION

The Late Quaternary climate has been affected by numerous and rapid fluctuations and different techniques have been developed to reveal their extent and associated effects on the environment. Here we present for the first time the application of the Mutual Ostracod Temperature Range (MOTR) method (Horne, 2007) on an 8.59 m long sediment core from Lake Trasimeno (central Italy) with the aim of reconstruct the palaeotemperature variations in central Italy. The provisional age model proposed by Marchegiano et al. (2017a) suggests the Co1320 Trasimeno sediment core covers the last 47,000 cal yr BP. The MOTR analysis was performed within the interval from 44,000 to 9,000 cal yr BP. This period encompassed a long mild period (MIS 3), followed by a colder one (MIS 2) and ended with the beginning of the Holocene, characterised by the abrupt restoration of warmer conditions. The MIS 3 and 2 enclosed high-frequency climate variations characterised by warmer (interstadial) and colder (stadial) periods (Abrantes et al., 2012). These features were recognized for the first time in the ice-core record from Greenland (Grootes & Stuiver, 1997; Johnsen et al., 1992) and subsequently documented in climate records all over the world (Voelker, 2002). In central Italy, several palynological studies (summarized in Fletcher et al., 2010), revealed that the Greenland Interstadials (GI) were characterised by relatively humid conditions, whereas dry ones prevailed during Greenland Stadials (GS). This trend has been further confirmed at Lake Trasimeno (43°09'N; 12°06'E, Umbria Region, central Italy) (Fig. 1) by the repeated changes of the ostracod assemblages that suggested frequent lake level variations that mirrored the alternation of dry and humid phases (Marchegiano et al. 2017a). Due to its very shallow depth (maximum depth of 6 m), its smooth bathymetry (Ludovisi et al., 2005) and its endorheic nature, Lake

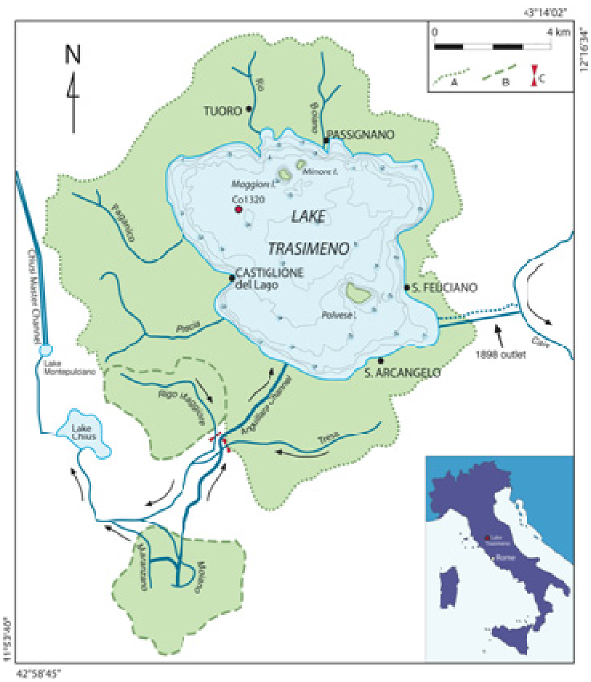

Fig. 1 - Map of Lake Trasimeno showing the location of core Co1320. Legend: A. natural catchment area; B. artificially-joined basins; C. sluice gates of the artificially-joined channels (modified from Marchegiano et al., 2017).

Trasimeno revealed to be particularly suitable to detect the changes in the lacustrine environment driven by climate, since its hydrological system strictly depends on climatically-governed precipitation/evaporation changes (Dragoni et al., 2012).

The continuous presence of fossil ostracods throughout the entire succession (Marchegano et al., 2017a), allowed to fruitfully apply the MOTR method

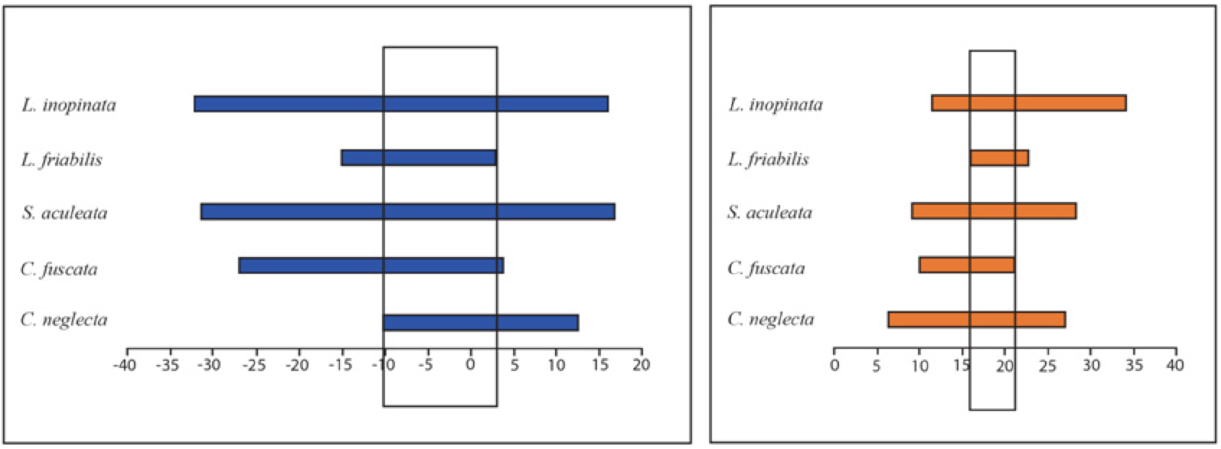

Fig. 2 - Example of the application of the MOTR method on sample 374 of the Co1320.

along the sediment core, trying to depict, for the first time, the palaeotemperature variations based on ostracods. In fact, until today, only few continental records provided high-resolution analyses of Late Quaternary climatic changes, mainly based on pollen [e.g. Lago di Lagaccione (Magri & Sadori 1999), Lago di Vico (Magri 1999, Magri & Parra 2002), Lago di Albano (Ariztegui et al., 2001), Valle di Castiglione (Magri, 1994), Lago di Monticchio (Allen et al., 1999), Lake Ohrid (Wagner et al., 2017)].

2. METHODS

The MOTR is a non-analogue method (Horne, 2007) for reconstructing palaeotemperature using freshwater fossil ostracod assemblages, based on the species still living today with a known climatic distribution. The temperature ranges, which enclose all the living records of the species, are determined by fitting WorldClim database (version1.3) (Hijmans et al., 2001) to the mapped coordinate points of the species' distribution and are expressed in terms of the maximum and minimum values of July and January temperature ranges. The temperature reconstruction for a given interval is provided by the mutual temperature range of all the species in the fossil assemblage. (i.e. the T interval in which they could have co-existed Fig 2.).

3. RESULTS

A total of three hundred and fifty samples were analysed to perform the MOTR method in the Trasimeno sedimentary core. The ostracod analyses (Marchegiano et al., 2017a) enabled recognition of 19 different species of ostracods referable to 15 genera: *Cyprideis torosa, Candona angulata, Candona neglecta, Candona candida, Heterocypris incongruens, Cytheromorpha fuscata, Sarscypridopsis aculeata, Heterocypris salina, Ilyocypris* sp.*, Eucypris mareotica, Darwinula stevensoni, Limnocythere inopinata, Limnocythere blankenbergensis, Potamocypris paludum, Trajancypris serrata, Amnicythere* sp.*, Herpetocypris helenae, Cypridopsis vidua, Plesiocypridopsis newtoni.* Among all of the recovered species, *Cyprideis torosa* was not taken into account because is a typically brackish water species (although it occurs sometimes in freshwater) while the MOTR method is developed only for freshwater species. Other species were also excluded: *Amnicythere* sp. and *Ilyocypris* sp., for reasons of taxonomic uncertainty, and *Trajancypris serrata*, *Potamocypris paludum* and *Herpetocypris helenae*, which are still not calibrated.

The temperature ranges were calculated for all the samples from 7.4 to 3.1 m depth in the Co1320 Trasimeno core to obtain the palaeotemperature variations during the whole sequence, represented by reconstructed palaeotemperature ranges to which maxima and minima curves can be fitted.

4. DISCUSSION AND CONCLUSIONS

Although the Mutual Ostracod Temperature Range method has been frequently applied to infer past climate conditions (Horne, 2007; Horne et al., 2012; Pint et al., 2015; Cosentino et al. 2017; Benvenuti et al. 2017), in this contribution it was used, for the first time, to reconstruct a palaeotemperature curve similar to those derived from other usual proxies (e.g. isotopes, pollen and beetles (inter alia Atkinson et al., 1987-1986; Allen et al., 1999; Pross et al., 2000; Pross & Klotz, 2002).

Notwithstanding uncertainties regarding where (within the reconstructed ranges) the actual temperatures were located, a preliminary inspection of the MOTR results suggests rapid temperature changes in central Italy in the interval from 44,000 to 9,000 cal yr BP.

In order to compare the global temperature changes of this period with the ones that affect central Italy, the MOTR-derived curves have been compared with the Greenland Isotopic Palaeotemperature reconstruction (NGRIP-members, 2004). Despite limitations of the use of a provisional age-depth model, the January and July temperature curves show a remarkable correspondence with features of the NGRIP-record, demonstrating their ability to record the millennial climate variations. The Trasimeno MOTR reconstruction also reveals the possible occurrence of rapid climate changes, which could be considered equivalent to those observed at Monticchio Lake by Allen et al. (1999) using pollen-based reconstruction methods. These qualitative correspondences demonstrate for the first time the potential of the MOTR method to reconstruct rapid climate changes, and efforts are in progress to validate and refine this preliminary result.

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