

Sub-millennial scale variability between Heinrich events 4 and 3 in the long terrestrial paleoecological archive of Lake Fimon (north-eastern Italy)

Federica Badino^{1,2}, Roberta Pini², Cesare Ravazzi², Simona Arrighi^{1,3,4}, Paolo Bertuletti⁵, Eugenio Bortolini¹, Carla Figus¹, Federico Lugli^{1,6}, Giulia Marciani^{1,4}, Davide Margaritora⁷, Gregorio Oxilia¹, Matteo Romandini^{1,7}, Stefano Benazzi^{1,8}

¹Dipartimento di Beni Culturali, Università di Bologna, Ravenna, Italy. ²C.N.R. - Istituto per la Dinamica dei Processi Ambientali, Milano, Italy. ³Dipartimento di Scienze Fisiche della Terra e dell'Ambiente, Università di Siena, Siena, Italy. ⁴Centro Studi sul Quaternario, Sansepolcro, Italy. ⁵Dipartimento di Scienze dell'Ambiente e della Terra, Università degli Studi di Milano-Bicocca, Milano, Italy. ⁶Dipartimento di Scienze Chimiche e Geologiche, Università di Modena e Reggio Emilia, Modena, Italy. ⁷Dipartimento di Studi Umanistici, Università di Ferrara, Ferrara, Italy. ⁸Department of Human Evolution Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany

Abstract

Marine Isotopic Stage 3 (MIS 3, ca. 60-30 ka BP) is regarded as one of the most unstable period of the Late Pleistocene as far as climate is concerned, closely interwoven with the late human evolution history. During MIS 3, episodes of massive iceberg discharge into the North Atlantic (Heinrich events [HEs]) enhanced sea surface temperature (SST) cooling at mid- to low-latitudes (Darfeuille et al., 2016) inducing rapid vegetation changes in S-Europe and in the Mediterranean area (Fletcher et al., 2010).

To contribute to the discussion about the influence of HEs on European vegetation dynamics, we present a new high-resolution record from NE-Italy (Lake Fimon, southern Alpine foreland) covering the HE3-HE4 interval. This area is well-known as it provides both a Late Pleistocene palaeoecological record (Pini et al., 2010) and several Middle to Late Palaeolithic sites yielding evidence of Neandertal and AMHs occupation (Fumane cave and Broion shelter; Peresani et al., 2008, 2016; Peresani et al., in press).

The published paleoecological record from Lake Fimon, the resolution of which was too low to reconstruct in detail the history of terrestrial and aquatic ecosystems between 41 - 30 ka cal BP, was reconsidered. The core was resampled to achieve a resolution of ca. 1 sample/80 yrs between 41 - 36 ka cal BP and ca. 1 sample/120 yrs between 36 - 30 ka cal BP. Changes in pollen-algae-spores %, pollen-slide- and macrocharcoal concentrations, and geochemical proxies help to decipher the effects of climate variability on vegetation.

Despite the pollen record points to a general persistent afforestation, HE4 and HE3 intervals are identified by significant drops of the dominant tree taxon, *Pinus sylvestris/mugo*. Such variations are mirrored by upland herbs expansion, including xerophytes and Compositae Asteroideae, indicating phases of climate deterioration. A general low frequency and intensity fire regime, possibly influenced by moist conditions characterizing this geographical area, is punctuated by some fire episodes occurring during periods of possibly enhanced drier conditions related to HEs.

The evolution of the sedimentary basin in relation to HEs can be summarized as follow. A shallow lake persisted during HE4; afterwards, paleoecological and geochemical data indicate blooms of planktonic algae (*Pediastrum*, *Gloeotrichia*, *Scenedesmus*), expansion of submerged macrophytes (*Ceratophyllum demersum*) and detrital carbonates increase. These evidences

suggest that the lake threshold rose before HE3, possibly due a clastic supply from an external fluvio-glacial river. The subsequent development of a Cyperaceae-dominated littoral belt suggests reduced level excursions. According to calibrated radiocarbon ages, the mire development lasted ca 3000 years (31-27.5 ka cal BP), until the building of a subsequent fluvio-glacial dam at the LGM onset.

Project funded by ERC under the European Union's Horizon 2020 research and innovation programme (grant agreement No 724046 - SUCCESS); website: <http://www.erc-success.eu/>.