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## FROST ACTIVITY AND ICE SEGREGATION IN A PALAEO SOL IN THE LIGURIAN ALPS (BEIGUA MASSIF, ITALY): EVIDENCE OF PAST PERMAFROST?

**ABSTRACT:** RELLINI I., TROMBINO L., ROSSI P.M. & FIRPO M., *Frost activity and ice segregation in a palaeosol of the Ligurian Alps (Beigua Massif, Italy): Evidence of past permafrost?* (IT ISSN 0391-9838, 2014).

This research is a part of a broader paleopedological investigation aimed at characterising and verifying the extent of the permafrost zone during the Last Glacial Maximum (LGM) in the Ligurian Alps. The paper presents the results of a micromorphological study of a palaeosol located at an elevation of 650 m a.s.l., near a blockstream deposit on Beigua Massif in northwestern Italy. We examined a profile exposing sandy sediments characterised by macroscopic structures that are clearly cryogenic in origin. These features were interpreted with their micromorphological characteristics, and we found that during the LGM, this unglaciated area of the Ligurian Alps was characterised by a periglacial environment with discontinuous permafrost even at low elevations.

**KEY WORDS:** Micromorphology, Periglacial processes, Last Glacial Maximum, Cryogenic structures, Ice lensing, Permafrost, Beigua Massif (Liguria, Italy).

**RIASSUNTO:** RELLINI I., TROMBINO L., ROSSI P.M. & FIRPO M., *Effetti del gelo e segregazione del ghiaccio in un paleosuolo nelle Alpi Liguri (Massiccio del Beigua, Italia). Evidenze di permafrost antico?* (IT ISSN 0391-9838, 2014).

Il presente lavoro è parte di un più ampio progetto paleopedologico finalizzato a verificare l'estensione del permafrost durante l'Ultimo Massimo Glaciale nelle Alpi Liguri. L'articolo presenta i risultati di un'indagine micromorfologica svolta su un paleosuolo ubicato a quota di 650 m s.l.m., molto vicino ad un blockstream, sul Massiccio del Beigua in Italia

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A grant from University of Genova supported this work; the Istituto per la Dinamica dei Processi Ambientali, Consiglio Nazionale delle Ricerche (Milano, Italy) partially funded this grant.

nord-occidentale. È stato esaminato e descritto un profilo impostato su sedimenti sabbiosi e caratterizzato da evidenti macrostrutture criogeniche. Queste strutture, anche alla luce delle loro caratteristiche micromorfologiche hanno permesso di ipotizzare che, durante l'Ultimo Massimo Glaciale, quest'area delle Alpi Liguri non modellata dall'azione dei ghiacciai, era caratterizzata da un ambiente periglaciale, con presenza di permafrost discontinuo anche a bassa quota.

**TERMINI CHIAVE:** Micromorfologia, Periglaciale, Ultimo Massimo Glaciale, Strutture criogeniche, ice-lensing, Permafrost, Beigua Massif (Liguria).

### INTRODUCTION

The term «past permafrost» refers to permafrost (presumably of the Pleistocene age) that does not exist today (French, 2008). Knowledge of the extent of the past permafrost in northern Italy during the Last Glacial Maximum (LGM) is poor. Existing palaeoclimatic reconstructions are uncertain and speculative. The first reconstruction based on selected pollen, charcoal, and macrofossils suggested that spruce forests occasionally covered this area during the Eemian Interglacial (Riss-Würm Interglacial in Alpine Europe) and the early Weichselian (Würm glacial stage in Alpine Europe). During the LGM, however, a maximum reduction phase of the spruce range began, and its extinction occurred across many districts (Ravazzi, 2002). In fact, Büdel (1959) argued that the area was located in a loess-tundra zone during the Weichselian.

The European distribution of past permafrost during the various stages of the LGM is relatively well known, and certain relict features (ice wedge casts, sand wedges, and pingo remnants) associated with permafrost are well preserved (French, 2008). Various authors (e.g., Velichko, 1982; Poser, 1948; Van Vliet-Lanoe, 1989; Vandenberghe & Pissart, 1993) performed extensive inventories of the known relict permafrost features in Europe during that