Intense pedogenic development and large carbon contents in soils above the Pleistocene trimline (NW Italian Alps)

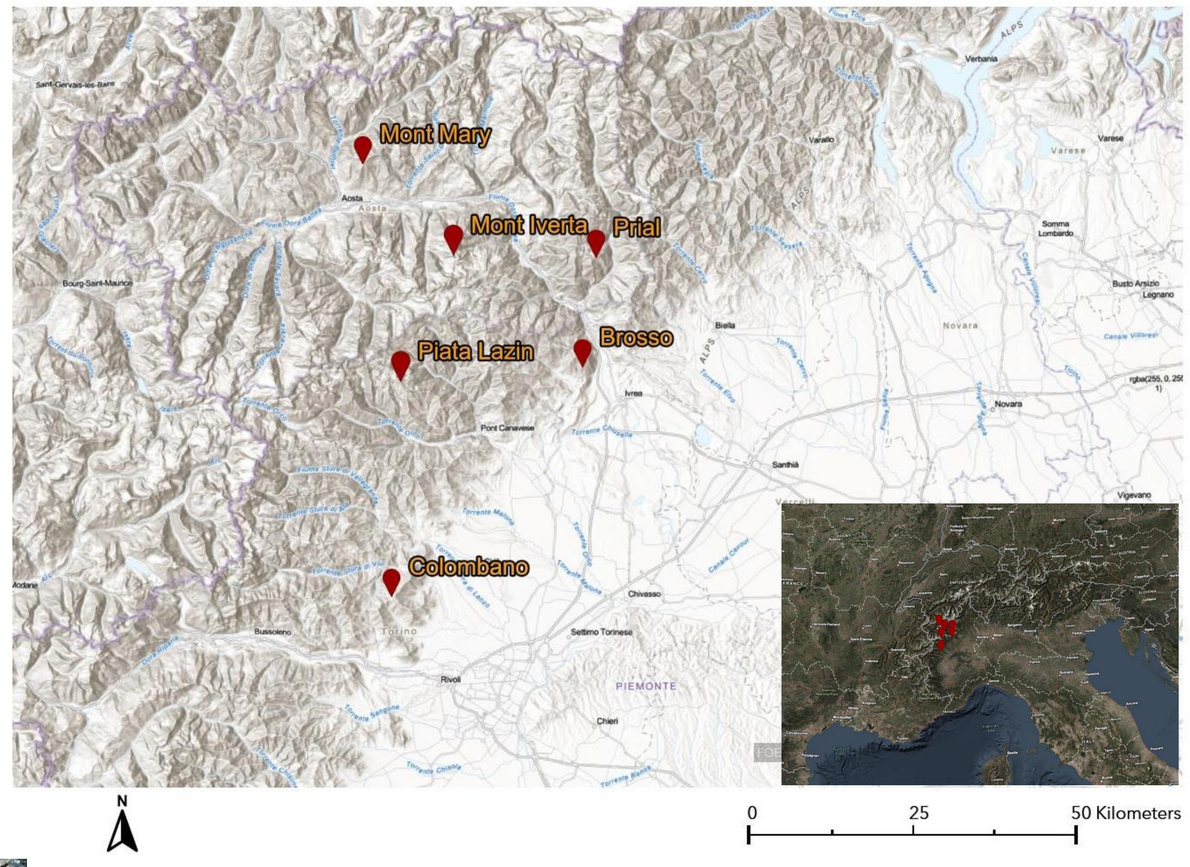
D'Amico M.[1], Melacarne D .[2], Pintaldi E.[2], Benech A.[2], Colombo N.[2], Freppaz M.[2,3]

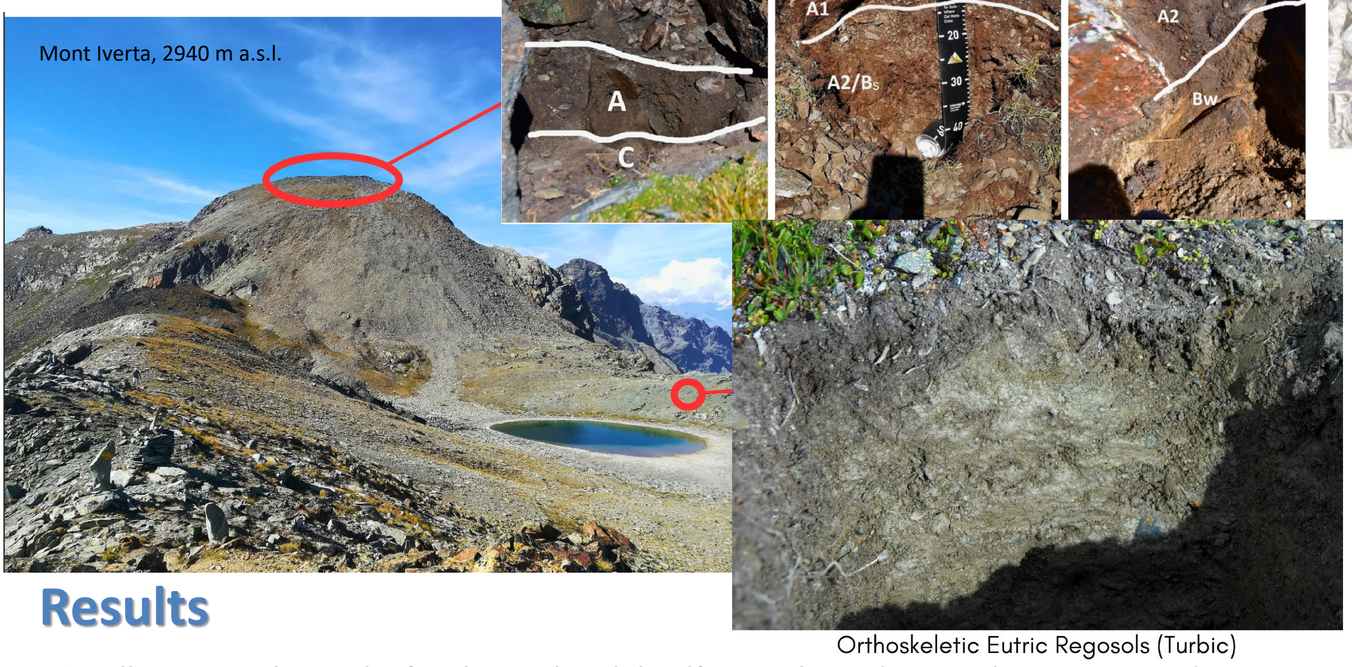
[1]Università degli Studi di Milano - DISAA, Via Celoria 2, 20133 Milano (MI), Italy
[2]Università degli Studi di Torino - DISAFA, Largo Paolo Braccini 2, 10095, Grugliasco (TO), Italy
[3]Università degli Studi di Torino, NATRISK, Research Centre on Natural Risks in Mountain and Hilly Environments, Largo Paolo Braccini 2, 10095, Grugliasco (TO), Italy

Introduction

Most of the Alpine range was influenced by glacier movement or by intense erosive processes during Pleistocene glacial periods, which erased previously existing soils and landforms. Thus, most of the soils in the Alps began developing since at least the end of the Last Glacial Maximum (LGM). However, some surfaces located above the trimline (the upper limit reached by valley and cirque glaciers) still retain "old" morphologies and can be considered paleosurfaces, often covered by fossil or active periglacial features.

After having found very well developed Umbrisols hidden inside blockfields at 3030 m a.s.l. on the Stolenberg Plateau, Monte Rosa Massif – NW Italian Alps (*Pintaldi et al. 2021), we explored other relict cryogenic landforms located above the Pleistocene trimline, such as blockfields and blockstreams, observing the soils hidden below the surface stone layers.

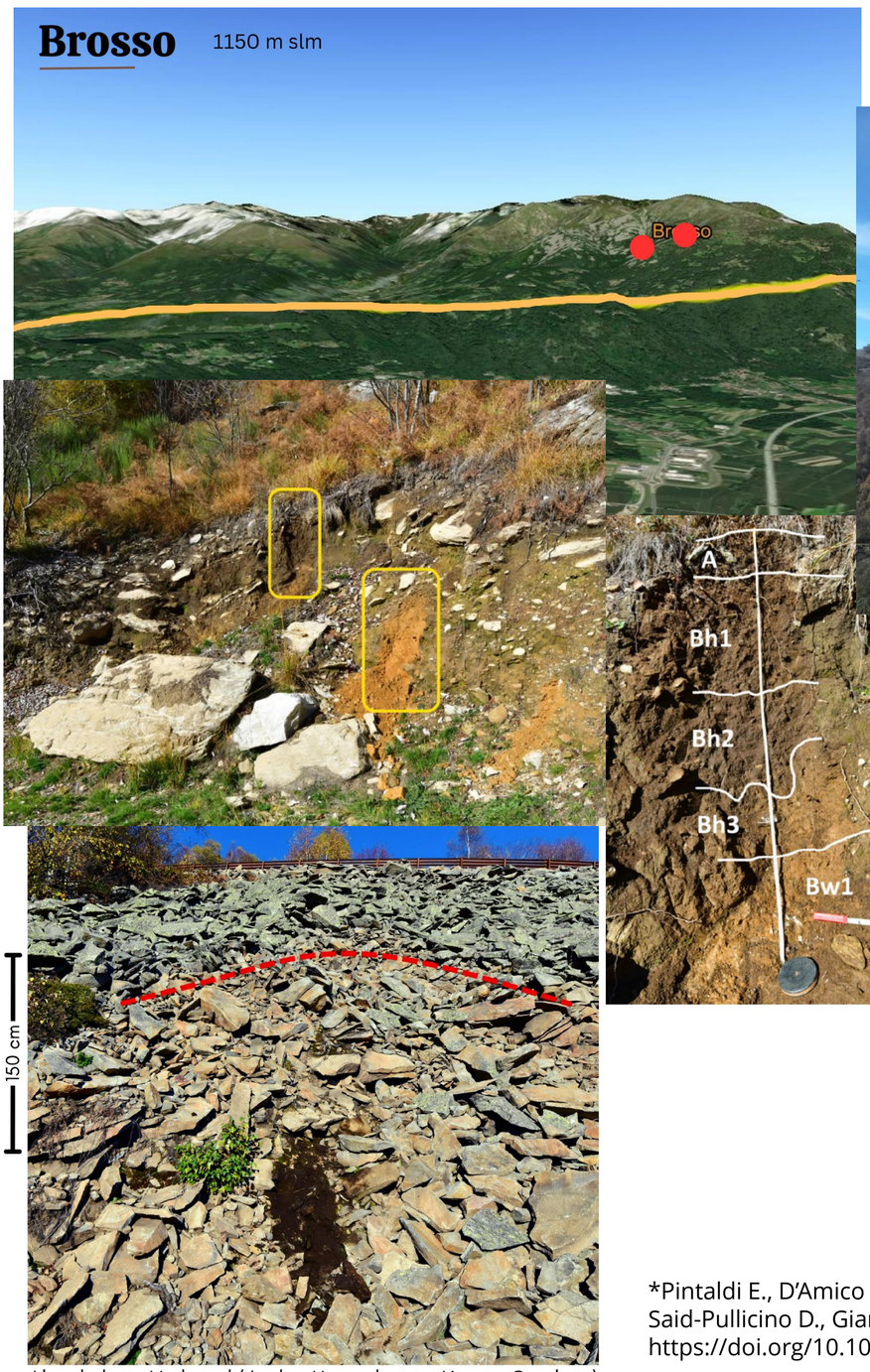




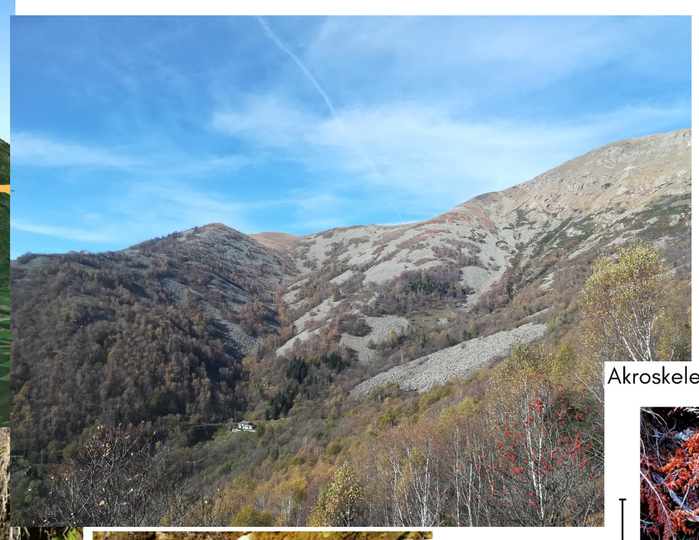
Orthoskeletic Eutric Regosols (Turbic)

Results

- **In all sites, soils inside fossil periglacial landforms showed a much stronger pedogenesis compared to younger, "holocenic" reference soils;**
- **Podzolization has been observed in soils now almost devoid of vegetation (Mont Iverta, 2940 m a.s.l.); reference soils, in this case, are weakly weathered Eutric Regosols (Turbic); Corg contents up to 13%, compared to 0.4 in reference soils;**
- **In some sites (Brosso), Umbrisols were extremely thick (A+Bh horizons > 160 cm), compared to ca. 40 cm in reference soils;**
- **Corg-rich Umbrisols were observed below 2 m-thick Pleistocene blockstreams, at present devoid of vegetation (Brosso); Corg > 1.5, up to 4%;**
- **Polycyclic Albic Podzols were found on Mont Prial, compared to Umbric Entic Podzols in reference sites; a significantly higher silt and clay contents, and lower P, characterize the "ancient" Podzols;**
- **E horizons and placic Bsm observed under blockstreams on peridotite, compared to Regosols in reference sites (Monte Colombano site).**

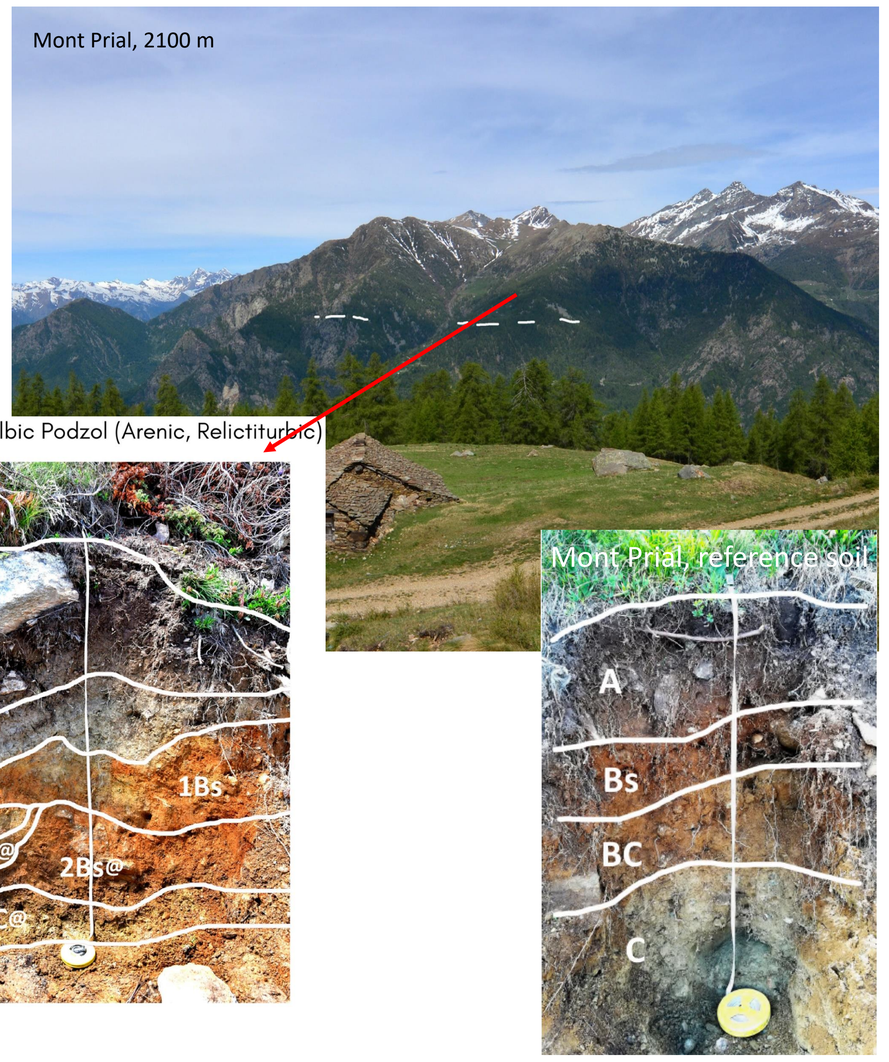


Akroskeletic Umbrisol (Andic, Hyperdystric, Humic, Sombric)



Methods

- **6 sites, 13 soil profiles and reference ones below the trimline**
- **Standard chemical analysis**
- **Bulk density measurement**
- **Carbon stock calculation**
- **14C dating (no results yet)**
- **Mineralogical analysis (note ready yet)**
- **Total and available phosphorus**



Akroskeletic Umbric Albic Podzol (Arenic, Relictiturbic)

Conclusion

- **Soils preserved under fossil Pleistocene blockstreams and blockfields bear signs of pedogenesis, not compatible with present day conditions**
- **Sometimes, extremely large carbon contents are observed even if the soil surface is at present devoid of a significant vegetation cover**
- **They represent an important paleoenvironmental archive, worth of being preserved with specific land management practices**

*Pintaldi E., D'Amico M.E., Colombo N., Martinetto E., Said-Pullicino D., Giardino M., Freppaz M. (2021). https://doi.org/10.1016/j.gloplacha.2021.103676