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Pedogenetic processes beneath high altitude sorted circles in the Italian Western Alps

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Most of the patterned ground phenomena occur in permafrost areas, whose distribution in alpine environments at middle latitudes is strongly controlled by local climatic conditions, and specifically by snow cover distribution. Accordingly, sparse permafrost features may be identified in the Alpine chain as paleoclimatic relict and/or due to local micro-climate.
The field study was undertaken in the Gran Paradiso National Park, at an elevation of 3028 m ASL, on a gentle slope plateau, exposed to wind. The dimension and distribution of stone circles was determined through field surveys. The soil temperature (10 cm depth) during the winter season 2007-2008 was measured by data loggers UTL-1. Nivo-meteorological data were recorded by an automatic weather station located 3 km away (2400 m ASL).
In the field, a trench was excavated within a sorted circle and three distinct areas were identified, I.e, the centre, an intermediate region and the stony border. In each of these three areas a soil profile was described. Samples were taken from the identified horizons and returned to the lab for routine analyses.
A marked difference was found from the centre to the border, with the presence of a true A horizon been detectable only close to the border. A surprisingly strong subangolar blocky structure was found across the whole trench, developing around the skeletal fragments, probably as a consequence of freeze-thaw cycles. Several physical and chemical properties displayed consistent patterns from the centre to the border of the trench.
The soil skeleton content decreased from the borders to the centre, ranging respectively from 42-70% to 33-39%. Clay content ranged from 55 and 101 g/kg, and was maximum in the centre of the two circles. Silt content followed the same pattern, while sand content was anticorrelated with both clay (square-R= 0.539) and silt (square-R= 0.937). TOC content was maximum at the borders (3.0 e 3.5 g/kg), often vegetated, and decreased towards the centre of the circles, where pH showed minimum values (4.8 – 4.7).The C accumulation on the borders suggests more stable conditions compared to the centre, which favours pedogenesis and horizonation.
We identified freeze/thaw cycles to be predominant processes in the centre, where the sorting is probably still active, while C accumulation and horizonation predominate on the borders.
A series of hypotheses will be presented to explain: (a) the relatively high amount of clay in such little pedogenized soils over coarse-sized material and (b) the relatively high concentrations of C and N in these high altitude soils.