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Alpine soils from the Rieding valley: geochemical, mineralogical and granulometric analysis

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Soils of the alpine zone are of particular interest in the context of soil formation after progressive glacier retreat and climate change. In this study, three alpine soil types from the Rieding Valley were analysed in the laboratory with regard to geochemistry (X-ray fluorescence analysis), mineralogy (using X-ray diffraction and the Rietveld method), determination of the organic content (wet and dry ashing) and granulometry with laser diffraction (particle sizer). The soils originate from different horizons (A, B and C horizons) and have different parent rocks (carbonate, silicate). The samples are of the type Rendzina (Cv horizon), Pseudogley (A horizon) and Brown Earth (Bt horizon).

Rendzina, as a shallow soil on carbonate rock, predominantly contains the oxides MgO and CaO. As the sample originates from the Cv horizon, it directly contains the weathered parent material (dolomite). In terms of trace elements, Sn and Sr in particular are enriched. The organic content is 5.7 wt% (dry ashing) and 3.0 wt% (wet ashing).

Pseudogley consists mainly of quartz, feldspar and phyllosilicates (with corresponding SiO₂ and Al₂O₃ contents). Increased iron and manganese contents compared to the Rendzina are clearly recognisable. Higher enrichment is also found in: Ba, Cr, Ni, Rb, Sr, Sn, V and Zr. The sample comes from the A horizon - the mineral topsoil, which is enriched in humus and therefore has a higher organic content (dry ashing: 15.1 wt%; wet ashing 12.0 wt%).

The colour of the brown earth is caused by the oxidative weathering of Fe²⁺ from phyllosilicates (biotite) to Fe³⁺ and iron (hydro)oxides, e.g. frequently goethite - this correlates with the main element contents of the sample. Of the three soils, brown earth has the highest iron content. Among the trace elements, Ba, Cr, Ni, Rb, Sr, Sn, V and Zr are clearly represented. The organic matter content was determined by dry ashing to be 5.0 wt% (wet ashing 2.0 wt%).

All three soils have grain sizes with a maximum between 10 and 20 µm. For the grain size analyses we used the laser diffraction method which has become a recognised method for particle size analysis of soils. However, there are a number of requirements for the pre-treatment of the sample, e.g. the removal of organic matter or carbonate components. The type of pre-treatment is a form of intervention in the distribution of the grains in the sediment. This study evaluates different methods of preparing optimal sample aliquots for a representative distribution of the grains. The fine fraction <63 µm was selected as the starting material for the grain size analysis. The following pre-treatment methods were compared: 1) untreated raw material including organic content, 2) prepared sediment without organic matter - humus destruction by dry ashing, 3) prepared sediment without organic matter - humus destruction by wet ashing. The grain sum curves produced using raw material correspond well with those of the ashed samples, but only as long as the organic content does not exceed about 5.0 wt%. Light mortaring does not falsify the result.

Furthermore, the type of sample feed into the dispersion unit was analysed (dry versus pipetting). The preparation of an aqueous suspension and subsequent pipetting proved to be less suitable than dry sample feeding.

Session: *Pangeo workshop: Earth Surface Dynamics*

Keywords: *alpine soil types, geochemistry, mineralogy, granulometry, sample pre-treatment*