

Multi element soil biogeochemistry on the southwest coast of Svalbard

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The southwest coast of Svalbard is very specific area in the high Arctic: it has complicated low mountain relief and much warmer and humid climate compared with the eastern areas at the same altitude. Here, under the Arctic tundra vegetation, a specific Follic Scleretic Umbrisols are formed. The surficial organic follic and upper mineral umbric are its principle horizons. The aim of the study is to assess natural levels and variation of 30 elements in the major Umbrisol's horizons.

Total concentration of 30 elements were determined in all major horizons at 37 sites along Ic-fjord, Grenfjord, Billefjord, Colesbukta and Congressdalen. Due to complex geologic background elements concentrations in the parent material (samples from 30-40 cm depth) of the study area are highly variable (Fig. 1). Silicon is prevalent element in the parent material at all sites. Due to the presence of carbonate rocks in profiles of some sites in the Billefjord area, the concentration of Ca varies by 70 times. The sites also vary significantly (max/min ratio in bracket) in terms of Se (>100), Hg (>100), Ag (81), Mo (41), Mn (17), Sr (15), Cd (15), Sr (15), Mg (12), Rb (10) and Bi (10) content at the bottom of the soil profile. Comparison of the median elements concentrations with Klark and median concentrations in the parent material of northwest of Europe revealed the following specific features of the parent material in the surveyed area (Fig. 2): it is enriched in As, Hg, V, P, Fe and essentially depleted in Ca, Sr and Mn. The same features were specific for soil derived from sedimentary rock in northern Norway (Reimann et al. 1998).

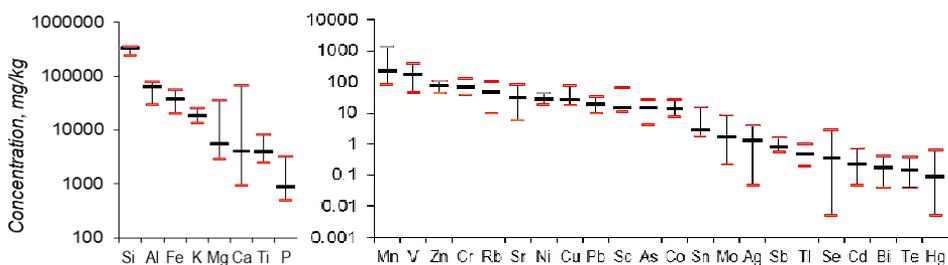


Fig. 1. Median and min-max variation of the elements concentrations in the soil parent material. Logarithmic scale.

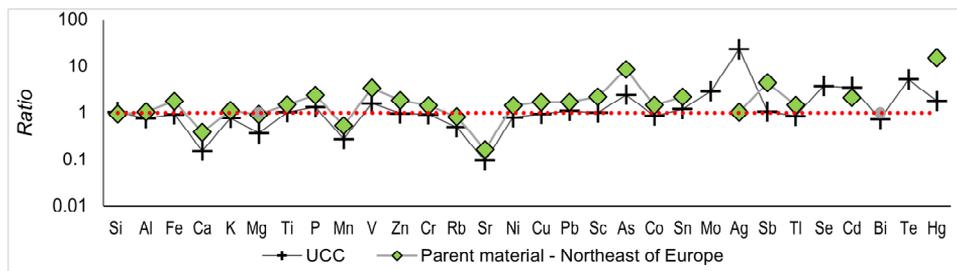


Fig. 2. Ratio between median elements concentration in the parent material of the study area and the Klark in the upper continental crust (UCC) (Hu & Gao 2008) and the median concentration of the elements in the parent material from the northeast of Europe (1365 sites over area of 1,500,000 km², Salminen at al. 2004). Logorothmic scale.

Compared to parent material, the upper mineral umbric horizon is significantly enriched in organic matter (Corg. varies from 1.5 to 13.5%) and mobile form of major nutrients – Ca, Mg and K. Total concentrations of Ag, Cr, Cu, Ni, Sc, Sn, Te, Tl, V, Zn in the umbric horizon do not essentially differ from the parent material (Fig. 3) at most sites. Concentration of some elements in the umbric horizon may be lower (Si, Al, Fe, Ti, Co) or higher (Ca, P, Sr, Hg and Se) than in lower soil horizons. Besides of bedrock peculiarity, organic matter enrichment and granulometric composition are other factors responsible for the umbric horizon chemistry.

Upper folic horizon is composed from decaying plants residue. Its chemical composition has no connection with the parent material, except the sites with specific material (e.g., carbonates or phosphorites). Concentrations of all elements in the folic horizon are also highly variable. Its chemistry can be also influenced by plant community, by enrichment in mineral particle of highly variable chemical composition (dust from barren ground/rocks and transport with lateral fluxes in landscape) and by sea aerosols (Sr, Mg).

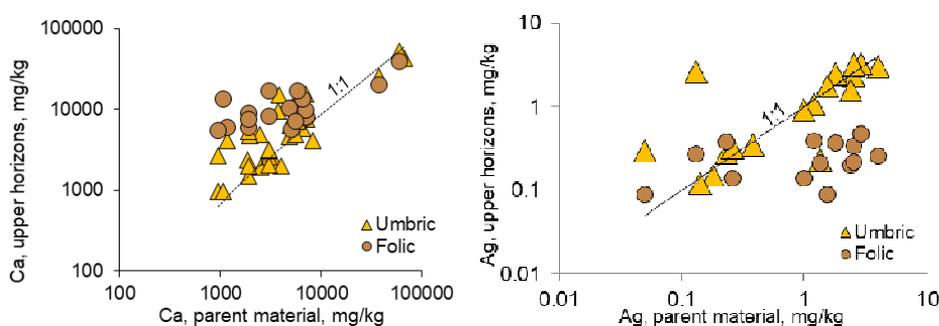


Fig. 3. XY diagram: Ca and Ag concentrations in the parent material vs. major soil horizons.

The major specific features of the folic horizon in the area are: relatively low Corg. content due to high mineral particle admixture and, hence, the high concentration of major geogenic elements – Si, Al, Fe, Cr, Ti, V. High concentrations of Hg, Cd Pb in the

folic horizon here can't be connected with pollution. An essential enrichment in above elements was found in the folic horizon over the northeast Europe (Salminen et al. 2004, Reimann et al. 1998). As far as all studied soil profiles were remote from the area directly affected by coal industry, high concentrations of Ni, Cu, Co, As, Sn, Mo, Sb, Hg in the folic are natural specific features of the studied area.

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