

ESTONIAN SOILS MACRO- AND MICRONUTRIENT CONTENT DEPENDENCE FROM THE LOCAL BEDROCK AND TRANSPORTED BY ICE FENNOSCANDIAN MATERIAL

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Introduction

Soil reflects the chemical composition of the parent rock element contents, changes are caused by migration of elements, agricultural soil use and anthropogenic pollution. Soil is an essential part of the environment as the medium for plant growth. Estonia is located in the southern shore of the Gulf of Finland and everywhere in Estonia the crystalline Precambrian basement, composed by metamorphic and felsic to ultramafic intrusive rock, is covered by Ediacaran and Paleozoic rocks. The sedimentary cover forms parallel layers, which together with basement are inclined to the south at 3m per 1km. The thickness of sedimentary rocks grows from 125m in the north to 600m in the south. The bedrocks are cropping as west-east belts, where older layers are southward covered by younger and younger rocks.

For plant normal growth and development are needed 6 nonmetallic elements (C, O, H, N, P, S), 4 metals (K, Mg, Ca, Na) and Cl as macronutrients to form the living cells. Another more than 20 essential micronutrients (As, Al, B, Br, Cd, Co, Cr; Cu, F, Fe, I, Mn, Mo, Ni, Pb, Se, Si, Sn, Sr, V, Zn etc) are needed for regulation of living processes (Thornton 1983; Nies 2004 etc),

The bedrock geochemistry

Bedrocks in the northern and central Estonia are represented by marl, lime- and dolostone. Limestone contents (w%): CaO– 45.7-52.7, SiO₂–1.2-10.1, Al₂O₃–0.4-2.12, MgO–0.8-1.25, K₂O–0.2-0.7, Na₂O–0.03-0.08; microelements (mg/kg): As–0.8- 4.8, B–9-21, Ba–14-211, Cd-<1-8.1, Co-<0.03-5.2, Cr–1.5-62, Cu–3-17, F-<100, Fe total–0.45-1.1, MnO–120-460, Mo–0.08, Ni–4-13, Pb–4-127, Sn-<1-1, V–9-12, Zn–4-32, U–0.3-2.6. Marl contents 15-25% of clay parts, in dolostone CaO is partly changed to MgO (14-21%). Cambrian blue clay and Lower Ordovician kerogenic argillite are richer by bioelements (argillite in brackets): SiO₂–59.24 (52.14), TiO₂–0.88 (0.76), Al₂O₃–7.38 (13.15), Fe₂O₃–4.29 (0.85). FeO–2.60 (3.02), MgO–2.58 (1.11), CaO–0.84 (0.22), Na₂O–0.13 (0.10), K₂O–5.84 (7.95), P₂O₅–0.31 (0.13), S–0.13 (2.19), Cl–0.05 (0.02), microelements (mg/kg): As–1.3 (37), B–150 (53), Ba–420 (379), Cd-<1 (<1), Co–20 (12), Cr–78 (80), Cu–25 (105), Mn–320 (158), Mo-<2 (56), Ni–40 (98), Pb–11 (77), Rb–176 (118), Se-<2 (2.3), Sn–3.9 (3.2), Sr–91 (53), Th–10.3 (11.7), U–2.9 (39), V– 109 (507), Zn–76 (47) (Kiipli et al. 2000). The south of Estonia is covered by Middle Devonian sandstone, which is composed from quartz, its composition (%): SiO₂–95.1, Al₂O₃–1.81, Fe₂O₃–0.11, FeO–1.33, K₂O–1.0.

Some microelements exceed 10mg/kg: B (23), Ba(147), Cu(10), Mn (98), V (11) (Kiipli et al,2000).

The sources of the macro- and micronutrients

The geochemical atlas on the humus horizon covers the whole territory and consists of 37 maps, 30 of which show single-element concentrations (Petersell et al. 1997). Comparing the atlas with geological map is easy to define the source of element, is it local or transported from the Fennoscandian Shield. Widely developed in the northern and central Estonia carbonate rocks are enriched here soils with Ca and Mg, partly they are transported by ice into soil parent material on the Sakala ana Otepää heights.

Along the North Estonian Cliff is clearly seen ~ 15km wide zone influenced by kerogenic argillite with high content of Mo, U, P, F, As and V. In Estonia concentration of Mo, Mn, Cr, Cu, P, Sr, Zn is up to 3 times lower than average for continental soils, concentration of B, Hg, Pb, F higher 2 or more times. The low concentration in Estonian soils is due to the low values in the local bedrock and in the material from the Fennoscandian Shield. The concentrations of K, Na, Ni, Mo, Zn, V, B, Ba, Cd, Co, Cr, Cu, Th, U and some other in soils are influenced by crushed rock material from the shield area.

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