INFLUENCE OF SPRINGS TO SOIL COMPOSITION IN NORTHERN FENNOSCANDIA

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It is well known for botanists that very rare plants can be found in near-spring mires, even in small ones. Springs have a dual influence: firstly, continuous outflow of cold water (+2–4ºC in northern Fennoscandia) keeps surroundings wet and cool, creating favourable conditions for cryophilic plants. Another aspect is that various dissolved chemical elements, i.e. needed nutrients for plants, are washed out and concentrate in the soil surrounding springs. Particularly, water flows slowly in small springs with a flow rate of 0.05–0.5 l/s, and often at low angles on hill foots, spreading on large areas. A large proportion of water quickly evaporates, while mineral material stays in soils, creating the required conditions for growth of more demanding and rare, usually protected, species.

Spring water analyses were done for three small springs with flow rates of 0.1–0.025 l/s from the SE slope of Mount Saana in Kilpisjärvi in Finnish Lapland, and for three springs with flow rates of 0.5–0.2 l/s in the eastern part of the Paanajärvi National Park in the Russian Republic of Karelia. Both territories are in natural state and under protection. Samples from Kilpisjärvi were analyzed in the geolaboratory of the Geological Survey of Finland (Systra, 2003) and in every sample 37 elements and NO^- were analyzed. Concentration of Ag, Be, Br, Cd, Cr, F, Fe, P, Pb, Se and Tl stay below the sensitivity of the used methods. In the samples from Paanajärvi a detailed analysis of 54 components was made (Borodulina & Systra, 2001). Concentration of Ag, Au, Be, Cs, Ge, Nb, Pt and Ta remained beneath the sensitivity level of the method used. Geological conditions at the sampling locations are the following: the upper part of Mount Saana represents a thrust nappe, composed by quartzite, below there is a dolomite marble layer, only slightly moved towards the SE; the lower part belongs to an autochthon, which is composed by Cambrian clayey slates and its Archean basement. The territory of the sampling sites in the Paanajärvi NP is composed of Early Proterozoic sedimentary and volcanic rocks.

For calculating annual washout rates, concentrations of elements and annual spring outflows were used. For Kilpisjärvi, the outflow was calculated for half a year, because the springs are liable to be frozen here during the winter season. Thick snow cover protects Paanajärvi springs from freezing. The main component everywhere was Ca, in Kilpisjärvi its annual washout was 6–23 kg, and in Paanajärvi 45–216 kg. The washout of other elements was significantly less, in Paanajärvi: Mg 2–11 kg, K 0.6–17 kg, Na 8–22 kg, and in Kilpisjärvi: Mg 7–35 kg, K 0.4-1.9 kg, Na 0.3–3.7 kg. Sulphur washout had similar rates: S 1.5–13 kg and SO_4^2 4.5–36 kg in Kilpisjärvi, and SO_4^{2-} 42–87 kg in Paanajärvi. Washout of P and N compounds was less: PO_4^{3-} 65–480 g, NH_4^+ 65–160 g, NO_2^- 65–160 g, NO_3^- 95–630 g in Paanajärvi, and NO_3^- 80–630 g in Kilpisjärvi. Cl washout in Paanajärvi was 4.5–11 kg, and in Kilpisjärvi 0.6–2.2 kg; SiO_2 19–58 kg and F 0,4-2,1 kg in Paanajärvi, and Si 0.75–4.7 kg in Kilpisjärvi. Higher content in bedrock and washout of microbiogenic elements was observed in Paanajärvi: Fe 0.3–1.3 kg, Ba 0.05–1.6 kg, Zn 0.1–1,2 kg, Al 0.1–0.64 kg, in Kilpisjärvi the concentrations were: Ba 2–23 g, Al 4-28 g, Zn 45–305 mg. Washout was comparatively high in Paanajärvi for the following microbiogenic elements: Mn 15–47 g, I 8,6–22 g, Ti 4-33 g, Rb 3.5–11 g, Sb 3.2–10 g, Cu 1.6–8.5 g, Ni 1.6–4 g, Cr 0.6–8.5 g, V 0.5–9.5 g, Br 6.2–11 g, Cd 0.2–7.8 g, Pb 2.0–15.3 g, Ga 0.9–2.8 g, Se 0.9–14.5 g, Nd 4-17 g, Hg 0.19–1.9 g, Ce 0.6–5.2 g. Low annual washout chracterizes such elements as As (about 400 mg), U (450–750 mg), W (60–95 mg), but for one spring – 1.1 g. Spring washout may be the cause for high content of hazardous elements found in peat (Orru & Orru, 2003).

Field works in the Kilpisjärvi area was done with financial support of the LAPBIAT grant HPRI–CT-2001-00132 and LAPBIAT 2 grant RITA–CT-2006-025969.