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The Correlation Between Radioactivity and Mineral Composition: an Example from Alkali Feldspar Syenites; Gföhl Unit, Moldanubian Zone

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Two small, up to 100 m long, bodies of alkali feldspar syenites crop out in the Oslava valley, north-west of the town of Náměšť nad Oslavou (western Moravia). The syenite intrudes into the Moldanubian biotite-bearing migmatites of the Gföhl unit. Both bodies are separated from a neighbouring large magmatic body, which is represented by durbachites of the Třebíč massif, by a several-hundred-meter-thick zone with amphibole-biotite-bearing gneisses and biotite bearing migmatites.

A high radioactivity of the alkali feldspar syenites was for the first time mentioned by Weiss (1974). Zircon and titanite are according to Weiss (1974) the most important radioactive minerals.

The rock consists of K-feldspar (77 - 92 %), amphibole (2 -17 %), quartz (1,5 - 9 %) and altered plagioclase (0,5 - 3%). Based on these data, the rocks can be classified as alkali-feldspar quartz syenite or alkali feldspar syenite. Zircon (0,5 - 5 %), titanite, biotite and apatite are minor phases. As the mineral composition shows, the rock is not homogenous. The coarse-grain syenite grades into fine-grain leucocratic alkali feldspar syenite in the centre of the body.

The leucocratic fine grain syenite display the highest radioactivity of the studied samples which correlates with the highest estimated concentration of Th (up to 961 ppm) and U (370 ppm). The Th concentration reaches in the coarse grain syenite only 44 - 98 ppm, the uranium concentration is even lower (10 -40 ppm). U and Th are bound predominantly in zircon as inclusions of uranothorite and its metamictised products. The zircon concentration increases up to 10 times; from 0,5 % in the common, coarse grain syenite to 5 % in the leucocratic syenite. The Th concentration increases in the same rate (from 44 - 98 to 322 - 961 ppm). The uranium follows more or less this dependence (10 - 40 - common syenite vs. 140 - 370 ppm - leucocratic syenite). Thus the radioactivity displays a direct dependence on the zircon concentration.

The Th/U ratio in the individual sample shows a large scale variation between 1.9 - 6.4. This variation is caused mostly by a fluctuation in the U concentration. EMP analyses of uranothorite, which is the most important U mineral in the rock, and its metamictised products show that the uranium concentration decreases strongly during metamictisation. The thorium concentration is, on the other hand, more stable. The variation of Th/U ratio is therefore more likely a secondary feature, originating during metamictisation, than a primary sign of the rock.