

Abstract

Eastern part of the Smrčiny (Fichtelgebirge) granite located in western Czechia is characterised by presence of springs with high radioactivity levels. A survey between years 2016-2018 described 48 radioactive springs in the area of towns Skalná, Plesná and Bad Brambach with ^{222}Rn activities higher than 1500 Bq/l associated mainly with muscovitic variety of the Smrčiny granite (type G1S_m). Spring Wetinquelle in Bad Brambach with highest ^{222}Rn activity (25 kBq/l) belongs to the most radioactive springs in the world.

This thesis focuses on clarification of the processes, which gives the waters flowing in the granitic environment such high radioactivity levels. By use of radiometric and mineralogical methods, radionuclide accumulations and uranium mineralisations originated by infiltrating waters were discovered and characterised and their connection to tectonic activity and presence of radioactive springs was discussed.

After radiometric survey of the area between towns Skalná, Plesná and Bad Brambach, 5 railway cuts and 2 natural outcrops were chosen for detailed study. Total amount of 567 tectonic structures were measured, of which 36 showed increased amounts of radionuclides (21-6982 ppm U, 35-8000 ppm Ra). The whole tectonic data set is dominated by ENE-WSW and NNW-SSE directions. The structures with increased radioactivity are most prominent in directions NNE-SSW, NW-SE and ENE-WSW reactivated by latter tectonic movements on Eger rift and Mariánské Lázně fault, which probably caused leaching of radionuclides from the rock environment and their accumulation in tectonised fillings of fissures with a presence of HFO (hydrated ferric oxides), where they were further redistributed by infiltration processes. Accumulations of radionuclides also show presence in seismically active N-S direction.

In railway cuts, 4 occurrences of secondary uranium minerals from uranium “mica” group were described: metatorbernites with greatly developed crystals, torbernites with degraded crystals, ongoing transformations into metatorbernites and metaautunite intergrowths and two occurrences of metaautunites creating tiny crystals growing on grains of strongly weathered granite.

Geophysical measurements on Břetislav and Pod Skalou spring sites showed strong directional congruence between fault structures below spring sites and structures with high amounts of radionuclides. Waters supplying the springs probably get their high radioactivity levels by flowing through these permeable structures with very high contents of U and Ra.

It was found that radioactive springs and significant radionuclide accumulations often concentrate close to earthquake epicenters and on tectonic directions affected by recent seismic activity, and therefore show some spatial connection. Existence of seismically active N-S trending zone intersecting the granite wasn't yet directly proven. However there is a probability, that zone of this type is located in a railway cut D4 described in this study.