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Gamma dose rate survey of Uranium accumulation in an ancient peat bog in the Swiss Plateau

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Extraordinarily high Uranium (U) concentrations with up to 400 mBq/l 238U were found in ground and surface waters in the western part of the Swiss Plateau, particularly close to the areas where the interface between Lower Freshwater Molasse (USM) and Upper Marine Molasse (OMM) is outcropping. This interface is known to exhibit a high organic material content encrusted with U precipitates that are leached when oxygen-rich rainwater infiltrates the permeable layers of the OMM and is retained at the USM aquitard. At Mont Vully, located ca. 20 km west of Berne (Switzerland), groundwaters with increased U content deriving from the USM/OMM interface have fed the wetlands north of the hill since the end of the last glaciation. Owed to the reducing conditions in bogs, dissolved U reprecipitated and accumulated in a peat horizon. During the 19th century, these peat bogs were drained to create arable land and the impermeable layer below the bog, which enabled its formation, was punctured by the installation of drainage pipes. The subsequent change in redox conditions to an oxidizing environment resulted in ongoing leaching of the accumulated U and outflow of U-rich water with more than 600 mBq/l 238U from the drainage pipes into surface water. In order to identify the dimension of U accumulation below the recent cropland, grid-wise gamma dose rate measurements were conducted with a 2”x2” NaI detector. The detector quantifies about 1 cps per nSv/h revealing comprehensive enhanced dose rates above the agricultural area with several hot spots of up to 160 nSv/h.
Geological maps indicating outcrops of the USM/OMM interface provide the basis for further sampling point selection in the Swiss Plateau. Subsequent water analysis for radionuclides is accomplished by chromatographic separation followed by alpha-spectrometry achieving detection limits of less than 1 mBq/l. Conclusively, the detected activity concentrations in groundwaters of the Swiss Plateau combined with gamma dose rate surveys above ancient peat bogs give indication where analogue U accumulations can be found.