



Soil erosion rates' assessment of a forested catchment using 239+240Pu and relation to landscape evolution

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Plutonium (Pu) isotopes are attracting an increasing interest among fallout radionuclides (FRN) for their suitability as soil erosion/deposition tracers. Most of the recent studies were carried out on permanent grasslands and some in coniferous forests.

One usually assumes that no erosion occurs in forested areas. However, this paradigm might be challenged because forest soils of Northern Germany in a hummocky ground moraine landscape exhibit sometimes a very shallow thickness on crest positions (Calcaric Regosols) and buried soils on slope positions (buried Ah as indicator). The question consequently is: Are these on-going or ancient processes? Therefore, a technique is needed that enables the determination of recent erosional processes and a possibility to relate it to more long-term soil changes.

In the present study, we measured the 239+240Pu stocks in a small, forested catchment (deciduous trees) that is characterised by a hummocky terrain including a kettle hole ("Melzower Forst"). Together with soil development depths, 239+240Pu stocks were correlated to relief parameters, e.g. the topographic position index (TPI). The TPI compares the elevation of each grid cell in a DEM with the mean elevation of a neighbourhood defined by a circle of a certain radius, in our study of 25 m.

We compared the 239+240Pu stocks of fifteen different profiles and their relative erosion/accumulation rates to the TPI. Moreover, we used several mathematical models to evaluate the Pu-data and to quantify the erosion rates for the last 55 years. Our results show a very high spatial variability of the 239+240Pu stocks, from 35 to 70 Bq/m², and no relationship to the TPI as has been demonstrated for arable land. Low annual rainfall, spatially distributed interception and stem flow might explain the high variability of the 239+240Pu stocks, giving rise to a patchy input pattern. The missing relationship between TPI and 239+240Pu stocks however demonstrated that no or negligible soil erosion has occurred during the last 55 years. As the forest has been protected for several hundreds of years, anthropogenic activities and maybe also natural events during the medieval times or earlier seemed to have caused strong erosional events which led to the soil pattern observed.