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ORAL PRESENTATION - Mobilisation of radionuclides and heavy metals from mill tailings at a former uranium mine in south east Finland

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Many new ore prospecting projects have been launched recently in Finland, seeking to exploit both metalliferous and non-metalliferous (e.g. phosphate) mineral deposits. Currently there is increasing awareness of the radiological impact of non-nuclear industries that extract and/or process ores containing naturally occurring radioactive material (NORM). These industrial activities may cause significant environmental problems if the waste generated during processing is not adequately managed.

The Paukkajanvaara mining site in Eno started operation in 1959. The mine was a test site for assessing the feasibility of larger scale uranium extraction. The ore was milled and enriched on site but mining proved to be uneconomic, and so operations ceased in 1961. In the late 1970's the entrance of the mining shaft was sealed with a concrete slab and the area including tailings, waste-water ponds etc., was abandoned. The site was left untouched for nearly 30 years until Finnish Radiation and Nuclear Safety Authority initiated a review. Their results indicated that ambient radiation levels at the site had increased by 0.5 μSv/h as a direct result of the earlier mining operations. Rehabilitation was completed by 1994 after which the area was released for outdoor use without restrictions.

The aim of this study was to examine the potential for mobilisation of radionuclides and heavy metals from the mill tailings and the waste rock pile. Samples of run-off sediment were collected along a transect from the waste rock to a small pond (Iso Hiislampi). Depth-profiled bottom sediment samples were also taken from the pond close to the mill tailings area. After pre-treatment, gamma spectrometry was used for direct determination of uranium and thorium progeny (principally, 234Th (238U), 235U, 226Ra, 210Pb and, - 228Ac (228Th)). Samples were then analysed by X-ray diffraction (XRD) to determine the main minerals present. Thereafter, aqueous samples were prepared by microwave digestion in nitric acid allowing determination of uranium, thorium and heavy metals by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and uranium and thorium by alpha spectrometry, respectively. For the latter method, uranium and thorium were separated using anion exchange chromatography. The use of complementary analytical techniques highlighted issues with complex mineralogical matrices and reduced uncertainty in the extent of legacy radionuclide and heavy metal contamination present at the site.

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