

# Management of Radon Releases from Waste Rock Dumps at Uranium Mining Legacy Sites in Germany

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## **Abstract**

At some of the uranium mining legacy sites in Germany (WISMUT sites) radon releases from waste rock piles trigger significantly the options of remediation. In particular, in the ore mountains (Erzgebirge), in Saxony, extremely high radon emissions from waste rock dumps have been observed. The radon emissions cause high outdoor radon concentrations of up to 1,500 Bq/m<sup>3</sup> in the immediate vicinity of the waste rock dumps. These high concentrations occur although the average specific activity of Ra-226 of the waste rock material is low, i.e. in the range between 0.3 Bq/g and 0.8 Bq/g.

Advective radon migration caused by buoyancy may be of significant importance for the radon situation at uranium mining waste rock dumps in case the dumps are high and show steep and long slopes. Compared with radon migration driven by diffusion which brings radon only from the top 2 m rock material to surface, convective soil gas streaming has the effect of, that an essentially bigger part of the body of the waste rock dump contributes to the radon emission. Convective soil gas streams lead also to the convergence of radon releases on comparably small fractions of the surface of waste rock dumps. This results in high outdoor radon concentrations at the respective parts of the waste rock dumps and its vicinity. Advective radon migration in waste rock dumps causes characteristic local and temporal patterns of radon releases. Under summer conditions high radon emissions are focused on the slopes near the toe of the waste rock dumps. In cases where dwellings are located in a distance of a few meters from such emissions, significant exposures of the general public occur.

At Wismut GmbH a special investigation strategy was developed to characterize the radon releases from waste rock dumps with respect to the local and temporal variations of radon fluxes. In addition to various measuring methods for the determination of radon flux (box method, measurement of the radon concentration close to the ground), methods for the visualization of the discharge areas of the soil gas streams are applied, i. g. infrared thermography. Characterization of the radon emissions is amended by a method for the characterization and the evaluation of radon immissions.

In order to reduce radon releases from waste rock dumps, Wismut GmbH covers the waste rock dumps with a mineral soil layer. As covering material natural soil is used featuring certain quality standards regarding the physical soil properties. During a period of about 15 years Wismut GmbH has gained substantial experiences with respect to waste rock covering. Investigation and evaluation methods developed by Wismut GmbH and selected results of the remediation to reduce radon releases from the waste rock dumps will be demonstrated by means of case studies.