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Natural Gamma-Ray Background Characterization in Pyhasalmi Mine

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We present the results of measuring the gamma-ray background performance of Pyhasalmi mine, the deepest one in Europe. Two underground facilities in Lab 2 (1440 m) and Lab 5 (1410 m) were investigated. Based on measurements made in Lab 2 with a low-background HPGe spectrometer, we determined the integral gamma-ray background count rate in the energy range of 40 keV to 2.7 MeV to be $0.095 \text{ s}^{-1} \text{ kg}^{-1}$. The minimum detectable activities of some natural and artificial nuclides were less than 0.071 Bq/kg (^{226}Ra), 0.77 Bq/kg (^{40}K) and 0.012 Bq/kg (^{137}Cs). The specific activities of natural nuclides in the shotcrete covering the walls of the Lab 2 were higher than those in the rock: 100.3 Bq/kg (^{232}Th), 161.7 Bq/kg (^{226}Ra) and 1171 Bq/kg (^{40}K) in the shotcrete covering and 47.6 Bq/kg (^{232}Th), 83.1 Bq/kg (^{226}Ra) and 1513 Bq/kg (^{40}K) in the rock. The measurements showed that the gamma-ray background level in Lab 5 is significantly lower than that in Lab 2. The integrated gamma-ray background count rate for the energy range of 40 keV to 2.7 MeV was $0.028 \text{ s}^{-1} \text{ kg}^{-1}$ for Lab 5. Purging the measuring chamber of the gamma spectrometer with nitrogen gas at a rate of 0.15 L/h allowed to further improve this parameter to $0.021 \text{ s}^{-1} \text{ kg}^{-1}$. In general, the results of this study confirm that the level and energy spectrum of background gamma radiation in the underground facility within the studied energy range is defined mainly by the composition of the walls of the Labs.