

RADIOMETRIC ANALYSIS OF SELECTED PHOSPHORITE DEPOSITS OF NORTHWESTERN SAUDI ARABIA

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Natural gamma radiations in the Earth's crust mainly comes from the decay of three radioactive isotopes: Potassium-40 (^{40}K), Uranium-238 (^{238}U) and Thorium-232 (^{232}Th). The decay chains of these 3 radioisotopes are illustrated in a figure. Natural Gamma Ray Spectrometry Facility at the ERL was used on full time basis over a period of three months to measure quantitatively the natural gamma-ray activity in 50 selected phosphorite deposit samples from the northwestern part of Saudi Arabia.

Samples were collected namely from Turayf area, Arar chalk, Tawil sandstone and Umm Wual regions. Each sample was crushed, placed in a 3"x0.5" cylindrical plastic container, air tight sealed to prevent any radon escape, and left for three weeks to allow ^{226}Ra decay to reach the equilibrium in the ^{238}U decay series. The sample was then placed on a 5"x5" NaI(Tl) detector which was connected to a spectroscopy amplifier, an ADCAM Multichannel Buffer Ortec 918A model and a PC based data acquisition and analysis system. The setup has already been calibrated [1] using 14 certified standards of K, U and Th from IAEA, Austria and NIST, USA. Each sample was measured for 24 h to reach a good statistical accuracy of a few percent. Spectra were acquired in 4096 channels and calibrated with standard gamma-ray sources (^{60}Co and ^{137}Cs). This calibration allows three selected gamma lines of 1460 keV from ^{40}K , 1765 keV from ^{214}Bi and 2615 keV from ^{208}Tl to be evaluated. Here, the line of 1765 keV of ^{214}Bi comes from ^{238}U and 2615 keV of ^{208}Tl from ^{232}Th . The integrated background-subtracted net counts under these peaks were compared with those from certified standards of known absolute concentrations of U and Th in ppm and K in wt. %.

The results of the measurements show a U concentration between 9-127 ppm with an average of 42 ppm, Th concentration of 3-28 ppm with an average value of 10 ppm and K concentration in the 0.18-2.42 wt. % range with an average of 0.8%. The uncertainties were 0.3-4 % for U, 1-17 % for Th and 0.7-15 % for K. The results will be presented and further geological interpretation of the results will be discussed using the relation between the content of K, U and Th and P_2O_5 as well as from the relationship among uranium, thorium and potassium [2].

References:

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