



Uranium, Thorium and some other trace elements in phosphorites from different provenances

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Data on the trace element composition of phosphorites is scarce. Some of them may be harmful at certain concentrations. Special concern is given to the radionuclides U and Th and some other heavy metals such as: Co, Cr, Cu, Ni and V. Phosphorites of different origins can vary significantly in the trace element concentrations. 37 samples of phosphorites from 16 deposits were analyzed for Uranium, Thorium and five potential toxic elements (Co, Cr, Cu, Ni and V) as well as 26 samples of data gathered from the literature. In total 63 samples of phosphorites from 20 deposits of 19 countries were studied: Algeria, Australia, Brazil, Burkina Faso, Chile, Colombia, Egypt, India, Israel, Mongolia, Morocco, New Zealand, Peru, Senegal, Syria, Togo, Tunisia, USA and Venezuela. Aqua regia extracts were used to estimate the "pseudototal" values, following standard procedures (ISO 11466, 2002) and measured by ICP-MS. The median concentrations (mgkg⁻¹) obtained were: U 53 (range 0.20-177), Th 4.05 (range 1-49), Co 4 (range 0.5-159), Cr 100 (range 15-1000), Cu 20 (range 5-213), Ni 21 (range 3-850) and V 70.05 (range 20-591). As 120 mgkg⁻¹ of U concentration of phosphorites is the value considered to be useful as a source of nuclear fuel, we now indicate the deposits with values higher than 120 mgkg⁻¹: Khouribga KIISB (Morocco) 121, Khouribga KIISL (Morocco) 123, Champ mines (Idaho, USA) 131, Noralyn (Central Florida, USA) 138, Bone Valley (Florida, USA) 140, Boucraa BGB (Morocco) 141, Boucraa BGC (Morocco) 152, Negev (Israel) 172 and Chatam Rise (New Zealand) 177. The highest Th concentration found was 49 mgkg⁻¹ at Bijawar Group (India). Uranium shows significant positive correlations with V ($r = 0.41$) and Cr ($r = 0.30$), and significant negative correlations with Co ($r = -0.47$). Other positive correlations are Cr with Cu ($r = 0.58$), Cr with V ($r = 0.52$) and Cr with Ni ($r = 0.51$). Cu correlates positively with Ni ($r = 0.84$) and with V ($r = 0.63$). Ni correlates positively with V ($r = 0.72$).