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Investigation of uranium contamination in ground water of southwest Punjab using EDXRF technique

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The Energy-dispersive X-ray fluorescence technique (EDXRF) is used for elemental analysis of the samples collected from the ground water and the canal water in the Bathinda district of Punjab state, India. The residues obtained after drying the water samples are analyzed using the EDXRF spectrometer consisting of 42Mo-anode X-ray tube equipped with selective absorbers as an excitation source and an Si(Li) detector. The maximum concentrations of 35Br, 38Sr and 92U elements are observed to be 5543, 6165 and 212 μg/L, respectively, in shallow ground water samples and 20, 200 and 5 μg/L, respectively, in the canal water samples. The observed concentrations of these elements show positive correlation with the Total Dissolved Salt (TDS) content of the ground water. To investigate the flyash from the coal-fired thermal power plants as a possible source of ground water contamination, the water samples collected from the surroundings of the power plants and the flyash samples are also analyzed. The elemental analysis rule out the possibility of flyash as a possible source of ground water contamination. The canals reaching the Malwa region are based on Sutlej river and the canal water is used extensively for irrigation. Samples collected from different locations of industrial waste water drains sinking into Sutlej river near Phagwara and Ludhiana were also analyzed. It is concluded that the industrial drains lead to uranium contamination in Bathinda. The presence of uranium in the ground water in the southwest Punjab due to weathering of granite rocks with high radioactivity content (uranium concentration ~8 ppm) at Tosham hills (distance ~ 200 km from Bathinda) is rather unlikely in the absence of very supportive conditions, viz., large water body with abnormal pH values and ground water flow from Tosham hill region to southwest Punjab. As the uranium contamination is occurring over vast regions of ground water, the source is likely to be not localized one. Southwest Punjab consists of Sutlej-Ghaggar plain. The soils in the region have largely developed on alluvium deposits up to depth of thousands of feet and evidences like high concentration of soil radioactivity or radon also do not favour existence of natural uranium ore deposits in Bathinda. It is a rich agricultural area cultivated with the help of extensive irrigation made possible by the canal water from the Sutlej river. The soils in the region are calcareous and contain uranium ~ 3-5 ppm. The ground water level is in the region is in general shallow. The irrigation schemes are mainly based on extensive network of canal water. The irrigation water percolating through the soil dissolves carbon dioxide produced from the plant root respiration and the microbial oxidation of the agricultural matter and results in carbonic acid. The carbonic acid reacts with the calcium carbonate (calcareous soil) to produce bicarbonate, which leaches uranium from soils and sediments to the ground water. Further, the use of agricultural additives like phosphates fertilizers (uranium concentration ~ few tens of ppm) enhances the uranium and chemical concentrations in the ground water. Due to minimal use of ground water, the chemical contamination in ground water is increasing.

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