

The uranium toxicity in groundwater in southern Punjab (Malwa Region), India

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The elevated level of uranium content in groundwater in parts of Sangrur, Mansa and Bhatinda districts of Punjab and Sirsa district of Haryana (29°45' to 30°00'N - 75°00' to 75°30'E and 30°00' to 30°15'N - 75°15' to 75°45'E) is a matter of concern. Exponential increase in instances of cancer cases in Malwa region of Punjab is attributed to the high concentration of uranium in groundwater.

For the study, total 700 water samples (both groundwater and surface water) from different aquifers spread over 2800 sq km were analysed for different geochemical parameters including uranium. The mean uranium concentration in water samples is 33.13 ppb, which is higher than both the EPA guidelines and BIS norms. The maximum concentration is 217.6 ppb and 294 samples are showing higher values above permissible limit. The strata chart of boreholes available at water supply schemes shows that in the study area three main aquifers are present- i. from 6m to 25m; ii. from 67 to 74m and iii. from 100 to 125m. In between these aquifers thick hard clay horizons are present. The high uranium concentration is present in samples of all depth. However, the surface water/ canal water/ RO filtered water are free from uranium.

Geologically, the area comprises mainly Older Alluvium and Aeolian sediments. The older alluvium comprises oxidised clay, silt and sand with presence of caliche. Aeolian sediments also calcareous in nature occur as sand dunes and sand sheet or Aeolian Flat deposited in smaller basins over Older Alluvium surface in semi-arid climate. The Delhi-Sargodha-Lahore ridge (subsurface) passes from the study area is a basement high which separates the Indus basin from the Punjab depression on the east and Punjab basin itself between north and south. The study area lies on this ridge itself and the basement contours shows that the depth of the basement is shallow (around 400 to 600m) here. Climatically the area is influenced by arid condition and the groundwater regime is at stressed condition owing to the shallow basin in the past. However, in post-independence era the area is influenced by canal system and the water level is at shallow depth.

The geochemical analysis shows high specific conductivity (in the range from 32 to 11744 μ seimens; mean value: 1795 μ seimens) and TDS content (in the range of 21 to 20592 ppm with a mean of 1218 ppm) in groundwater in the study area. Using the classification of water salinity described by Freeze and Cherry [1], the groundwater samples ranged from fresh (0 to 1000 ppm TDS) to brackish (1000 to 10000 ppm TDS). The pH of the water in study area ranged from 6.9 to 9.5 with an average of 7.9 (alkaline in nature). All other parameters viz. Cl, Ca, Mg and hardness is also high in the study area and put together all it can be alleged that the quality of groundwater is not suitable for drinking purpose. The positive correlation of high uranium values with bicarbonate (secondary growth) and TDS is implied that the mobility of uranium in groundwater is controlled by TDS and bicarbonate. The piper [2] plot shows that predominant water facies are (Ca+Mg) - HCO₃, (Na+K+Cl) - SO₄ type, (Ca+Mg) - SO₄ type and (Na+K) - HCO₃ type in the study area. This wide variation of water types reflects the interaction between geology and related geochemical processes significantly affects the groundwater compositions. The uranium content of surface soil samples shows low uranium content except in one sample the value of uranium is

14.76 ppm (Lohakhera, Sangrur). This observation does not favour presence of local source of high uranium concentration in the study area.

References:

[1] Freeze RA and Cherry JA (1979) In: Groundwater: Prentice Hall.

[2] Piper AM (1944) In: A graphic procedure in the geochemical interpretation of water analysis : Trans. Amer. Geophys. Union (25): 914-928.

