Tracing the sources of salinity and water quality in groundwater from Rajasthan

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Groundwater is becoming the primary source of drinking and agricultural water in many parts of India. Recent studies have shown that climate change, through warming of the Indian Ocean, has caused a major reduction in precipitation over northern India, which has in turn increased both groundwater extraction and groundwater table decline[1]. One of the most vulnerable regions in the Indian subcontinent is northwestern India, where arid climate and endemic groundwater quality issues, such as high salinity and fluoride, pose serious risks. Investigation of the groundwater geochemistry from 130 wells in four sites in Rajasthan has shown elevated levels of salinity, nitrate, fluoride, and uranium. Integration of geochemical (e.g., Br/Cl, Na/Cl) and isotopic ($\delta^{11}B$, $^{87}Sr/^{86}Sr$, $\delta^{18}O$, $\delta^{2}H$) tracers suggests that groundwater quality is controlled by: (1) evaporation of recharge water; (2) dissolution of salts in the unsaturated zone; (3) weathering and mobilization of constituents from the host aquifer rocks, particularly in the alluvial aquifers; and (4) secondary reactions such as boron adsorption onto clay minerals. The data show a high radiogenic signature ($^{87}Sr/^{86}Sr$ ratios from 0.712 to 0.733) in groundwater from the alluvial aquifers in Rajasthan, which indicates groundwater interaction with the weathering products of granitic/gneiss basement rocks. In contrast, the wide range of relatively high $\delta^{11}B$ values (8 to 39‰), combined with high correlations between B/Cl and Na/Cl ratios imply secondary ion exchange and boron adsorption reactions. Overall, the geochemical data indicate multiple processes that affect the groundwater quality in Rajasthan aquifers. The combined decline in water availability and the low quality of groundwater has major implications for human health and food security in Northwestern India.

[1]Asoka, Gleeson, Wada, Mishra (2017), *Nature Geoscience* **10**, 109–117