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Extent and Impact of Arsenic and Fluoride Leaching from Hydrothermally Impacted Sediments of the Independence Basin Aquifer System, Mexico

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The Independence Basin Aquifer System (IBAS) located in Guanajuato (central Mexico) is among one of the many Latin American regions that exhibits elevated concentrations of arsenic (As) and fluoride (F^-) in drinking waters (groundwater). Groundwater in San Miguel de Allende, a municipal area located in southern IBAS, contains up to 50 µg/L of dissolved As (exceeding WHO and national limits of 10 and 25 µg/L, respectively), and 3.4 mg/L of F^- (exceeding WHO limit of 1.5 mg/L). Mobility of these toxic elements in IBAS groundwater has been linked to interactions between recharge water, sediments containing volcanoclastics, pH dependent desorption, and geothermal influence. Evidence of hydrothermally impacted groundwater is represented by a strong correlation between groundwater temperature (>30°C) and concentrations of As, F^-, and geothermal tracers such as lithium (Li) and boron (B). We aim to investigate the influence of hydrothermal activities in this region on mobility of As and F^- in groundwater and to map similar correlations with Li and B. We analyzed sediment samples from two drill cutts (56 and 350 m in depths) collected from on either side of the Taxco-San Miguel de Allende fault for mineralogical characterization and elemental composition on powdered samples using X-ray diffraction and X-ray fluorescence, respectively. The results showed that the average As and F concentration in two cores were 0.87 and 2.32 mg/kg, and 9.74 and 21.70 mg/kg, respectively. Bench-scale incubation experiments are underway to study the mobility of As and F^- from these sediments under simulated geothermal conditions with varying pH and temperature. Groundwater modeling software such as PHREEQC and Geochemists' Work Bench will be implemented to calculate saturation indices of different minerals involved at low-enthalpy geothermal temperatures and pH of 5, 7, and 9, as well as to model dissolution, adsoption, or readsorption reactions that mobilize or sequester As and F^- from aquifer sediments. The results of this study are important to identify the sources and mechanisms contributing to mobilization of As and F^- in hydrothermally influenced groundwater systems and will assist the administrators and government to provide safe drinking water to the residents of IBAS.