Contribution of Biotite weathering for arsenic pollution in the southern Indus Plain aquifers, Pakistan.

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Toxic levels of arsenic in groundwater pose a serious and widespread threat to human health and the environment, with approximately 150 million people worldwide being exposed to arsenic toxicity. In the southern Indus Plain, aquifers are naturally populated by arsenic, which is found in recent/sub-recent sediments primarily derived from the Himalayas and adjacent rocks during the Holocene period. Previous studies have indicated that the reductive dissolution of arsenic-bearing iron oxyhydroxides, facilitated by the microbiodegradation of organic matter, is a dominant mechanism for arsenic release. However, the source of arsenic in sediments remains poorly understood. The present study investigates the contribution of biotite leaching to the release of arsenic into groundwater. These investigations aim to improve our understanding of arsenic pollution in the Indus Alluvial Plain, with implications for developing effective mitigation strategies to ensure access to safe drinking water for the local population. Eight aquifer sand samples from the Matiari district of Sindh were collected for petrographic, scanning electron microscopy (SEM), and geochemical analysis. Petrographic and SEM studies revealed appreciable quantities of arsenic-bearing biotite in these sediments, along with its weathering products, including iron-rich chlorite and phlogopite. A Frantz Isodynamic Magnetic Separator was employed at different strengths to separate the magnetic and non-magnetic fractions in the aquifer sand samples (n=8). These fractions (n=19) were subsequently analyzed for trace elements, including arsenic, vanadium, chromium, nickel, copper, selenium, molybdenum, cadmium, lead, and uranium, using inductively coupled plasma mass spectrometry (ICP-MS) and atomic absorption spectroscopy (AAS). The results showed that arsenic concentrations in magnetic minerals

ranged from 8.6 to 51.7 µg/Kg, while arsenic concentrations in non-magnetic minerals ranged from 1.1 to 24.2 µg/Kg. The data indicated that high concentrations of arsenic are associated with the magnetic fraction found in the sediments. Arsenic is primarily derived from the FeOOH coating on the surface of magnetic minerals, and the dissolution of these coatings in a reducing environment result in the release of arsenic into groundwater.