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Mineralogical Controls on Arsenic Transport in Brahmaputra River Sediments

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Human exposure to toxic arsenic (As) concentrations in shallow groundwater continues to drive a wide range of diseases and premature deaths in South and Southeast Asia. In Bangladesh alone, over 38 million people consume groundwater with As exceeding the WHO guidelines. The dissolved As in shallow aquifers is derived from fluvially deposited sediments physically and chemically weathered from the Himalayas and associated uplifts. Sediment provenance has been suggested to be associated with As release from primary geologic formations. The evolution of As mineral hosts during fluvial transport owing to chemical weathering and hydrodynamic sorting must also play a role in explaining the spatial distribution of dissolved As in low-lying shallow aquifers.

This study investigates the sources and transformation of As-bearing phases along the Brahmaputra River in Assam, India. The study focuses on suspended and bedload sediments derived from three broadly different geologic provenances during the monsoon season. We hypothesize that (1) sulfide-rich and granitic source uplifts contribute larger As loads, (2) hydrodynamic sorting concentrates primary As-bearing minerals in the bedload near source regions followed by weathering and subsequent transfer to clay fractions during downstream transport, and (3) Fe-oxides represent an important final host phase for As in suspended sediments, alongside clays and silicates.

Suspended and bedload sediments were collected from the Brahmaputra main channel and three major tributaries: the Kopili, Dhansiri, and Subansiri Rivers. These rivers drain the Shillong Plateau, Naga Hills, and Himalayas, respectively. Suspended sediments were sampled at 25% and 50% depths using a Van Dorn sampler, and riverbed sediments were collected using a weighted bucket. To analyze Fe-oxide–associated metals, sediments were separated into clay, silt, and sand fractions and measured for As and trace metals using sequential extraction with hydroxylamine hydrochloride, followed by total digestion for clays and silicates. A handheld XRF was used to scan bedload sand samples for bulk element composition.

In bulk bedload sediments, As concentrations range from 1.8 -5.0 mg/kg. We will present As and trace metal concentrations for Fe-oxide and bulk minerals for suspended and bedload size fractions. These results should help elucidate the processes mediating As transport in fluvial systems.