Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16972

Dynamics of submarine groundwater discharge aided arsenic cycling in an estuary adjoining the Bay of Bengal

POULOMEE COOMAR[1], KOUSIK DAS[2], SWATI VERMA[3], PRERONA DAS[1], ASHIS BISWAS[4] AND ABHIJIT MUKHERJEE[1]

[1]Indian Institute of Technology, Kharagpur
[2]SRM University
[3]National Institute of Oceanography
[4]Indian Institute of Science Education and Research (IISER), Bhopal

Presenting Author: rimpakoomar@gmail.com

Important reactions take place at interfaces. One interface would be that between freshwater and seawater at estuaries. Here interactions between terrestrial water flows and seawater exert great control on trace elements (TE) discharge to the sea. However, sub-surficial reactions between discharging groundwater intermixed with re-circulating seawater, which is called submarine groundwater discharge (SGD) plays a role equivalent to or more important than surficial flows in controlling TE budget and cycling.

Although the role of SGD in transporting TE to the ocean is well recognized, only a few studies address its role in cycling and transport of arsenic (As) to the global oceans. The work presented here is a high-resolution study investigating the geochemical processes controlling the cycling of As in one such estuary adjoining the Bay of Bengal. Arsenic and other solutes were measured in a series of multi-depth observation wells and sediment cores, extending from the high tide line to 100 m seaward, for pre-and post-monsoon seasons. Results reveal the presence of a plume carrying up to 30 µg/L dissolved load of As at a distance of 40 to 60 m seaward. The As is associated with a plume of iron (Fe) and both exhibit similar variation in areal dimension with season. Fluctuating plume size can be attributed to seasonal variation in fresh groundwater input to the site. Arsenic geochemistry is controlled by Fe-Mn redox cycling. Field-observation and geochemical modelling demonstrate Fe-hydroxide precipitates at the site which act as an interim As sink in pre-monsoon, switches into a As source on alteration of geochemical condition in post-monsoon. Seasonal changes in terrestrial freshwater flux alter the balance between oxidative (As capturing) and reductive (As releasing) processes leading to changes in plume size. Estimates indicate up to 55 mg m^{-2} d^{-1} As is released to bay from the site. The study is the first to report on the chemo dynamics and transport of As cycling to the Bay of Bengal and estimate As flux from in-field measurements. The work also highlights the impact of temporal variation of groundwater-seawater interaction dynamics on this cycling.