Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14498

A Sr isotopic study of the interaction of river water, seawater, and groundwater in the Hooghly (Ganga) estuary.

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The Himalayan River systems (Ganges-Brahmaputra) contribute significant flux of radiogenic Sr to the oceans. Thus, it is hypnotized that the increase in seawater $^{87}Sr/^{86}Sr$ over last 40 Myr is primarily driven by the Himalayan weathering flux carried by these rivers[1]. Estuaries are a major pathway for the transfer of dissolved and particulate load from continents to the ocean. Here we report variations in Sr concentrations and $^{87}Sr/^{86}Sr$ in water samples of variable salinity from the tidally dominated Hooghly (Ganga) estuary in India. These samples were collected from 3 different seasons (2019-2021) and spans over ~200 Km from the mouth of the estuary to the freshwater endmember. River water was collected from within 0-16 m depth of the Hooghly main channel at locations identified by their salinity, tidal impact, and confluence of tributaries. Ground water (30-300m) was collected from both banks of the river. The [Sr] and $^{87}Sr/^{86}Sr$ of were measured using ICP-OES and TIMS, respectively. Salinity was measured on site using a salinity probe (PCSTestr35). The $^{87}Sr/^{86}Sr$ of groundwater demonstrates limited variability (0.720-0.730) compared to the river water (0.709 to 0.728). Our results indicate that in the tidal section of the river (80-200 Km from the mouth of estuary), there is fresh groundwater discharge while in the estuarine section (0-80 Km) there is saline groundwater discharge. Our measurements of depth-dependent river water samples (0-16 m) reveal that at the mouth of the river, despite higher salinity (15-25 psu), the $^{87}Sr/^{86}Sr$ of the water mass is highly radiogenic (0.720-0.729) which is in contrast with the high salinity. This observation is best explained by prolonged interaction of saline ground water with the bottom sediments with the movement of the tidal front. In addition, this observation is consistent with published body of work on saline groundwater discharge into Bay of Bengal from the Hooghly estuary[2]. We hypothesize that the tidally influenced residence time of water in the estuary plays a critical role in modulating the Sr isotopic composition of the water column.

[1] Palmer & Edmond (1989) *Earth and Planetary Science Letters*, *92*(1), 11-26.

[2] Chakrabarti et. al. (2018), *Scientific reports*, *8*(1), 4383.