Silicate weathering and dissolution recorded by Si isotopes in shallow groundwater near the Indian coast

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We collected 12 shallow groundwater (GW) samples from boreholes along the North-East, South-East and South-West Indian coastline and the freshwater estuarine surface waters nearby during high discharge (summer monsoon) and during base flow (dry season). We measured the major elements contents of the GW, their Si isotopic composition and compare with their superficial estuarine freshwater counterpart to understand the variability of GW and riverine Si isotope signatures supplied to the ocean. Mean GW $\delta^{30}Si$ is 0.8 ± 0.6 ‰ (without significant seasonal difference) while mean freshwater estuaries $\delta^{30}Si$ is 1.1 ± 0.6 and 2.3 ± 0.4 ‰ for wet and dry seasons respectively. All groundwater samples have higher Si contents than freshwaters estuaries (392 ± 168 vs. 168 ± 84 mM respectively) and except two samples, GW are lighter than surface water as usually observed in groundwater due to dissolution of primary and/or secondary minerals during rock-water interaction in aquifers. There is also a significant positive relationship between $\delta^{30}Si_{GW}$ and DSi_{GW} contents which is indicative of chemical weathering. This is in agreement with saturation indexes since in all GW samples albite and amorphous silica are undersaturated while clays are generally oversaturated.

Noteworthy, the variability of $\delta^{30}Si$ in these shallow GW is as large as the one observed by Georg et al. (2009) on Ganges-Brahmaputra GW which was then attributed fully to a depth control from 1.3 ‰ for shallow to -0.2 ‰ for GW at 300m below surface. Our results thus challenge such hypothesis. Moreover, our data suggest that the isotopic shift induced by dissolution is not proportional to the quantity dissolved. In this presentation, we will discuss the possible weathering and dissolution processes that could explain the variability of $\delta^{30}Si_{GW}$ and their implication for Si supply to the ocean.