Geochemical behaviour and marine flux of barium in the eastern coast of the Arabian Sea

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We investigated the source-sink processes affecting Ba fluxes from the Western coast of India to the Arabian Sea. For this, we analysed the seasonal and inter-annual variability of dissolved and particulate barium in Nethravati-Gurupur Rivers, and their estuary on one hand, and the dissolved barium from Mandovi and Periyar estuarine systems on the other hand.

No significant inter-annual variability of DBa was found in the Nethravati-Gurupur river. The moderate correlation between DBa and F^- indicates their common mineralogical origin, possibly fluoride bearing muscovite mica and/or hornblende present in the granite-gneiss and amphibolite. The DBa in the river water is ~100 nmol/L which is lower than the expected Ba (400 to 800 nmol/L) concentration for granite-gneiss lithology suggesting incongruent release of barium from the bedrock. Ba is incorporated in particulate phase during chemical weathering, as evidenced by the lower molar Ba/Na (0.8) in dissolved phase, and higher molar Ba/Na (17 to 21) ratio in the SPM and bed sediments compared to the bedrock molar Ba/Na (6 to 14) ratio.

In the estuary, DBa shows significant seasonal variation, from about ~100 nmol/L during monsoon and post-monsoon season to 250 nmol/L in the Periyar and Mandovi estuaries and to 790 nmol/L in the Nethravati-Gurupur estuary during pre-monsoon season. The salinity vs DBa concentration relationship suggests non-conservative mixing with maximum DBa excess at 6 to 10 psu in the Nethravati-Gurupur estuary, at 14-20 psu in the Mandovi estuary, and at 11 psu in the Periyar estuary. These relationships suggest massive Ba release (up to 1000 nmol/L) from particles in the mixing zone. The particle dissolution is also supported by the evolution of $^{87}Sr/^{86}Sr$ isotopic ratio in estuarine water and particles along the salinity gradient. The river borne particle dissolution leads to slightly radiogenic $^{87}Sr/^{86}Sr$ in the estuarine water as evident from the deviation from the theoritical mixing line. Unlike other estuaries, the coastal groundwater discharge is insignificant contributor of solute in the Nethravati-Gurupur estuary as it acounts for less than 5% of the annual rainfall.