Large stable Ca isotopic ($\delta^{44/40}$Ca) variation in open ocean samples from the Bay of Bengal

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The stable Ca isotopic composition ($\delta^{44/40}$Ca) of modern seawater is considered to be constant (1.88 ± 0.1 ‰)[1–2] because of the long residence time of Ca (~1 Ma) in seawater comparared to the ocean mixing timescales (~1500 yrs). Based on this premise, the variation in $\delta^{44/40}$Ca of seawater from 1.3‰ during the Ordovician to ~2‰ at present has been explained by the oscillating mineralogy of marine carbonates between aragonitic to calcitic[1]. However, no systematic study has ever been attempted in a single ocean basin to test the assumption of a uniform $\delta^{44/40}$Ca composition of seawater at any instant of time.

In the present study, $\delta^{44/40}$Ca values of water samples collected from the Bay of Bengal (BoB), which is one of the most stratified and seasonally dynamic oceanic systems in the world, is reported. The water samples from the BoB were collected over a span of ~3 years during both monsoon and non-monsoon months over an area of ~3 × 10^5 sq. km. Calcium stable isotopes were measured using a ^{43}Ca-^{48}Ca double spike technique using a Thermo Fischer Triton Plus TIMS at the Centre for Earth Sciences, IISc. The external reproducibility (2SD) of the $\delta^{44/40}$Ca values are better than ±0.08‰[3]. Salinity of the water samples were measured on-site. The $\delta^{44/40}Ca_{SRM915a}$ of the BoB water samples (n = 36) varies from 1.06‰ to 2.24‰ that covers the variability in $\delta^{44/40}$Ca in seawater from the Ordovician to present-day[1]. Absence of any systematic difference in $\delta^{44/40}$Ca between the monsoon- and non-monsoon- water samples suggests that differential continental input alone can not explain the observed variation in the BoB. The depth-variability in $\delta^{44/40}$Ca values in the northern BoB matches well with the aragonite and calcite saturation depths[4] and also indicate the contribution from submarine groundwater discharge[5]. Our results have implications for the reconstruction of the Ca isotopic evolution of seawater through time.

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