Trace element budgets in Lake Baikal question the dominant effect of salinity in estuarine removal processes

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Removal of riverine trace elements from solution is well known for marine estuaries, resulting in dramatically lower concentration in seawater for elements like Fe, Mn, REEs, Al, and Be compared to rivers. Traditionally, this is often attributed to salinity induced coagulation and removal of colloidal matter and associated particle reactive elements[1].

Although Lake Baikal has a lower ionic strength than its tributaries, a similar drop in concentration from riverine values is observed for many of the same elements (like Fe, Mn, REEs, Al, Be, Cu, Y). Based on comparable Ce anomalies of lake surface waters and tributaries, the drop in concentration at the river-lake interface is mostly due to adsorption of solutes onto existing particulates. REE concentrations (as well as Fe, Mn, Be) in the lake also decrease with depth while Ce anomalies get more negative, indicating the ad-/absorption of REEs by newly formed authigenic FeMn phases[2]. The resulting short residence time of Nd in the lake leads to a non-uniform distribution of Nd isotopes. In contrast, Sr concentrations are similar in lake and rivers and Sr isotopes show a uniform distribution within the lake.

The controlling parameter for the drop in concentrations of these trace elements across the river-lake interface appears to be pH, which is elevated in the lake (8.3-8.5 at the lake surface) compared to riverine values (7.8, flow weighted average). This finding is consistent with observed correlations between pH and the concentrations of some of these elements in river waters[3]. Together, these results call into question our understanding of the processes occurring in marine estuaries. Possibly, pH rather than salinity is also the dominant driver in the marine context.

1. Sholkovitz GCA 40, 831–845 (1976).
2. Bau GCA 63, 67–77 (1999).
3. Gaillardet et al. ToG 2. edit 7, 195–235 (2014).