

Porewater hydrochemistry in the subterranean estuary of a tropical, microtidal, and monsoon-dominated submarine groundwater discharge site

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The subterranean estuary (STE) plays a crucial role in mediating the flow of water and chemicals between land and the sea. Our two-year study along the southern coast of Karnataka, India, assessed the porewater dynamics in the STE for a complete tidal cycle. Porewater samples were collected in three transects (0, 25 and 50 m) at every 10m intervals from the high to the low tide line. Samples were collected at depths 25, 50, 75, and 100 cm and measured for pH, dissolved oxygen (DO), temperature (T), oxidation-reduction potential (ORP) and electrical conductivity (EC) onsite. Along with the porewater samples, three-dimensional beach profile measurements were taken at a 5*5 m grid. The beach was gently sloping with minor undulations between 20 and 30 m from the high tide line. The sediment core procured from the intertidal zone at various points showed uniform medium-grained deposition with no significant variability. Due to this, the seepage was discharging at a uniform elevation (18m from the high tide line) in the intertidal zone. The DO values showed maximum concentration at 50 cm depth near the seepage face, depleting at deeper points after being consumed after 50 cm. Fresh SGD was discharging at 30 m from the high tide line for transects 1 and 3 and 20 m in transect 2, as delineated by EC profiles. The fresh SGD (fSGD) also showed low temperature and high pH compared with seawater. ORP showed high ranges near the high tide line and low values near the low tide line at all depths. The physicochemical parameters also showed changes at the upper saline plume, seepage face and saltwater wedge. Overall, the temperature, density and volume of recirculated seawater determine the mixing in the upper saline plume and are responsible for most of the changes in the STE. The mixed semidiurnal tides prevail in the study area, moderate the proportion of fSGD and rSGD and discharge more fSGD during the spring tide.