The Role of Fresh and Saline Submarine Groundwater Discharge in Nutrient Contribution to Coastal Seawater, Dor Bay (Israel)

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ABSTRACT
Submarine Groundwater Discharge (SGD) is widely accepted as a major factor in coastal water quality. More specifically, it was suggested by several authors (e.g. Moore 1996, 1999) that the circulation of seawater in the sediment and the resultant saline SGD is a dominant factor in the transport of nutrients and other solutes to the sea. A recent SGD study at Dor bay (southern Carmel coast, northern Israel) reveals that unlike fresh SGD, recirculated seawater in this site is nutrient poor. SGD at Dor is on the order of 8 cm/d. Two different geological units are discharging to the bay, a Pleistocene calcareous sandstone (locally called 'Kurkar') and an overlying Holocene loose sand. Based on salinity and radon, it was established that fresh water discharge is mainly from the Kurkar unit, while the saline SGD is mainly via circulation in the loose sand. Nutrient concentrations in the bay are very low (e.g. 2 μM NO_3), while high in onshore groundwater (e.g. 200-400 μM NO_3). Nutrient concentrations in water discharging from seepage meters deployed in the bay were relatively low (2-80 μM NO_3), and on a diagram of nitrate versus salinity, they plot below the mixing line between nutrient-rich groundwater and nutrient-poor seawater. This implies (1) that the saline SGD fraction (recirculated seawater) in the discharging water is nutrient-poor and (2) that even the nitrate in the fresh SGD is undergoing partial denitrification in the subterranean estuary. In a similar way, silica concentration is either on or below the mixing line between silica-rich groundwater and silica-poor seawater. Phosphate patterns are different, since phosphate is very low in the Kurkar groundwater and is similar to seawater concentrations (0.1-0.2 and 0.1 μM PO_4, respectively). On the other hand, phosphate concentrations in seepage meter water are mostly somewhat above the groundwater-seawater mixing line, probably due to the contribution from the subterranean estuary. In summary, the observations from Dor bay reveal that at least in this case recirculated seawater does not carry nutrients to the sea, thus raise questions about the significance of saline SGD to the quality of coastal seawater.

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