Deep Submarine Groundwater Discharge Facilitated by Seawater Circulation in a Confined Aquifer

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ABSTRACT

Deep Submarine Groundwater Discharge (DSGD) is a ubiquitous and highly significant phenomenon, yet it remains poorly understood. In this work we use numerical modeling (FEFLOW) to investigate a case study of DSGD offshore northern Israel, aiming to understand the main features and mechanics of steady-state DSGD: The hydrogeological setting that enables it and the parameters that affect it. Underground mapping suggests the outcropping of a confined aquifer strata (Upper Cenomanian Judea Group) on the continental shelf break, 5-15 km offshore. Numerical simulations of DSGD from a confined aquifer - similar to the case-study aquifer - are then performed in order to investigate the characteristics of such a hydrologic system. The main findings are thus: steady-state DSGD from a confined aquifer occurs far offshore even under moderate heads. It is accompanied by a circulation cell that forms around an intrinsic transition zone between salty, cold seawater and fresh, warm terrestrial groundwater. Circulation consists of seawater entering the confined aquifer at the exposed section offshore, mixing with terrestrial groundwater within the aquifer, and seeping saline warm water out the upper part of the exposed section. In addition, the simulated confined aquifer displays a very flat fresh-salt water transition zone extending far offshore, as observed in natural offshore aquifers. These new insights have potentially important implications for coastal hydrology, seawater chemistry, biogeochemistry, and submarine slope instability.