Dissolution of Salt and Perturbation of Subsurface Temperatures by Salinity-Driven Free Convection at the Bay Marchand Field, Offshore Louisiana

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ABSTRACT

The destruction of salt by subsurface dissolution is an important component of salt tectonics, although data on the details and rates of dissolution are sparse. We previously documented the existence of a large plume of saline water originating from what is now recognized as a probable solution cavity at subseafloor depths of approximately 1 to 2 km on the northeast flank of the Bay Marchand Salt Dome, offshore Louisiana. The saline plume extends laterally downward to the southeast and south within sandy Pliocene and Miocene sediments. Our more recent work supports the hypothesis that the plume is basal leg of a large fluid convection system driven by fluid density differences resulting from the dissolution of salt. The downward leg of the system is pulling shallow formation waters down toward the salt-sediment interface, resulting in continuing dissolution of salt. The upward and upper legs of the convection system may involve highly diffuse rather than focused fluid flow and possibly transport upward across the sediment-water interface. Lateral fluid flow downward and away from salt is rapid enough that isotherms in the vicinity of the saline plume are depressed as much as 400 m vertically. Preliminary heat balance calculations suggest that lateral fluid flow rates perhaps on the order of 1 m/yr within the plume could account for the observed temperature perturbations.