Controls of Subsurface Heterogeneity on Groundwater Discharge in Coastal Environments

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High temporal monitoring of the water table from fourteen wells distributed around Baffin Bay in south Texas revealed spatial variability in groundwater levels, salinity, alkalinity, and radon-222 (Rn^{222}) concentrations. This variability could be attributed to different groundwater recharge inputs. We hypothesize that in coastal Texas, groundwater upwelling occurs preferentially along deep-seated fault systems into the overlying shallow aquifer systems. To quantitatively test this hypothesis, gravity, passive seismic, and time domain electromagnetic (TDEM) geophysical datasets were collected to characterize the subsurface lithology and structures on the west coast of the Baffin Bay area. The gravity survey was used to map deeper lithologies and structures extending beyond those detected by the TDEM surveys. In contrast, the seismic survey is intended to map the spatial variability in the depth to bedrock and validate/calibrate the gravity data. In addition, TDEM methods are sensitive to electrical resistivity, which indicates important hydrogeologic properties of aquifer materials like porosity and permeability, and the saturating fluid salinity. The gravity, seismic, and TDEM data were collected along seven profiles oriented parallel and normal to the shoreline with a station interval of 1 km. A LaCoste & Romberg G-976 gravimeter, Tromino Blu, and G-TEM equipment were used to collect the gravity, seismic, and electromagnetic datasets, respectively. A conventional processing regime such as inversion is currently being applied to the collected datasets to produce geologic cross-sections showing spatial variability in lithologic units and geologic structures. The preliminary findings indicate the dipping and thickening of subsurface layers in the southwest direction, away from Baffin Bay and the Gulf of Mexico (GOM), as indicated by the simple Bouguer gravity anomaly data analysis. Further field surveys focus on generating an enhanced three-dimensional subsurface geologic model for the study area.