Mapping Saline Groundwater in a Coastal Southern California Aquifer System

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Abstract

Extensive data, including lithologic information, geophysical logs, and water-quality data have been collected in the San Diego, California area since 2003 to evaluate the suitability of the San Diego Formation and overlying alluvial deposits for use as a drinking water supply. Lithologic information was compiled from descriptions of drill cuttings collected during the installation of 9 multiple-well monitoring sites to depths of more than 700 meters and was combined with available geospatial data sets, surface geologic maps, and various literature references to wells and outcroppings to generate a three-dimensional geologic framework model of the coastal San Diego area. Natural gamma-ray and electromagnetic induction (EM) logs were obtained prior to the installation of the monitoring-well sites and during subsequent site visits. EM logs are sensitive to changes in lithology and water quality; because the lithology remains constant repeated EM logs were used to show changes in water-quality due to natural recharge processes, seawater intrusion, or other processes. Water samples were collected and analyzed for selected major- and minor-ions, the stable isotopes of hydrogen, oxygen, and strontium, and the radiogenic isotope of carbon-14. Through the use of the geophysical logs, water-chemistry data, and cross sections derived from the 3D geologic framework model, it was possible to map the groundwater quality in the coastal aquifer system. In addition, by using sodium-to-calcium molar ratios, in combination with the isotopic data, the occurrence of saline groundwater as a result of seawater intrusion was distinguishable from groundwater in a previously-saline aquifer which has been “freshened” by continental recharge. These findings indicate multiple groundwater flow paths exist in the coastal aquifer system.