Three-dimensional lithologic model of the San Diego Coastal Aquifer, Southern California, USA

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ABSTRACT

A three-dimensional (3D) lithologic model of the San Diego Coastal Aquifer was created as part of the United States Geological Survey (USGS) hydrogeologic study of the San Diego–Tijuana area, USA and Mexico. The coastal aquifer provides a modest groundwater resource for the San Diego metropolitan area, and is primarily composed of the marine Plio-Pleistocene San Diego Formation and overlying marine and terrestrial deposits. This model covers a 40 km^2 area of the aquifer south of downtown San Diego, and proximal to San Diego Bay. Lithologic data from 22 wells, including four deep (450 to >600 m), USGS monitoring-well sites, were simplified into three primary types (gravel, sand, and combined silt and clay), and were characterized with respect to borehole sediment cuttings and geophysical logs from the four USGS well sites. Data from all wells were used to construct a relatively simple 3D lithologic model of the San Diego Formation and overlying deposits. The 3D computer model was generated by horizontally extruding lithology interval data away from each borehole, and correlating that data with lithology extruded from other nearby boreholes. This model is augmented by the presence or absence of marine fossil shells to define regional depositional trends. Preliminary results indicate that local geomorphology, changes in sea level, and regional tectonics control lithologic patterns in the aquifer. For example, a 1-km-wide-lens of sand and gravel is interpreted to be the paleo-footprint of the modern day Sweetwater River. Increasing thickness of lithologic packages from east to west supports contemporaneous deposition with down-drop of the structural San Diego Basin. Sedimentary deposition during different transgressive and regressive sea-level cycles may have influenced vertical and horizontal variations in lithology, such as a series of lithologic layers that appear to inhibit vertical groundwater flow, as indicated by vertical hydraulic-head and water-quality differences at USGS well sites. Evaluation of regional depositional patterns is being used to identify preferential pathways for groundwater flow that could be targets for future groundwater extraction, but can also serve as pathways for seawater intrusion, as already observed in this area at two coastal USGS well sites.