Injected Sands: Mother Nature's Giant Frac Jobs?
Dr. Will Schweller, NCGS President, Consultant

Abstract

Injected sands, also known as clastic injections, have been recognized in the geologic literature for well over a century, but have been largely ignored until the past two decades. Discovery of significant oil and gas reserves in injected sands in fields in the North Sea and West Africa, among other areas, sparked a renewed series of studies that has improved our understanding of these unusual features, but many significant questions remain unanswered.

Outcrops of injected sands found in widely separated localities display a wide variety of geometric forms and internal features. Some of the largest and best known examples occur along the California coast near Santa Cruz and inland along the western flank of the San Joaquin valley. The San Joaquin examples demonstrate how injected sand dikes can propagate hundreds of meters upsection, creating significant vertical hydraulic connections and hydrocarbon migration pathways where none previously existed. Other outcrop examples in central France and northern Tunisia show large-scale lateral injection and even downward propagation of injected sand dikes.

While fairly easy to recognize in outcrops, injected sands are much harder to identify in subsurface cores, borehole images, and wireline logs, and are generally too small or thin to see even in high-resolution 3D seismic data. Vertical wells rarely intersect near-vertical dikes, and clastic sills can closely resemble normal deposited sand layers even in cores. Key features in cores and borehole images can be used to improve the confidence in identifying clastic sills and dikes.

Predicting the amount, orientation and possible effects of injected sands in subsurface reservoirs remains a challenge even after they are recognized. In some cases, the improved vertical connectivity from injected sills enables reducing the number of wells to drain a reservoir, while in other cases the injected sand complexes can lead to misleading estimates of total reserves. Comparing limited subsurface data with detailed outcrop studies can help to model the possible geometries and predict the effects of what can be seen as enormous natural frac jobs. Insights from natural outcrops of injected sands can help to predict the character of man-made injected sands in industry frac jobs and wastewater disposal wells.

Biography

Dr. Will Schweller's interest in geology started when he was about 6 years old, collecting rocks and fossils in northwest Pennsylvania. He eventually completed a BS in geology at Penn State University, then switched sides of the country to do a MS in marine geology at Oregon State University working on turbidites in the Peru-Chile trench. He then returned to the East coast to do his PhD at Cornell, studying sediments that overlie the Zambales ophiolite, one of the world's largest ophiolites on the island of Luzon in the Philippines.

Following his long tenure as a graduate student, Will joined Gulf Oil Company's research division in Pittsburgh, Pennsylvania in 1981. Gulf was engulfed by Chevron and Will moved to Chevron's research division in southern California in 1985, and then to the San Ramon location in 1999. During his 28 years with Gulf and Chevron, Will worked on a variety of sedimentary systems but was primarily focused on deep-water sediments and borehole images as well as teaching in classrooms and in the field. He is co-inventor on two patents that define uses of borehole images for building reservoir models.

He retired from Chevron in 2009 and has continued to do consulting and teaching for the oil and gas industry. He was elected president of NCGS in 2014.