# REPURPOSING PETROLEUM SEISMIC REFLECTION SURVEYS FOR GROUNDWATER STUDIES

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The hydrogeologic parameters and structure of an aquifer are the most critical elements that determine the success of a ground water study such as siting a production well, developing a groundwater management plan for a basin, or building a reliable groundwater model. Unfortunately, these parameters are largely unknown prior to committing to a site and drilling a well. Drilling to deep aquifer is expensive and the amount of available well data is often very limited. It is also difficult to predict how far the conditions encountered in a well can be extrapolated within the basin and many significant hydraulic features are often missed or poorly understood. As a result, many groundwater projects are hampered by limited by sparse subsurface information and many well projects have failed due to unexpected or poorly understood stratigraphic or structural complexities. Methods that can map aquifer thickness and porosity, identify faults, fracture zones, and discontinuities in confining units at lower cost and with greater data density are critically needed in many groundwater basins.

Seismic reflection technology has been developed by the oil and gas industry to map subsurface reservoirs in detail. This technology is now economically feasible for use in the groundwater industry. Seismic reflection surveys produce high resolution images of the subsurface and can be used to identify favorable aquifers, map the presence and continuity of confining units, and identify faults or fracture zones that may create hydraulic boundaries. Seismic reflection surveys are able to map fine scale stratigraphic details to depths of several thousand feet. Modern processing and interpretation techniques can identify permeable sand zones, faults, and other stratigraphic and structural features that control well yield. New high-resolution seismic reflection surveys can be designed to image the zone of interest and provide far superior visualization of the subsurface than can be obtained by other methods. Unfortunately, the cost to acquire high resolution seismic reflection data is relatively high which has limited the application of the method for water supply applications.

Fortunately, in many areas seismic reflection data has been collected for oil and gas exploration or other objectives. This data is often available for purchase at a nominal price, though the quality and acquisition geometry of older data is generally inferior to contemporary high-resolution surveys. The quality of vintage data can often be improved through reprocessing using contemporary techniques and by optimizing the choice of parameters to focus on the intervals of interest, which tend to be shallower than the original survey objectives.

The use of pre-existing vintage seismic reflection data will be demonstrated by a case history in Central California where seismic data collected for geothermal studies in the 1990s has been reprocessed to map the structure and stratigraphy of aquifer zones and confining units at depths of 400 to 2,000 feet. Attribute processing was used to map the net and gross sand of the major aquifer intervals, map the thickness and continuity of clay confining units, and map faults and fracture zones. The data is being used to calibrate the data from a regional airborne EM survey and improve the conceptual hydrogeologic framework, which will assist selecting potential future ASR and production well sites.

A second case history will document the use of a contemporary 3D petroleum survey to map aquifer units at depths of 400 to 2,000 feet. A ERT survey was added to explore the upper 400 feet of the site. The survey located several wells sites and led to the development of an approved water supply of 400 acre feet with a non-tributary designation.