Bay Area Geophysical Society Seminar Series

Bill Cumming
Cumming Geoscience

November 19, 2020 5 PM
Webinar

MT discrimination of geothermal system components; upflows, outflows, boiling and maybe magma

Abstract: Magnetotelluric (MT) resistivity sounding is the predominant geophysical method used in the exploration of conventional geothermal reservoirs shallower than 3000 m. It is typically used to image the low resistivity, impermeable smectite clay and zeolite alteration that caps almost all volcano-hosted geothermal reservoirs and to image the lower resistivity hydrothermal alteration of the shale that caps geothermal reservoirs hosted in sediments. When integrated in a resource conceptual model with supporting geoscience and thermodynamic information, MT is usually among the most important constraints on the components of the geothermal reservoir used to target wells and assess resource capacity prior to drilling. For example, in all types of geothermal systems, the shallowest part of the reservoir is often characterized by a dome in the base of the low resistivity clay cap, open to the reservoir outflow direction. In many US Basin & Range <200°C geothermal systems heated by deep-circulation in

fault zones, the deep fractured upflow can be targeted using MT by following the base of the clay cap to greater depth where lower resistivity indicates more intense smectite clay alteration adjacent to the upflow. In volcano-hosted geothermal systems, interpreting the geometry of both the top and the bottom of the low resistivity clay cap relative to the water table has been used to identify shallow >230°C reservoir boiling zones and sub-boiling cooler reservoir outflows. These features are relatively shallow and so they can often be characterized using 1D MT inversions except near boundaries where 3D inversion is needed. Because encountering magma in wells at <2200 m depth has severely limited the conventional capacity of basalt- and trachyte-hosted geothermal reservoirs, reliably predicting the geometry of magma has been the goal of many MT surveys and 3D MT inversions, with mixed results that suggest opportunities for improvement in both 3D MT inversion and MT data acquisition.

Speaker Bio:

William (Bill) Cumming is an independent consultant who provides technical services for geophysical surveys, geothermal resource assessment, geophysical research and training in the geothermal industry. His 40+ years of geothermal experience include over 20 years with Unocal Corporation (now Chevron) in positions from Geophysicist to Chief Geoscientist. Since 2000, he has provided consulting services to geothermal industry, academic and government clients at over 45 geothermal fields and 150 prospects in the Americas, SE Asia, Europe and Africa. His recent publications have been directed at geothermal education, geophysical research and integrated geoscience assessments of geothermal resources. In 2013, Bill received a Geothermal Resources Council Special Achievement Award for "outstanding contributions in improving the use of geophysical methods and conceptual models in the evaluation and development of geothermal resources." Contact: wcumming@wcumming.com