A Conceptual Approach to 3-D Play Fairway Analysis for Geothermal Exploration and Development

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ABSTRACT

“Play fairway” analysis has long been utilised in the hydrocarbon industry to assess exploration risk from regional to prospect-level scales. More recently this methodology has seen increased traction in the geothermal industry and resulted in a series of studies in the US. Some of the projects include the states of Hawai’i (Lautze et al., 2015, 2016, 2019), Nevada (Faulds et al., 2018, 2016, McConnville et al, 2017) and Utah (Wannamaker et al, 2016, 2017).

In a play fairway analysis, several parameters potentially indicating the presence of a geothermal resource at depth are categorized, weighted and combined together. This provides spatial distribution of the geothermal resource favourability to limit exploration risk. These analyses are generally limited to the compilation of surface data or results from past surface-based surveys for extended geographical areas, although some parameters such as the geothermal gradient are calculated using dispersed well data.

In this paper, a 3-D conceptual approach to the play fairway methodology is introduced, based on the existence of sub-surface data obtained at the project scale from advanced geological and geophysical surveys, drilling of exploration and/or development wells, laboratory analyses and well testing. A 3-D subsurface modelling tool was used to integrate the various types of data and then perform calculations and conditional queries using a gridded block model, resulting in a favourability Index model of the geothermal resource.

Additionally, this 3-D favourability Index model is always based on the best understanding of the resource as it will dynamically update when new data is integrated. The model can also be refined with additional parameters relevant to specific projects (e.g. local legislative constraints). The methodology and the calculations created can easily be transferred to any other geothermal field dataset to compare results providing a repeatable workflow allowing prospects to be easily benchmarked or compared.