Basin Temperature Modeling using large Bottom Hole Temperature Datasets

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Abstract

Subsurface temperature is a key parameter in development of conventional, unconventional hydrocarbon and geothermal resource plays.

There are two main methods of estimating rock temperature from Bottom Hole Temperature (BHT) datasets data:-

- For small datasets, average temperature gradient is calculated between two or more uncorrected BHT/depth control points. A linear relationship is generally assumed between the ambient surface temperature and BHT temperatures at other depths within the well-bore are determined by interpolation. More advanced techniques use measurements of increasing temperature with increasing time since (mud) circulation (TSC), to extrapolate the temperature at static conditions (eg Horner method).
- For large datasets, regression techniques have commonly been used to correct BHTs and to calculate geothermal gradients. Corrections (usually functions of depth) are applied to raw BHTs to derive "real BHT's". Corrections are based on the relationship between relatively small numbers of fluid flow temperatures (DSTs, RFTs) and the depth average of larger raw BHT datasets. Different depth based equations have been derived for many basins in the Onshore USA.

There a number of problems with the regression based approach:

1. Basins are not flat or lithologically uniform, so there is no reason why corrections should be related to depth alone.
2. The method averages all BHT data with equal weight; short and long TSC data are treated equally
3. The resultant correction, although providing an average temperature which may be acceptable, implies corrected BHT's that are hotter than likely temperatures, which is physically dubious

A new methodology for basin temperature modelling has been developed that utilizes large volumes (~10,000 points) of properly indexed and QC'd BHT data for an onshore basin or area. This methodology honors the observation that borehole temperatures equilibrate, increasing