Using geothermal gradient anomalies of hydrocarbon entrapment in rejuvenating mature basins and identifying missed and bypassed traps

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Extended Abstract

Objectives

Anomalous geothermal gradients of oil and gas fields are known since early well-logging days; they are by-products of migration, entrapment and leakage of heat conveying fluids. Bottom-hole temperatures (BHT) acquired by calibrated maximum recording thermometers permits mixing of old and new BHTs. This paper argues for a procedure of cross-plot identification and contouring geothermal gradients in order to find possible, probable and potential undiscovered or bypassed hydrocarbon traps in dry-holes showing geothermal anomalies similar to the producing field anomalies among hundreds of exploration and producing wells in mature basins.

Procedures

A. A computer programme (CGG-ESTI©) was used to correct, statistically test BHT records of the wells, and separate the ones with statistically significant BHT data. Then plot the compensated geothermal gradients (CGG) and extrapolated surface temperature (ESTI) for all wells. **B.** Cross plot significant CGGs vs. ESTIs to interactively define the seclusion limits of producing and suspended wells cluster against dry holes cluster. **C.** Conduct discriminative contouring* to generate compensated geothermal gradient contours (CGG), and extrapolated surface temperature intercepts contours (ESTI) of the studied basin. **D.** Use the two seclusion limits identified by CGG-ESTI cross-plot analysis to delineate the Optimum regional fairways of anomalous CGG and ESTI secluding limits of producing and suspended wells cluster that contain trends of proven and probable missed traps against a background of low geothermal gradients of dry-holes.

Results

The previous procedure defines the geothermal gradients cluster of proven traps, and then uses their geothermal signature to delineate potential, probable and possible CGG-ESTI anomalies of hydrocarbon entrapment. This procedure was applied on BHT readings of wells in offshore Nigeria, UK, Louisiana and onshore Iraq, Libya, and Louisiana with up to 75% success rate.

Conclusions and Applications

Computerised graphical BHT correction proved to be satisfactory, and CGG-ESTI cross-plot analysis revealed clustering of producers and suspended wells vs. dry holes and non-producer wells, which interactively explored to decide the optimum CGG and ESTI contours that delineate the geothermally anomalous spots and trends. The Compensated geothermal gradient method and CGG-ESTI Software provide an additional tool for integrative prospects generation, rejuvenating mature basins, concessions reviews and re-entry justification of possible, probable and potential “un-discovery wells” currently categorised as dry holes in many mature basins.

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* Geothermal Gradient Anomalies of Hydrocarbon Entrapment, UKCS Quadrants 35-54.Target Exploration Consultants Report (Tar-8), 355 p.