
Temperature Structure of the Jafurah Low, Eastern Saudi Arabia: Enigma or Opportunity?

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The Jafurah Low in eastern Saudi Arabia is a tectonic sag basin elongated in the north-south direction (200 km by 50 km). It is surrounded by Ghawar, Abqaiq, Dammam, Awali and Dukhan Fields, and discoveries on the Niban terrace immediately north of the Qatar Arch-Jawb Platform. Second-order structures include the Niban terrace, and low structural culminations (Harmaliyah, Kharma, and Tinat) paralleling the basin margin.

Subsurface temperature patterns within this tectonic province show a progressive pattern of lower geothermal gradients in more basinward areas. There is a discontinuity in the gradient trends, approximately at the Permian-Triassic stratigraphic intervals. Temperature data above this interval all follow similar trends, with a subsurface temperature gradient of approximately 17.5°F/1000 ft (3.2°C/100 m). These gradients are consistent below the Permian-Triassic, although they are offset to cooler values in more basinward wells. For example, the expected subsurface temperatures at 15,000 feet (4572 m) depth are some 20-25°F (11.1-13.9°C) lower for basinward wells than basin flank wells, which are 15-20°F (8.3-11.1°C) lower for basin-edge wells. Therefore, greater depths may be drilled in this basin away from the basin flanks before subsurface temperatures become prohibitive, opening up a large area of the Jafurah Low to future exploration.

Explanations for this subsurface temperature pattern include an isothermal basement, producing lower average thermal gradients away from the basin flanks toward the basin center. Also, subsurface fluid flow through the base of the Mesozoic section from basin center to flanks would remove heat and explain the temperature discontinuities near this stratigraphic level.
