Depositional and Diagenetic Controls on Khuff Reservoir Characteristics in the South Pars Gasfield, Offshore Iran*

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Search and Discovery Article #20170 (2012)**
Posted August 31, 2012

*Adapted from oral presentation at AAPG Annual Convention and Exhibition, Long Beach, California, USA, April 22-25, 2012

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Abstract

This synthesis is based on information already published. Key relationships regarding factors that determine Khuff porosity are highlighted from three recent articles, two in AAPG Bulletin and one in Journal of Petroleum Geology.

Khuff reservoirs in Well A of the South Pars gasfield are presently at 2.8-3.3 km depth, but the mineralogic composition of each layer and the pore spaces present were formed in near-surface settings and have been little modified during burial, except by infilling with stylolite-derived calcite and dolomite cement. Bulk chemical analyses show that anhydrite occurs almost exclusively in the dolostone intervals, whereas the limestones are anhydrite-free. This association reflects dolomitization in the sediments underlying restricted lagoons and sabkhas where both anhydrite and dolomite formed from evaporatively concentrated seawater. Limestone intervals were preserved from dolomitization in part because of deposition during times when the Khuff shelf-lagoon was flooded to overall greatest depths by normal marine waters during transgression and early highstand. The anhydrite-dolomite association indicates that there has been little large-scale redistribution or late introduction of anhydrite. Porosity creation by meteoric leaching is nevertheless likely to be important both in limestones, forming moldic and other vuggy pores, and in dolostones, where vug-forming Ca-sulfate dissolution is the expected result.

Burial diagenesis in the studied cores consists mainly of chemical compaction along stylolites and resulting cementation in close proximity to these sources of dissolved carbonate. Vertical (layer-to-layer) porosity variation in the formation is a function of stylolite frequency and anhydrite abundance. In Khuff limestones, the pores visible in thin section are mainly grain-molds and preserved-primary pores, and former pore spaces are infilled by both early calcite cement (possibly sourced from aragonite dissolution) and late calcite cement (sourced from nearby stylolites). The dolostones contain preserved-primary, moldic, and intercrystal pores, all of which are interpreted to have formed before or during eogenetic dolomitization. Dolostone pores have been partially infilled by both anhydrite and dolomite cement. Khuff porosity variation on a regional scale (Saudi Arabia, Bahrain, Qatar, Iran, UAE, Oman) is primarily controlled by increasing chemical compaction with greater burial depth and temperature.

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Main points of this talk

KHUFF **DEPOSITION**

1. Bulk chemical analyses show that anhydrite occurs mainly in dolostone intervals, whereas most limestones are anhydrite-free.

2. The limestone intervals have higher proportions of thicker bedded, high-energy grainstone facies. These intervals were most plausibly preserved from dolomitization because of deposition during times when the Khuff shelf was flooded to overall greatest depths by normal marine waters during transgression and early highstand.

3. This interpretation implies that the conventional sabkha-lagoon-shoal-foreshoal depositional model is overly simplistic. The depositional system changed fundamentally between the different stages of Khuff accumulation.

Main points of this talk

4. Despite considerable burial depth (2.8-3.3 km), the pore spaces present formed at near-surface depths and have been little modified during burial, except by infilling with stylolite-derived calcite and dolomite cement and local redistribution of anhydrite.

5. Vertical (layer-to-layer) porosity variation is a function of stylolite frequency and anhydrite abundance; both of these factors reflect depositional (sequence-stratigraphic) control.

6. Khuff porosity variation on a regional scale is partly controlled by increasing chemical compaction with greater burial depth and temperature.