

Exploration and Commercialization of Tight Gas Reservoirs in Saudi Arabia

Ahmad Bohmail¹, Doug Cook¹, and Marty Rademakers¹

¹Saudi Aramco

ABSTRACT

Gas exploration and production in Saudi Arabia ranges from prolific conventional reservoirs to ones that are challenging. There is also a concerted effort to address unconventional gas resources, but this is not the focus of this presentation. This presentation will examine examples of gas reservoirs being actively explored and exploited in Saudi Arabia. Some cases are prolific and others are tight and benefit from stimulation. Examples will be shown from exploration of the Permian Khuff carbonate reservoir, the Permo-Carboniferous Unayzah clastic reservoir, the Devonian Jauf clastic reservoir, and the Ordovician Sarah and Quwarah clastic reservoirs. Case studies of exploration will be discussed in stratigraphic order.

The Khuff reservoir is often prolific in some zones, but in others it can be challenging from a standpoint of understanding reservoir heterogeneity and obtaining commercial flow rates from volumetrically significant areas of tight reservoir. A recently updated depositional model has added delineation opportunities and success in extending gas limits. Underbalanced coil tubing drilling (UBCTD) has yielded horizontal and multilateral wells with significantly improved reservoir contact and flow rates. A new method of biosteering (real time micropaleontology) has been developed to keep these horizontal wells in zone while drilling. Lessons learned in UBCTD can potentially be applied to tight clastic reservoirs, especially ones that easily suffer from formation damage. While reasonably high permeability Pre-Khuff clastic gas reservoirs have been discovered, many are tight and though generally considered conventional reservoirs, they have sub-commercial flow rates. Successful frac stimulation cases will be presented for Unayzah and Jauf reservoirs in the Ghawar area, and for the Sarah and Quwarah reservoirs in Northwest Saudi Arabia. The Silurian Qusaiba hot shale is considered the source for virtually all of these reservoirs. Other source potential has been recognized. A paraffinic oil produced from a Unayzah reservoir has been shown to have a self-sourcing lacustrine origin. Gas found in some Quwarah intervals are thought to be too far below the Qusaiba hot shale to have been sourced from it. The underlying Ordovician Hanadir shale member of the Qasim is a possible source candidate.