geoconvention
Calgary • Canada • May 15-19 2017

A Comparison between the Exploration plays of western Iran and Iraq, and implications for their remaining exploration potential

Jon J Noad
Sedimental Services; jonnoad@hotmail..com

Summary

A combination of extensive fieldwork and log analysis has enabled the sedimentological character of the various play elements of the Zagros Mountains of Iran to be summarized. This includes the major reservoir intervals of the Bangestan and Asmari Formations, as well as the source rocks of the Kazhdumi and Gurpi Formations, and the Fars evaporite seal. Many other Iranian formations were examined, described and correlated across the country during the study. The work was supported by detailed literature reviews that have been used to simplify the complex nomenclature for the various formations across the Zagros mountains. A similar log analysis and literature review has been undertaken for the Iraqi Zagros and beyond, allowing the various play elements of the two countriries to be correlated, compared and contrasted, possibly for the first time.

Introduction

Iran and Iraq host the fourth and fifth largest oil reserves in the world, around 300 Billion barrels in total. In 1908 the first major oil accumulation on the Arabian plate was discovered at Masjid-I-Suleiman in Iran, in the Oligo-Miocene Asmari Formation. The recoverable oil and gas reserves of the Zagros foreland basin were estimated, in 1992, at around 200 billion barrels and 650 Tcf respectively. Around 50-60% of the hydrocarbons are housed as re-migrated oil in the Tertiary Asmari carbonate reservoirs. The total oil produced to 1992 is estimated at around 53 billion barrels.

Despite the enormous remaining oil potential, surprisingly little has been published on the sedimentology of the formations that host and source the oil in both countries. An extended field trip to Iran in 2001 enabled the collection of detailed sedimentological data on many of Iran's best known formations. Follow up work synthesized a wealth of data and different formation names to develop a relatively simple stratigraphy. This column could then be compared to Iraq, where a similar exercise was undertaken. The precarious political situation in Iraq prevented any fieldwork being undertaken, so the stratigraphy of Iraq is based on well logs and published data. For each formation, the implications of its character for potential hydrocarbon accumulations was also analysed.

Structural Geology

The northwest-southeast structural trend of the Zagros fold belt resulted from compressive folding during the Upper Pliocene. This Alpine orogeny masks and modifies earlier patterns of structural deformation. Three structural belts have been defined: the Simply Folded Belt lies to the southwest, and passes over into the Imbricated Belt in the High Zagros, while further to the northeast the Crush Zone has generally been considered to represent with the suture zone between the Iranian and Arabian Plates. The major oil

fields extend from the outer Simply Folded Belt to the mountain front, which marks the appearance of surface exposures of the Asmari Limestone and older formations. There is a relatively sharp boundary between the Abadan Plains, and their gentle structural undulations (Pejudesh 1973) and the Zagros folds. The high relief, elongate anticlinal folds of the inner belt contrast with the low relief badlands of the outer belt. The Asmari reservoirs lie beneath a thick Mio-Pliocene cover of evaporites (McQuillan 1991).

The geological history from the late Proterozoic to mid Tertiary is one of remarkable stability, punctuated by episodes of extension in the Permo-Triassic and brief convergence in the late Cretaceous. The mid Tertiary continental collision leading to the Zagros orogen imposed a dominantly northwest/southeast fold trend (the so-called Zagros trend) that contrasts with the dominant north/south pattern (Arabian trend) developed prior to this time. This contrast can be seen in the shape of the oil fields.

Method

The data was stored in two “super-regional” Petrel models, each one covering a country. Around 60 to 80 wells were incorporated in each of the models, with huge variations in the quality, relaibilty and diversity of the well log suites. Efforts were made to simplify the stratigraphy erected for each country, as there were typically a plethora of formation names in use. The wells logs were correlated and facies models built in Petrel. The final models provided a data repository, as well as information on sweet spots, depositional loci and abrupt thickness changes that might represent regional faults.

Example of cross-country correlation

IRAN	***IRAQ***	***Comments***
Asmari	Jeribe (Euphrates)	Limestone
Jahrum		No obvious equivalent
Pabdeh	Avaneh, Palani, Damman, Jaddala	Clastic interval
Gurpi	Shiranish	Typically marly, potential source rock
Ilam	(Sadi)	Dirty limestone
Surgah	Ahmadi	Generally shaley or marly
Sarvak	Mishrif (Mauddud)	Limestone
Kazhdumi	Nahr Umr	Generally sandy clastics with source rock potential
Dariyan	Shuaiba	Limestone
Gadvan	Zubair	Generally sandy clastics
Older		Only seen in Azadegan-1

Conclusions

Through the use of disparate data sources, fieldwork and well logs, it has proved possiblke to build up regional correlation panels and facies models which are considered unique on the level of detail that thye show. Having such data sets ofr both Iran anad iraq has allowed the petroleum systejms of the two countries to be correlated, compared and contrasted in a way that may not have been attempted before. The results of this analysis have significant implications for future petroelum exploration in both countries.

Acknowledgements

I appreciate the enthusiasm of Harry McQuillan when he took us into the field in Iran back in 2001.