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SEISMIC SEQUENCE STRATIGRAPHY IN SE ASIA

G.A. Kirby*

ABSTRACT

Sequence stratigraphy involves the division of the succession of rocks deposited in a sedimentary basin into a series of 'cycles' or sequences in which there are similar vertical changes in rock types, caused by changes in relative sea level during deposition. It has come to occupy a central place in geological thinking in the past decade, particularly in understanding the way in which sedimentary basins are infilled and the influence of changes in sea level through time on this process. This aids understanding of the distribution of potential reservoir and source rocks and the location of subtle stratigraphic traps.

Seismic data played a key role in the development of sequence stratigraphic concepts. Seismic interpretation permits the definition of sequences and an understanding of both their development and architecture together with a prediction of lithofacies distribution. It is therefore an important tool in hydrocarbon exploration. Sedimentary basins in SE Asia, many with considerable hydrocarbon potential and at varying stages of exploration, occur in a wide range of tectonic settings. Seismic profiles across the margins of these basins provide the potential to apply models of sequence development and to test and develop new concepts on a regional basis.

Several countries in SE Asia, notably Indonesia and Malaysia, have a long-established oil industry with large amounts of associated data, but others are still at an early stage of exploration. It is likely that much oil and gas remain to be found, even in those countries with a long history of exploration. It is increasingly recognized, however, that to maximize discovery of oil and gas, the more subtle accumulations as well as the obvious large structures need to be found and tested. The discipline of seismic sequence stratigraphy has great potential to suggest new areas for exploration which otherwise might not be considered.

A project funded by the Overseas Development Administration of the British Government and aimed at improving the understanding of seismic sequence stratigraphy and application of this discipline to oil and gas exploration was undertaken by the British Geological Survey. It involved both training and technology transfer and was administered in SE Asia by the Committee for Coastal and Offshore Geoscience Programmes, 'CCOP' which is a long-established body concerned with regional geological studies of SE Asia. Geologists from governmental geological organizations associated with the oil and gas industry in nine SE Asian countries participated in the project. It is hoped that a more widespread and consistent application of sequence stratigraphic concepts throughout the region will advance geological understanding of basin-infilling and enhance exploration success. This extended abstract summarizes some of the results of this project.

As part of the project, seismic profiles were submitted by China, Indonesia, Korea, Malaysia, the Philippines, Thailand and Vietnam. Successions detailed by these profiles range in age from Palaeocene to Recent. Most are of clastic facies, but examples of carbonates are also included.

Application of these techniques on a regional scale in most cases permits subdivision of the succession into meaningful units which can often be related to the known stratigraphy of an area.

The confidential status of the data unfortunately precludes display of these profiles in these conference proceedings; however, several points of both specific and general interest and application emerge.

1. In Central Luconia, analysis of well data documents cyclical deltaic successions divided by periodic marine influxes. High-quality seismic data reveal the successions as forming the highstand and transgressive systems tracts of a series of sequences, which are controlled by both

* British Geological Survey - Keyworth

rises and falls in relative sea level through time. Associated lowstand deposits have not been documented or predicted from an analysis of well data, but these are revealed by the seismic profiles and are often of substantial thickness. They have some potential as hydrocarbon reservoirs.

2. In North Sumatra, detailed analysis of seismic and associated well data suggests potential for substantial refinement and redefinition of stratigraphic units which permit more meaningful correlation of reservoir successions across the area.
3. Prograding carbonate successions from the Bali-Flores Sea in Indonesia can be subdivided on the basis of internal reflection terminations into a series of sequences. Lowstands of sea level can be seen to control the formation of karstic surfaces on the periodically-emergent platform. This has implications for the development of secondary porosity and hence on reservoir potential.
4. Even in areas of structural complexity, such as North Sabah, Malaysia, detailed analysis of reflection terminations on high quality data allows the definition of sequences and their component system tracts and hence enhances the possibility of predicting reservoir distribution.
5. There appears to be a suggestion of broad synchronicity of certain lowstands within the region, in particular the lowstand towards the end of the Middle Miocene, suggesting the possibility of early prediction of facies distribution in poorly explored basins.

The need for good litho- and biostratigraphic data in addition to high quality seismic data is clear from this study. Some of the profiles submitted to this study are single line interpretations,, and it may be that a thorough study of grids of data around the single line supplied may suggest a different interpretation. However, it is hoped that at the very least, these seismic lines act as a point of discussion.