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ABSTRACT

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Defining Structural Style Using Satellite Imagery and DEM's: Examples from the Bird's Head, Western Papua and the Masilah Basin, Yemen

Optical and satellite-borne radar data have been used some time to interpret surface structures that can act as structural indicators of buried traps. However, in recent years new sensors allow more detailed interpretation from continental to individual fold scale. This paper briefly reviews the sources of these data and their integration into both regional and license-specific, oil exploration case studies in the Salawati and Bintuni Basins, Western Papua and the Masilah Basin, Yemen.

In 2000 the Space shuttle recorded C band radar (Shuttle Radar Topography Mission or SRTM) over most of the Earth's land surface and for the first time, provides geoscientists with a global 90m resolution DEM (Digital Elevation Model). Raw data can be downloaded free, although processing the data incurs some costs. ASTER data can provide 30-50m resolution DEMs but, being derived from optical imagery, can be cloud prone in the tropics. However, it is very cheap and can also be downloaded from the Internet. The SPOT 5 satellite can obtain 20m data, but is also cloud prone and is moderately expensive.

A recently completed project in Western Papua used a combination of these data types to help focus regional exploration and also provided a GIS-based structural and stratigraphic framework. Regional Landsat TM and ETM+ data are cloud prone throughout the region so colour-coded SRTM radar data was digitally merged with the ERS-1 Radar data, providing a textured DEM that revealed topographic and terrain type signatures. Structural mapping used the Landsat (where unaffected by cloud), radar and the merged SRTM-ERS image to define regional fault patterns and fold-fault styles; results were input into ArcGIS. This data was integrated with public domain petroleum system data in order to identify new surface leads and prospects in presently unlicensed parts of Western Papua.

Further, more detailed work in the region concentrated on using the SRTM DEM to provide dip and strike measurements. These are computed from slopes and slope aspects derived from the DEM. The dips can then be used to analyse fold morphology and style. By integrating these data into Midland Valley's software, a number of fold-fault solutions can be modelled to fit the surface data.

An analogy from the Masilah Basin, Yemen, is provided to compare and contrast the techniques used. As Yemen is an arid environment, plenty of cloud-free data are available. Both Landsat ETM+ and SPOT 5 data were used in this extensional tectonic setting to map lithologies and structures in the region. The “spectral resolution” of Landsat ETM+ and the 20m spatial resolution of SPOT 5 DEM allowed mapping of individual lithologies whose contacts were digitally linked to elevation values from the DEM. From these data a structure map for a key horizon in the region was created. Previous study has suggested that structures at this stratigraphic level mimic structure at key reservoir levels. The results enabled the client to assess leads without recourse to expensive seismic reprocessing and provided structural coverage and control between below average quality 2-D seismic data.

Satellite data can readily provide exploration companies with low cost solutions to both regional and more localised structural problems in both arid and humid, tropical environments.