

No evidence of seepage in Central North West Shelf

Hydrocarbon seepage survey downgrades prospectivity

John Kennard

In May–June 2006, RV *Southern Surveyor* surveyed the central North West Shelf, off the Western Australian coast near Broome, to improve our understanding of the petroleum prospectivity of the offshore Canning and Roebuck basins. This frontier exploration region is located between the proven hydrocarbon provinces of the Carnarvon Basin to the southwest and the Browse Basin to the north.

The aim was to identify sites of natural hydrocarbon seepage, which can provide direct evidence for an active petroleum system within the subsurface. As hydrocarbon seepage sites can support highly diverse ecosystems due to nutrients, biogeochemical cycles and changes in sediment substrate, they may also be associated with palaeo-reefs or modern reefs.

Sample sites identified

Areas of potential hydrocarbon migration and seepage to the seafloor were initially identified from existing seismic, remote sensing (synthetic aperture radar), bathymetry and echo-sounder data. During the survey, multibeam swath bathymetry, 12 and 120 kHz echo-sounder, 120 kHz side-scan sonar, 1.5 kHz sub-bottom profile and fluorometric data were acquired across 18 potential hydrocarbon seepage sites on a 300 to 1500 metre line spacing (figure 1; Areas 1 to 11 and X1 to X5).

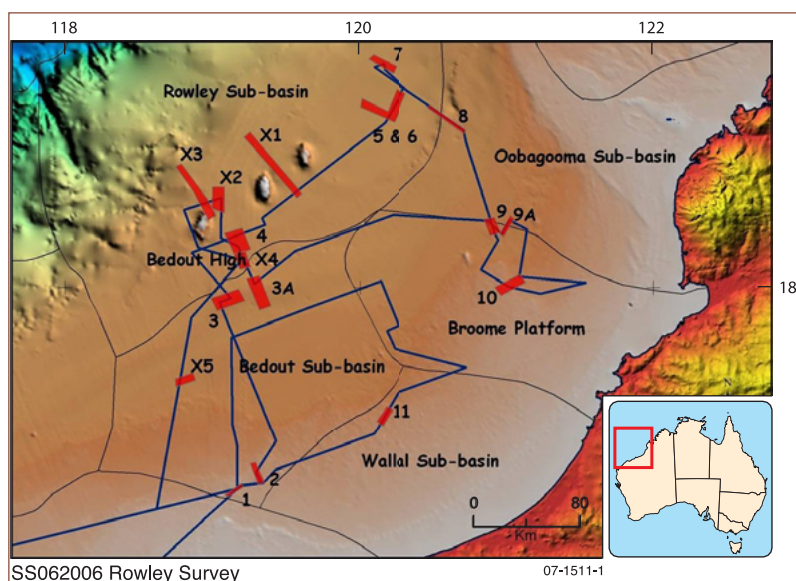


Figure 1. Ship track and surveyed areas, central North West Shelf.

Sampling sites within each mapped area were selected by integrating all survey data. Sediment grab, gravity core (4 to 6 metre recovery), vibro-core (up to 4.7 metre recovery) and dredge samples were collected for follow-up sedimentological, headspace gas and biomarker analysis. Seafloor video footage, conductivity–temperature–depth water column profiles and water samples were also acquired.

Identified features of interest include shallow and near-seabed seismic amplitude anomalies, shallow faults, erosional escarpments and sinkholes, an extensive ~40 metre thick pelagic ridge, megadunes (5 to 8 metre relief), dunes (2 to 4 metre relief), pockmark fields and plume-like water column features.

Active fluid escape from the seabed was documented at Area 9, where a series of oolitic megadunes are pierced by clusters of crater-shaped pockmarks approximately 2–15 metres in diameter. Video footage indicates that the pockmarks are commonly lined with nodular concretions (figure 2), and in one instance active venting of a cloudy fluid was observed from the pockfield.

Petrological, geochemical and biomarker analyses of the nodular concretions indicate that they are cemented by acicular aragonite that precipitated from fluids of normal marine chemistry. Similarly, biomarker and headspace analyses of sediments recovered from all surveyed potential seepage sites show no evidence of thermogenic hydrocarbons, although several core samples contain high amounts of CO₂ (20 000–232 000 parts per million in the headspace gas) probably generated by modern biogenic processes.

Faults produced Miocene and modern reefs

Sub-bottom profiles indicate that the Mermaid Fault Zone, a major deep-rooted northeast trending wrench zone along the inboard edge of the Rowley Shoals reefs, comprises a network of anastomosing

strike-slip faults that extend to within a few metres of the seabed (figure 3). Transpressional (left-lateral) faulting and associated folding and uplift along this zone are thought to have initiated Miocene reef growth and subsequent build-up of the present-day Rowley Shoals.

The survey tested several promising potential hydrocarbon migration-seepage pathways in the region, but did not find any evidence of a currently active petroleum system. This finding, in conjunction with the lack of exploration success in the region, especially the recent deepwater Whitetail-1 (2003), Wigmore-1 (2003) and Huntsman-1 (2006) wells in the deepwater Rowley Sub-basin, downgrades the petroleum prospectivity of these parts of the central North West Shelf and reorders their priority in relation to other frontier areas in offshore Australia.



Figure 2. Pockmark lined with nodular concretions (108 metres water depth).

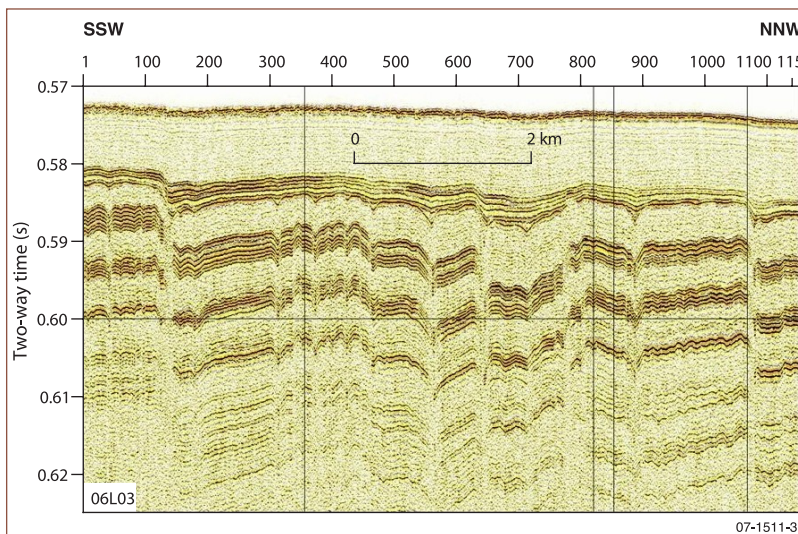


Figure 3. Sub-bottom profile showing network of strike-slip faulting, Area 6, Mermaid Fault Zone. Vertical thickness about 40 metres.

For more information

phone John Kennard on
+61 2 6249 9204
email john.kennard@ga.gov.au