in brief

Marine environmental data assists offshore CO_2 storage assessment of Vlaming Sub-basin

Geoscience Australia is currently undertaking marine surveys to provide seabed environmental information to support assessments of the CO_2 storage potential of several offshore sedimentary basins[1]. The surveys are being undertaken under the Australian Government's National CO_2 Infrastructure Plan (NCIP) to help identify sites suitable for the long term storage of CO_2 within reasonable distances of major sources of CO_2 emissions[2].

Detailed seabed data was recently captured in two selected areas of the Rottnest Shelf, Western Australia, using the RV *Southern Supporter*, to help inform an assessment of the CO_2 storage potential for the Vlaming Sub-basin. The Vlaming Sub-basin was previously identified by the Carbon Storage Taskforce (2009) as potentially suitable for CO_2 storage (Figure 1a). The principal aim of Geoscience Australia's marine survey was to look for evidence of any past or current gas or fluid seepage at the seabed, and to determine whether the location of these features are related to basin structures, such as faults that have been identified in a number of seismic lines, that may extend up to the seabed. The survey also mapped seabed biota in the areas of interest because some communities may be associated with seepage. This research addresses key questions on the regional seal integrity of the South Perth Shale and the potential for containment of CO_2 in the Early Cretaceous Gage Sandstone (Figure 1).

Multibeam sonar bathymetry and seabed backscatter data, and acoustic sub-bottom profiler (chirper) data were acquired over 653 km^2 of seabed (Figure 1a). These geophysical data were used to select sites for sampling the seabed, and 89 sediment grab samples and 12 lines of towed underwater video footage were obtained.

The two study areas are part of a shallow water (< 100 m) carbonate-dominated shelf with very little sediment (sediment starved). Several key seabed features were identified using the new geophysical data, and are being investigated in order to understand the relationship between the present seabed and the geological history of this shelf, and to provide an understanding of possible fluid seepage from the underlying Vlaming Sub-basin.

Preliminary analysis of the new data show that they will greatly increase our understanding of the geomorphology and benthic habitats of the Rottnest Shelf. In particular, a number of features may represent sites of past fluid seepage and their recognition provides fresh insight into the evolution of this continental shelf. These include: in Area 1, northwest trending linear structures, suggestive of faults, present on the seabed. Area 2 in particular (Figure 1b) is characterised by extensive beds of free-living coralline red algae (rhodoliths), with rhodoliths having accumulated along parabolic ridges on the seabed in approximately 35 m water depth (Figure 1b); and individual mounds overlain by rhodoliths, are present in water depths of 80–85 m below present sea-level. Rhodoliths are particularly important in marine ecosystems, providing a transitional niche between rocky reef and sandy areas.

Geological processes operate on a variety of spatial and temporal scales, and have given rise to the present form of the seabed in the study areas. Inshore of the parabolic ridges, which are likely to be remnants of coastal dunes deposited during periods of lower sea-level (Brooke *et al.*, 2010), the shelf is mostly sediment starved with Quaternary limestone cropping out on the seabed. A spatial correlation between a number of ridges on the seafloor, sitting in depths of 85 to 35 m below present sea-level, and the sub-surface geology, is suggestive of links between faults that run through the deeper Vlaming Sub-basin, fluid seepage and the modern seabed. The drowned relict coastal dunes formed with sub-aerial exposure of the Rottnest Shelf during periods of low sea-level. Further analysis of the survey data should help clarify whether the location of the seabed ridges is linked to past seepage from the basin.

Detailed analyses of the seabed sediment samples (geochemical, sedimentological and biological) from these locations, and further processing of the geophysical data will be completed in

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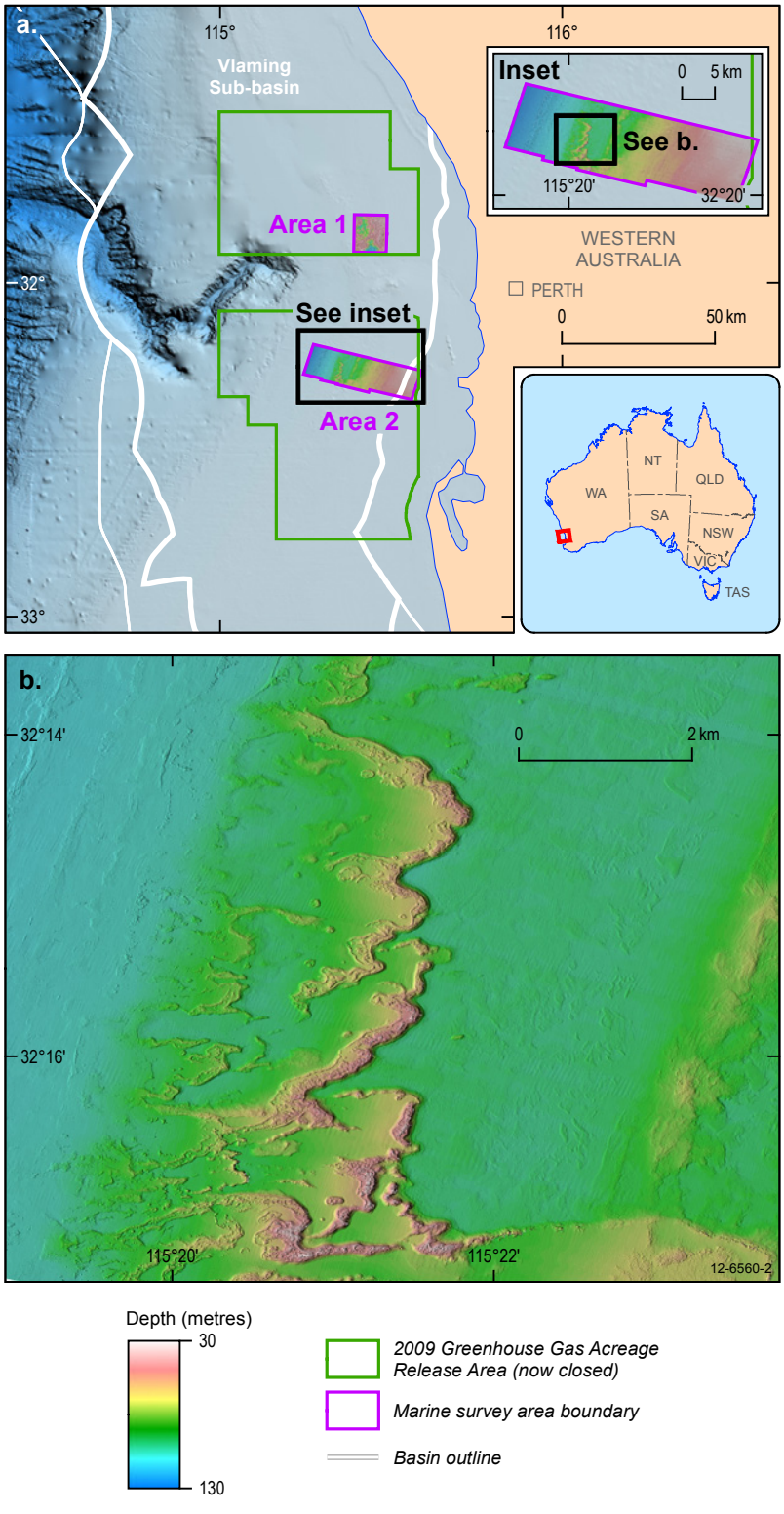

Figure 1a. Location of study areas (Areas 1 and 2) on the Rottnest Shelf, Western Australia showing the offshore 2009 Greenhouse Gas (GHG) acreage release areas (now closed, green boxes); **1b.** Area 2, southwest of Rottnest Island with large parabolic ridges (sites of rhodolith accumulation) rising up to 10 m above the seabed.

December 2012. Results of the analysis of these data will be published in Geoscience Australia Records, map products, and other publications to support the NCIP work.

References

Carbon Storage Taskforce 2009, National Carbon Mapping and Infrastructure Plan – Australia: Concise Report, Department of Resources, Energy and Tourism, Canberra.

Brooke, B., Creasey, J., Sexton, M., 2010. Broad-scale geomorphology and benthic habitats of the Perth coastal plain and Rottnest Shelf, Western Australia, identified in a merged topographic and bathymetric digital relief model. International Journal of Remote Sensing, 31, 6223-6237.

Related articles/websites

[1]Greenhouse Gas Storage
www.ga.gov.au/ghg.html

[2]Carbon Capture and Storage Flagships program
www.ret.gov.au/energy/clean/ccs/ccsfp/Pages/default.aspx

National CO_2 Infrastructure Plan
www.ret.gov.au/energy/clean/ccs/geological/nco2infplan/Pages/default.aspx

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in brief

Marine environmental data to shed light on CO_2 storage in Petrel Sub-basin

In May 2012, Geoscience Australia, in collaboration with the Australian Institute of Marine Science (AIMS), carried out a marine environmental survey in the Petrel Sub-basin, northern Australia. The purpose of the survey was to gather pre-competitive geophysical and biophysical data on seabed environments within targeted areas of the Petrel Sub-basin to help facilitate an assessment of CO_2 storage potential in these areas. The survey was undertaken as part of the Australian Government's National Low Emission Coal Initiative (NLECI[1]).

These new data will support the regional assessment of CO_2 storage prospectivity in the Petrel Sub-basin and contribute to the nation's knowledge of its environmental assets.

The Petrel Sub-basin (Figure 1a), located beneath the Joseph Bonaparte Gulf, northern Australia, was identified in 2009 in the Carbon Storage Taskforce Report as potentially suitable for geological storage of CO_2 because of its favourable geological setting and proximity to offshore gas and petroleum resources. More than 650 km^2 of the seabed in the central Gulf were mapped to characterise their benthic habitats, using Geoscience Australia's shallow-water multibeam sonar system onboard the AIMS research vessel, Solander. The two study areas were located within the boundaries of the Petrel Sub-basin and one of the 2009 Greenhouse Gas acreage release areas (now closed) (Figure 1a). The survey involved the acquisition of approximately 5300 line kilometres of multibeam sonar data, to enable geomorphic mapping, and 650 line kilometres of multi-channel shallow sub-bottom profile data to investigate possible fluid pathways in the shallow subsurface geology. Seabed samples, including biota and sediment, were collected at 13 stations, to characterise the seabed environment and identify evidence of possible seepage. Conductivity, temperature and depth measurements of the water column were also collected at ten locations to characterise its vertical structure and help identify possible seepage. Finally, measurements of waves, tides and ocean currents were acquired at two stations (one within each survey area) to help characterise the regional oceanographic processes.

The northern study area is characterised by steep to vertically-sided flat-topped banks, which stand 30–40 m above the surrounding seabed, whereas palaeo-channels (valleys formed during periods of lower sea level), plains, ridges and pockmark fields are the primary geomorphic features in the southern area (Figure 1b). Preliminary analysis of sediment samples indicate that the plains are comprised of fine- to medium-grained sands, and muds, whereas palaeo-channels (valleys) comprise coarse- to very coarse-grained sands. Large areas (~380 km^2) of the seabed in the southern area contain pockmarks (small shallow depressions in the seabed); those on the plains and in valleys are commonly up to three metres deep and 30 m in diameter. Larger pockmarks (>10 m in diameter) generally occur in fields ranging between 10–100 km^2, and cover >80% of the southern study area, while smaller pockmarks (<10 m diameter) typically occur in closely spaced clusters within the fields of larger pockmarks. Comparatively fewer pockmarks are present in the northern study area and occur primarily as clusters on the margins of banks and ridges. The geochemical analysis of samples from areas of pockmarks may indicate whether these features are related to the seepage of fluids or gas from the seabed, and the origin of the seepage – from the deep basin or from within surficial sediments.

Infaunal assemblages are dominated by crustaceans and polychaetes, and to a lesser extent echinoderms and molluscs. Once identification of specimens to operational taxonomic units is complete, further analysis will investigate the relationships

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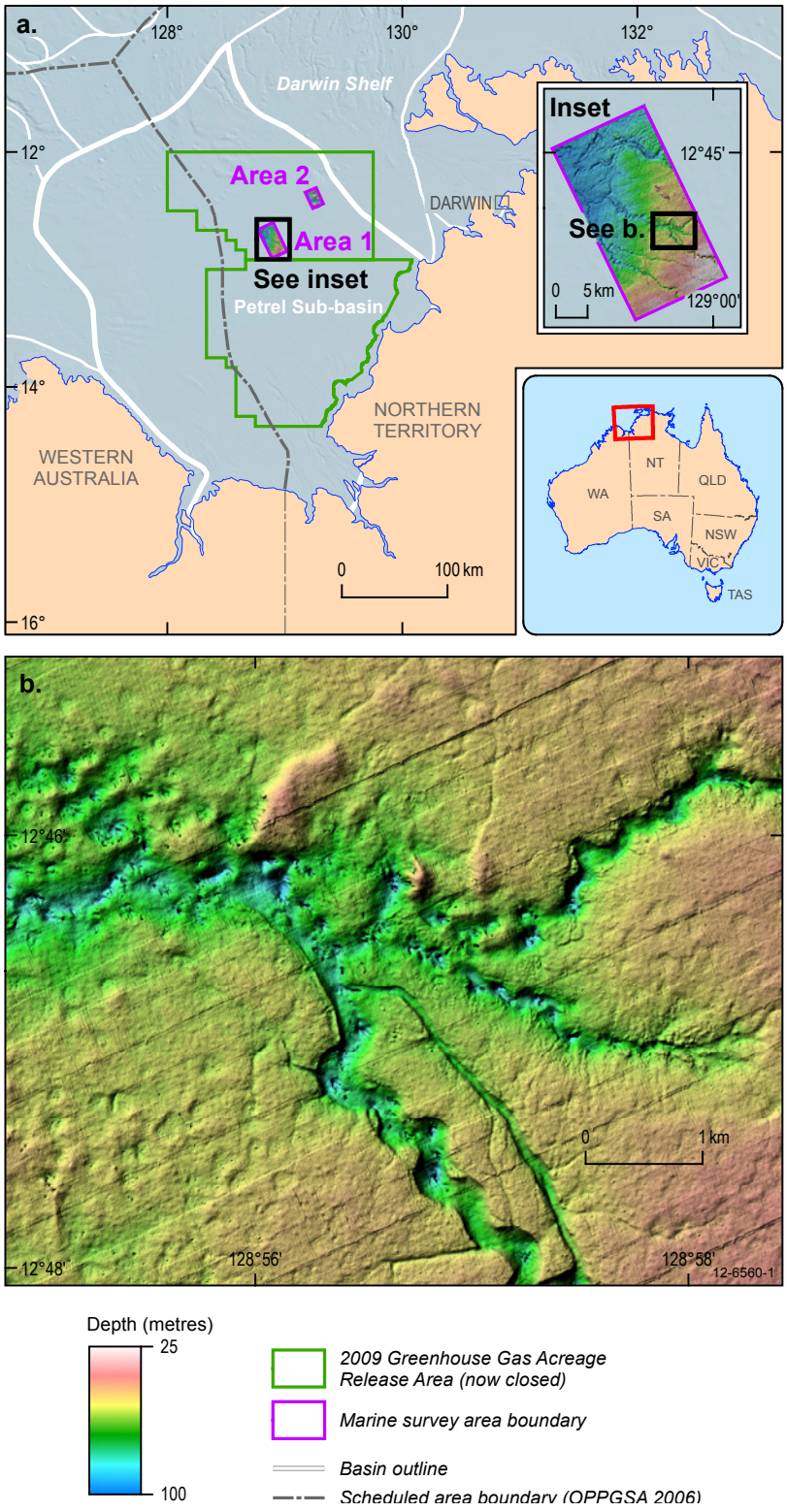

Figure 1a. Location of survey areas in the Petrel Sub-basin, northern Australia. Former Greenhouse Gas acreage release areas (released in 2009 and now closed) are also shown. **1b.** High-resolution false-colour bathymetry image of the southern acquisition area, showing palaeo-channels (valleys).

amongst environmental factors and infauna, particularly in relation to those indicative of fluid seepage and unique communities. The major analyses of samples and data and their interpretation will be completed by December 2012. These new data will support the regional assessment of CO_2 storage prospectivity in the Petrel Sub-basin and contribute to the nation's knowledge of its environmental assets.

References

Carbon Storage Taskforce 2009, National Carbon Mapping and Infrastructure Plan – Australia: Concise Report, Department of Resources, Energy and Tourism, Canberra.

Related articles/websites

[1]National Low Emissions Coal Initiative (NLECI)
www.ret.gov.au/energy/clean/ccs/nleci/Pages/index.aspx

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in brief

Scientists investigate Victorian earthquake

The most significant earthquake experienced in Victoria in 30 years is to come under examination from seismologists and natural hazard researchers as temporary seismometers are deployed in the area surrounding the epicentre.

The magnitude 5.4 earthquake occurred in the state's southeast at 8:53pm on 19 June 2012, 16 kilometres southwest of the Gippsland township of Moe. There have been more than 170 aftershocks following the Moe event, the largest recorded at magnitude 3.5.

It is the largest earthquake in Victoria since November 1982 when an earthquake also measuring magnitude 5.4 occurred near the town of Wongungarra, 100 kilometres north of the event near Moe. In 1969 there was a magnitude 5.3 event centred on Boolarra, 15 kilometres southeast of the Moe event.

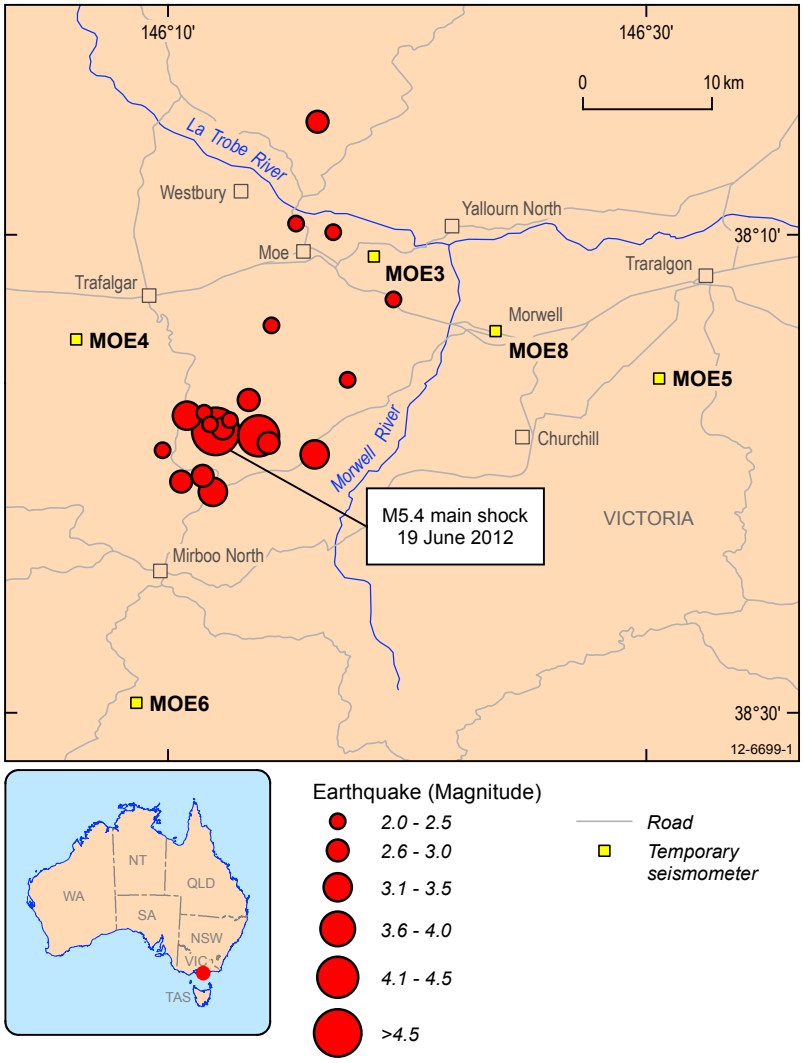

Figure 1. The map shows the magnitude 5.4 main shock that occurred in June 2012 and the aftershocks located through the use of the Australian National Seismograph Network (ANSN) until August 2012. The aftershocks as recorded by the ANSN range in magnitude from 2.0 to 4.4. The map also shows the locations of the temporary seismometers deployed by Geoscience Australia in the days following the main shock (labelled MOE3-MOE8).

Using data captured by the temporary seismometers, seismologists will analyse aftershock data to further clarify the location of the main shock, and to help identify the active fault system which produced the earthquake. The data will also help to refine local ground motion models for predicting the amount of shaking produced by earthquakes in Victoria.

Post-analysis information will help to improve future assessments of the likely earthquake hazard in the area around Moe and Traralgon, and more broadly, the likely hazard in Victoria's Gippsland region.

These earthquakes are called intra-plate, and occur due to the release of stress that has built up in the Earth's crust, caused by movement of the tectonic plates. The Australian continent is part of the Indian-Australian plate which is being pushed slowly north-east at approximately 7cm per year.

Related articles/websites

Earthquakes @ Geoscience Australia
www.ga.gov.au/earthquakes/getQuakeDetails.do?quakeId=3226344&orid=614420&sta=TOO

For more information

email ausgeomail@ga.gov.au