in brief

Major program of deep-crustal seismic reflection transects

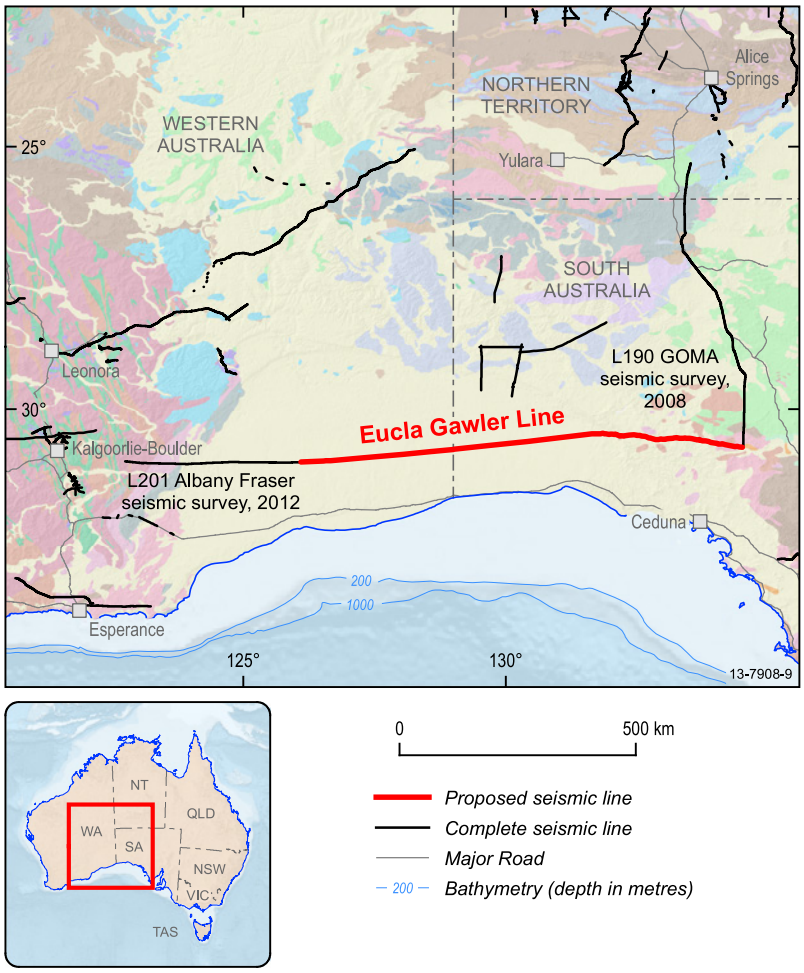

Figure 1. Location of the Eucla-Gawler seismic transect (red) overlain on the geology map of Australia and with existing deep crustal seismic transects (black).

Figure 2. Vibroseis trucks working on a GA deep crustal reflection seismic transect

A major new tranche of regional-scale seismic reflection surveys commences this month with a field crew mobilising to the Nullarbor region of Western Australia. In an exciting national collaboration, Geoscience Australia will be working with the Geological Survey of Western Australia, the Geological Survey of South Australia and AuScope Earth Imaging (part of the National Collaborative Research Infrastructure Strategy) to acquire data along the trans-Australian railway-line between Haig (WA) and Tarcoola (SA). Geoscience Australia will be contributing financially to the project through the new minerals pre-competitive data funding that it received in November 2012, with funding in South Australia through the PACE initiative and in Western Australia through the Exploration Incentive Scheme (EIS). Geologically, the 870 km transect (Figure 1) will cross the greenfields Eucla Basin, image continental-scale basement magnetic and gravity features such as the Mundrabilla Lineament and the Coompana magnetic anomaly, and also extend into the highly prospective Gawler Craton. The line will fill a 'gap' in seismic coverage to complete a string of deep-crustal seismic transects stretching from west to east across the Australian Continent. This big-picture coverage will enable researchers and resource-explorers to assess major crustal

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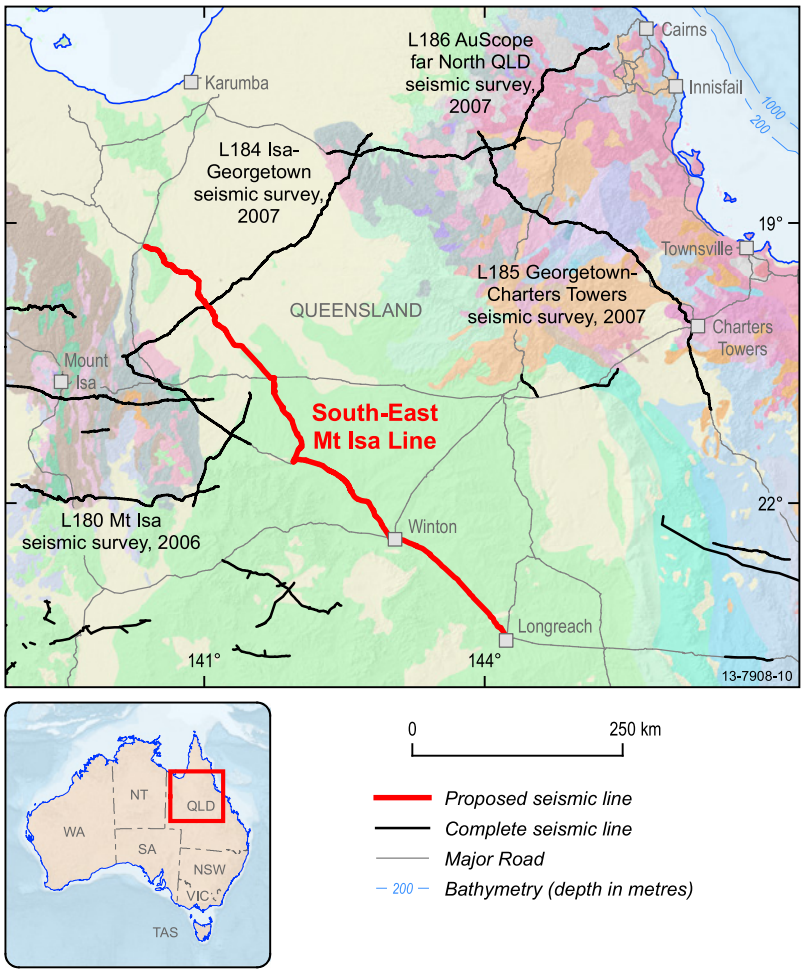

Figure 3. Location of the south-east Mt Isa seismic transect (red) overlain on the geology map of Australia and with existing deep crustal seismic transects (black).

Figure 4. Onshore seismic crew en-route to a GA deep-crustal seismic transect in Western Australia. A typical remote area crew consists of 40 people, over 20 4WD and other support vehicles, and a mobile camp.

blocks and deep-crustal structures using a nationally consistent dataset, and will be an important asset to geologists trying to reconstruct the tectonic evolution of Australia.

A second major survey is scheduled to commence in Queensland around April 2014, and is a collaboration between Geoscience Australia and the Geological Survey of Queensland, with funding coming from the Queensland Government Greenfields 2020 program. The line will extend 670 km over the south-east Mt Isa Province (Figure 3) and cross the Cork Fault, a continental-scale structure separating the Mt Isa block from the geological terrains underneath the Eromanga Basin to the south. The line will also traverse the Millungera Basin, discovered by a seismic survey acquired during the Onshore Energy Security Program, which has potential for unconventional hydrocarbons, carbon capture and storage, and geothermal energy.

The final survey proposed for the 2013–14 financial year is along the Great Northern Highway in northwest Western Australia (Figure 5). The 660 km line would be funded by the Commonwealth Government's National CO_2 Infrastructure Plan and the Geological Survey of Western Australia and would cover the onshore Canning Basin, extending from just north of Port Headland to the Gibb River Road near Derby. Acquisition is expected to commence in April–May 2014.

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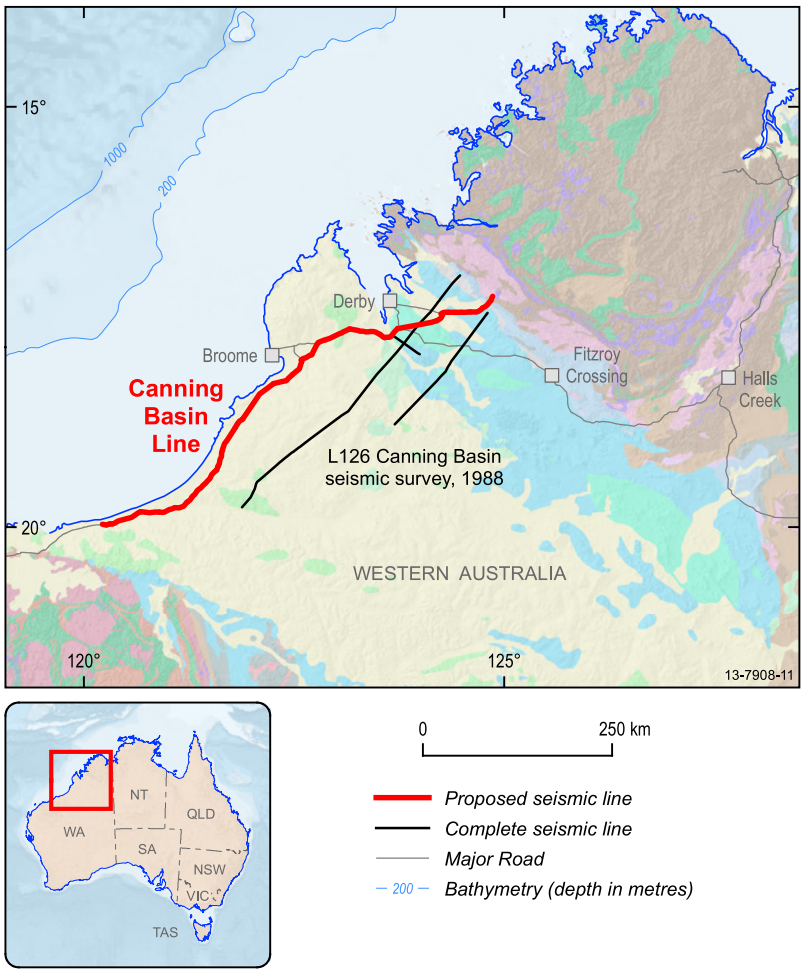

Figure 5. Location of the Canning Basin seismic transect (red) overlain on the geology map of Australia and with existing deep crustal seismic transects (black).

Related articles and websites

Seismic Acquisition and Processing Project
www.ga.gov.au/minerals/projects/current-projects/seismic-acquisition-processing.html

Seismic
www.ga.gov.au/minerals/disciplines/geophysics/seismic.html

Continental Geology Section
www.ga.gov.au/minerals/projects/current-projects/continental-geology.html

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New seabed discoveries in the Timor Sea

In 2012, Geoscience Australia completed a marine survey of an area in the newly declared Oceanic Shoals Commonwealth Marine Reserve in the Timor Sea. Undertaken as a collaborative survey with the Australian Institute of Marine Science (AIMS), the University of Western Australia and the Museum and Art Gallery of the Northern Territory, the survey was an activity within the Marine Biodiversity Hub funded through the Australian Government's National Environmental Research Program. The Oceanic Shoals area was chosen through discussion with Department of the Environment for whom the area is of particular interest and is highlighted in marine bioregional plans for the North and Northwest Marine Regions.

The 25 day survey was undertaken during September and October 2012 on the AIMS Research Vessel, RV Solander, and acquired data from four areas in the western sector of the Oceanic Shoals Commonwealth Marine Reserve. Covering 507 square kilometres, these areas incorporate a variety of seabed geomorphic features across water depths ranging from 30 to 180 metres, including carbonate banks, terraces and pinnacles, as well as soft sediment plains and valleys.

Data acquired from each survey area included:

- high-resolution multibeam sonar bathymetry and acoustic backscatter
- sub-bottom acoustic profiles

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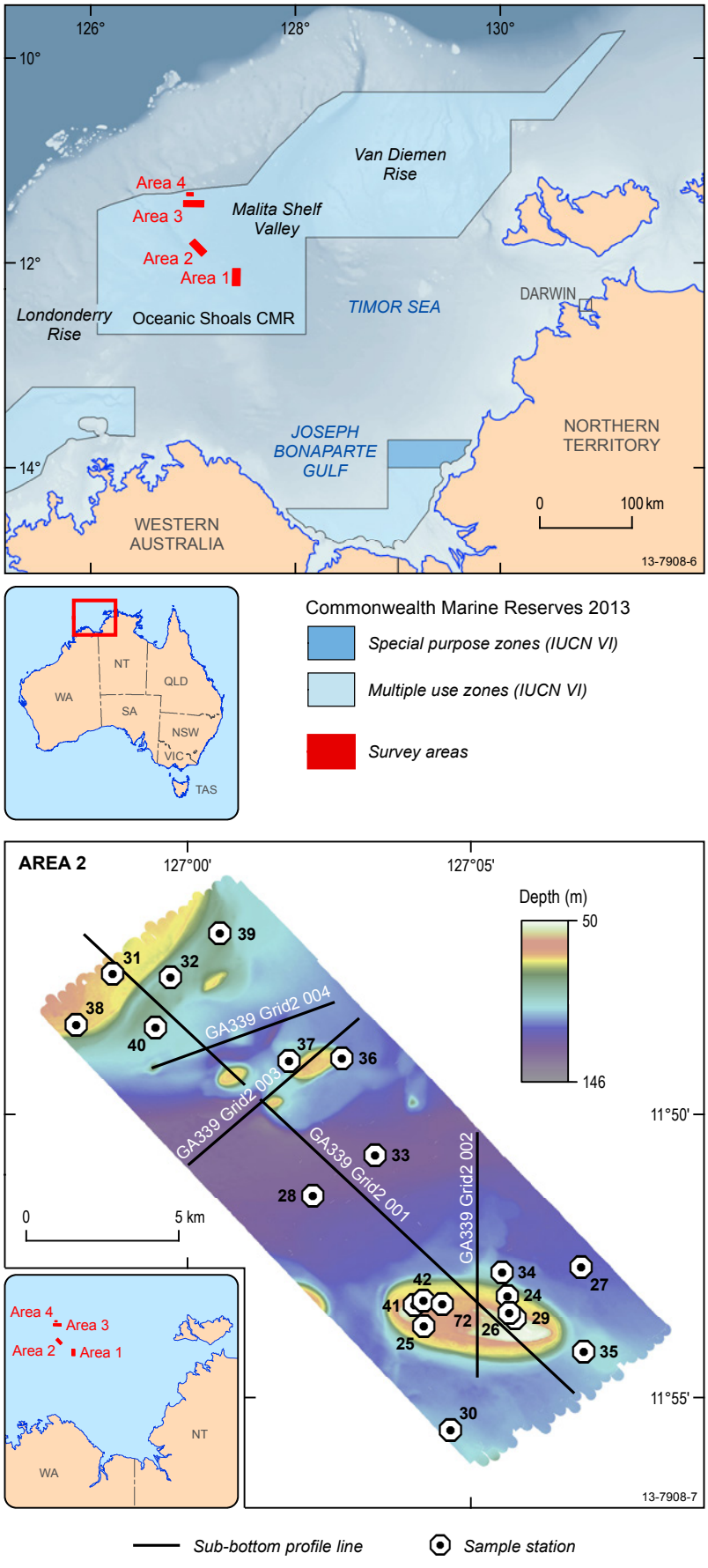

- physical samples of seabed sediments and infauna (hard- and soft-bodied organisms)
- physical samples of epibenthic biota (sponges and corals)
- video and still camera observations of seabed habitats and associated biological communities, including fish
- observations of pelagic predators (whales, dolphins)
- oceanographic measurements.

In total, samples and/or video observations were collected at 70 stations.

Significant findings included:

- The geomorphic diversity of the seabed within the Oceanic Shoals Commonwealth Marine Reserve is well represented in the western part of the reserve, with numerous banks and terraces providing hard substrate for benthic communities.
- The biodiversity on banks appears to vary as a function of water depth and associated light and turbidity conditions, with shallower banks (less than 45 metres) supporting more biodiversity than deeper banks, including hard corals.

Figure 1. Location map of areas investigated during the Oceanic Shoals Commonwealth Marine Reserve Biodiversity Survey (**top**).

Figure 2. False colour bathymetry image of Area 2 with sub-bottom profile (sparker) lines and sampling stations indicated **(bottom)**.

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- Sponges are located on all the banks that were surveyed, with 350 species identified in the samples collected. However, species richness and endemism of sponges in the survey area may not be as high as that further to the east. This assumption is based on initial comparison with sponges from previous Geoscience Australia surveys in the Timor Sea.
- Spatial gradients in epibenthic biodiversity exist as a possible function of marked changes in substrate, light and turbidity levels along the depth transition from bank to terrace to plain.
- Tidal currents play an important role in regulating levels of suspended sediment (turbidity) and in the redistribution of sediment across the plains and around banks and terraces, with some smaller banks partly buried by sediment.
- Demersal fish communities respond to spatial patterns in benthic biodiversity, occurring in larger and more diverse populations on the shallower, less turbid banks.
- A wide variety of high-order pelagic fish species occur in these waters.

Data collected during the survey will be used to support research being undertaken in the Marine Biodiversity Hub, including the modelling of ecosystem processes for the northern region, and to support the work programs of the Australian Government Department of the Environment. These data will be made publicly available via the Marine Biodiversity Hub website and the Australian Ocean Data Network Portal, adding to the knowledge base of Australian tropical shelf habitats and contributing to the long term management of these poorly understood areas.

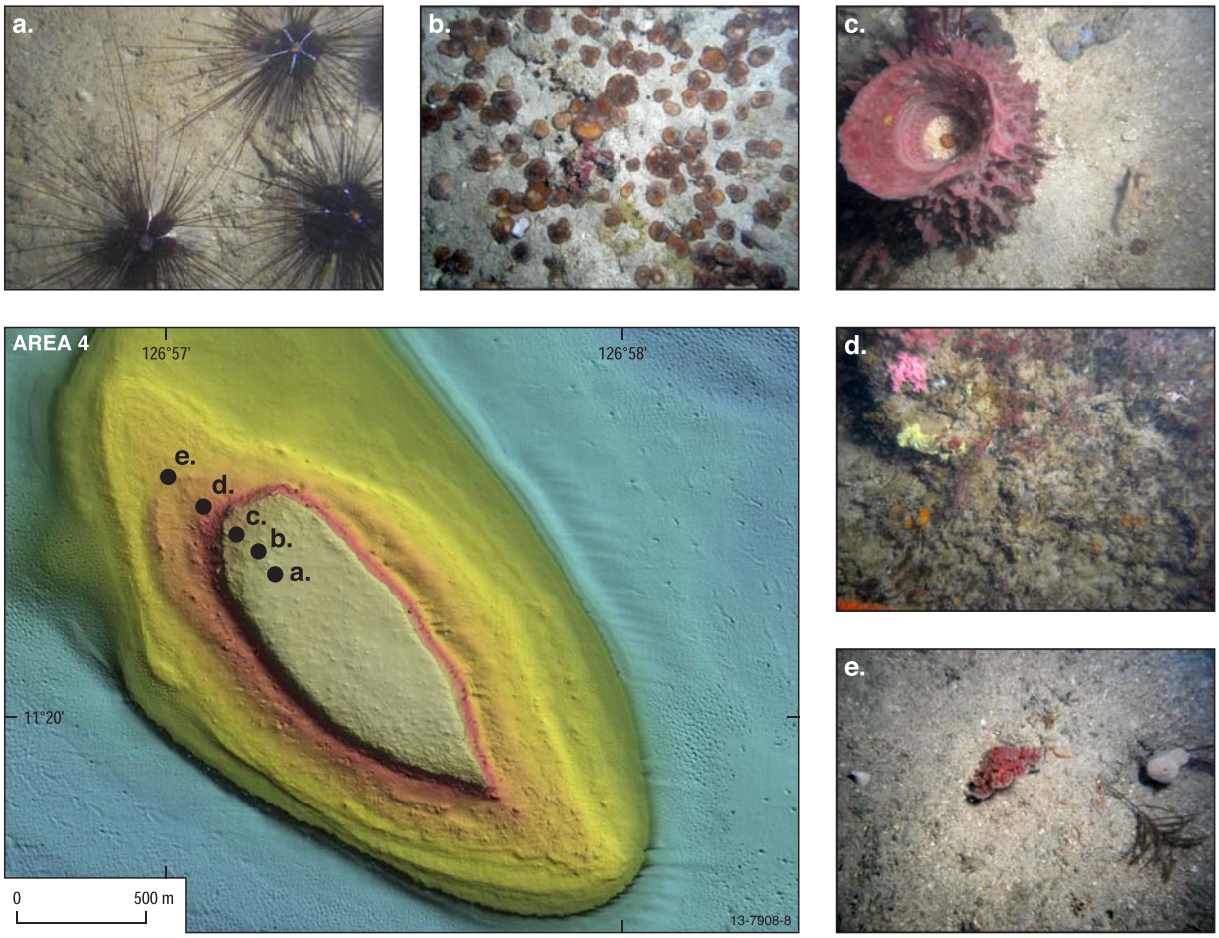

Figure 3. Representative underwater photos from Area 4, showing: **(a)** the top of the bank with conspicuous sea urchins; **(b)** mushroom corals; **(c)** a barrel sponge Xestospongia; **(d)** the flank of the bank supporting encrusting and low-relief epifauna, and; **(e)** the margin of the bank showing scattered epifauna and low levels of bioturbation.

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Related articles and websites

Marine bioregional plans
www.environment.gov.au/topics/marine/marine-bioregional-plans

Oceanic Shoals Commonwealth Marine Reserve (Timor Sea) Biodiversity Survey *(Geoscience Australia Record 2013/38).*
www.ga.gov.au/metadata-gateway/metadata/record/gcat_76658

For more information

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Synthetic Aperture Radar calibration using the Australian Geophysical Observing System corner reflectors

Geoscience Australia will conduct a field performance evaluation during the next 3 to 4 months of 18 corner reflector prototypes which will be used to support the Australian Geophysical Observing System (AGOS). The prototypes (Figure 1) have been deployed over a test site north of Canberra. Synthetic Aperture Radar (SAR) satellites operating at X and C-band will be used to acquire data over the test site for evaluation. Following the evaluation, the corner reflectors will be deployed permanently in areas of research interest for AGOS.

Figure 1. Corner reflector deployed at a test site north of Canberra.

Through its Education Investment Fund (EIF) the Australian Government has invested $23 million in building AGOS, which is a component of the AuScope program. The geospatial component of AGOS will include:

- Global Navigation Satellite System (GNSS) instrumentation
- a network of high precision GNSS monuments
- a robotic GNSS antenna calibration facility
- high precision GPS monuments
- corner reflectors
- a SAR data repository.

These geospatial components will enable the precise measurement of ground deformation with the corner reflectors supporting studies that use Interferometric SAR (InSAR) techniques. As a secondary benefit, the corner reflectors will offer a reliable means to perform ongoing radiometric and geometric calibration of SAR instruments on satellites.

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The performance of SAR instruments needs to be verified by internal and external calibration to achieve high radiometric and geometric accuracies. For radiometric calibration, the performance of the SAR instruments is related to a known measurement standard; point targets such as corner reflectors or active transponders can be used. Geoscience Australia has chosen corner reflectors because they are low maintenance and low cost compared to active devices such as transponders, which also need power for operation. Relative to their small size, corner reflectors exhibit a high radar cross section (RCS) that can be maintained over a wide range of incidence angles, ensuring their identification in the SAR image.

Geoscience Australia designed and manufactured 18 corner reflector prototypes with different sizes and material finishes to test and identify their optimal characteristics for InSAR and calibration applications. A triangular trihedral design was chosen for the reflectors because of the simplicity of manufacture, long-term structural rigidity and relative stability for large radar cross section. The prototypes were characterised at the Defence Science and Technology Organisation ground range radar test facility in Adelaide, by comparing actual RCS measurements with the expected theoretical values and quantifying the change in RCS at different azimuth and elevation angles. Results from the characterisation of the corner reflectors have shown that the RCS performance of the prototypes is comparable to theoretical values.

The corner reflector infrastructure is expected to be exploited by international satellite operators for independent verification of SAR instrument performance, and will count towards Australia's valuable contribution to international efforts on calibration of satellite borne instruments.

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