in brief

Early results from Northern Perth Basin seepage survey

A marine survey was recently completed by a team of scientists and technicians from Geoscience Australia who were searching for evidence of natural hydrocarbon seepage sites in the offshore northern Perth Basin. The survey, undertaken between 20 September and 18 October 2011 on the Australian Government's Marine National Facility, the RV *Southern Surveyor,* studied nearly 3500 square kilometres of the continental margin off Geraldton, Western Australia.

The first leg of the survey acquired 4000 line kilometres of multibeam bathymetry and sub-bottom profiler data plus 1500 line kilometres of sidescan sonar data. These data were used to map the morphology (or shape) of the seabed and the structure of the sub-surface sediments within 100 metres of the seabed. Researchers from CSIRO Petroleum and Geothermal Research in Perth, who joined Geoscience Australia staff during the first leg of the survey, deployed hydrocarbon sensing equipment capable of detecting oil in seawater.

The second leg was equipped with a remotely operated vehicle (ROV) supplied by research collaborators from the Royal Netherlands Institute for Sea Research and the University of Ghent in Belgium who also joined this leg of the survey. It is the first time this type of equipment has been deployed for such research purposes in Australian waters (figure 1). The ROV was deployed nine times within the study area, providing many hours of excellent underwater video footage from multiple camera angles. Nearly 100 sediment samples were also collected.

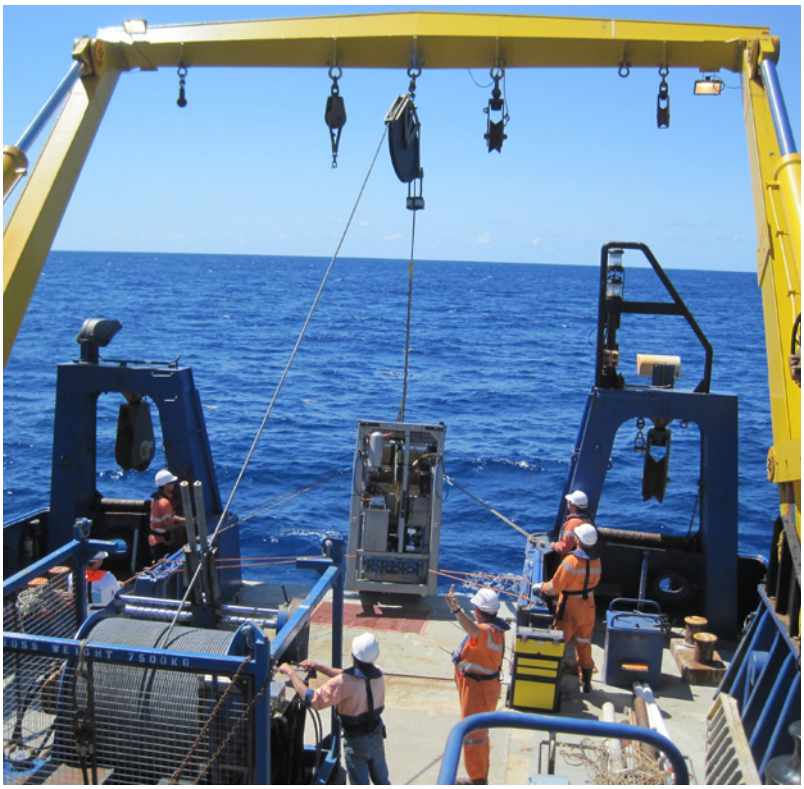

Figure 1. The remotely operated vehicle being deployed from the Australian Government's Marine National Facility the RV *Southern Surveyor* during the marine survey searching for evidence of natural hydrocarbon seepage sites in the offshore northern Perth Basin. The RV *Southern Surveyor* is owned and managed by CSIRO.

Acoustic data acquired in this region revealed pockmarks on the seabed and numerous 'flares' in the water column. Carbonate blocks and other interesting features were also observed in this area with the ROV. These acoustic and seabed features are located over a major fault system with evidence of recent tectonic movement, in a zone of palaeo-oil generation and migration.

These features in the northernmost part of the survey area, in approximately 500 metres water depth, are analogous with known hydrocarbon seepage sites in the Timor Sea. Sediment and biological samples from this area are currently being analysed, and further reports will be provided as results become available.

For more information

email ausgeomail@ga.gov.au

Related articles/websites

AusGeo News 103: Hydrocarbon potential of the offshore northern Perth Basin

www.ga.gov.au/ausgeonews/ausgeonews201109/hydrocarbon.jsp

in brief

Field test on CO_2 storage capacity a world first

Geoscience Australia is a partner in the Collaborative Research Centre for Greenhouse Gas Technologies, (CO2CRC) and has recently made a significant contribution to a complex field test at their demonstration site in the Otway Basin, Victoria. It was the world's first test comparing five different approaches to assess the storage capacity of supercritical carbon dioxide (CO_2), also known as residual gas saturation, within a sandstone potential storage reservoir. Supercritical carbon dioxide behaves similarly to a fluid when injected. A comparison of test results and the overall performance of the different methods will guide industry in the development of common practice standards to assess residual gas saturation.

After injection of the CO_2 into a well some of the supercritical CO_2 becomes permanently trapped in capillaries between sand grains, a condition also known as residual trapping. The extent of this residual trapping is an important property which contributes to the total CO_2 storage capacity of a geologic reservoir. To date, only a few attempts have been made to quantify residual trapping within the demonstration storage reservoir.

Drilling of the 1565 metre deep CRC-2 well at the Otway Basin site was completed in March 2010. This was followed by the extensive downhole and surface installations to allow for: the injection and production of large quantities of fluids, the *in situ* measurement of reservoir properties, and the sampling of fluids under reservoir pressure. A test sequence detailing each operational step over a three-month period including engineering requirements, modelling of reservoir properties, staffing and risks was also developed.

Residual Gas Saturation Test

The Residual Gas Saturation Test commenced in mid-June 2011 with an initial production of 510 tonnes of water over 15 days followed by a range of tests and operations including the injection of 150 tonnes of supercritical CO_2. The Residual Gas Saturation Test involved five independent tests:

Figure 1. The test team gather around the head of the injection well at the CO2CRC Otway Project during the dissolution test in September 2011.

1. A thermal conductivity test—heating and cooling cycles along the well casing are imposed and the derived thermal conductivity can be related to the residual gas saturation.
2. A hydraulic test—the pressure response during water injection and subsequent return to the baseline (when pumping ceases) are recorded and utilized to infer the amount of gas trapped in the formation. The residual gas changes the permeability of the pore spaces and the associated hydraulic pressure build-up during the injection phase.
3. A noble gas tracer test—the inert gases krypton and xenon plus water are injected into the formation where the residual CO_2 saturation had been artificially produced. During the latter state, these tracers partly diffuse into the supercritical CO_2 phase and remain locked in the reservoir. The difference in tracer concentrations in the back-produced water (or water pumped to the surface) before and after the supercritical CO_2 was formed can be used to estimate residual gas saturation.
4. An organic tracer test—dissolved organic compounds

in brief

plus water are injected into the formation. The organic tracers partially react with the supercritical CO_2 for 10 days forming daughter products. The concentration of these daughter products relates to the degree of residual gas saturation.

5. A dissolution test—water with a low CO_2 concentration is injected into the formation and this leads to the dissolution of supercritical CO_2 within the formation. The CO_2 concentration in the back-produced water increases over time and this increase can be measured and used to infer the initial residual gas saturation.

These tests were successfully completed by mid-September 2011. Geoscience Australia's contribution during the Residual Gas Saturation Test included:

- leading the field teams for the continuous noble gas (test 3)and dissolution tests (test 5)
- providing technical support staff for the continuous sampling and analysis on site
- building and deploying a field laboratory for the on-site analysis of gas and fluid composition
- providing training for field teams in all aspects of sample collection and analysis.

For more information

email ausgeomail@ga.gov.au

Related articles/websites

CRC for Greenhouse Gas Technologies (CO2CRC)

www.co2crc.com.au

Protecting marine communities in eastern Antarctica

An international effort is currently underway to establish a representative system of marine protected areas (MPAs) in the Southern Ocean around Antarctica. These MPAs will contribute to the long-term conservation of marine biodiversity in the region. In eastern Antarctica, seven broad areas have been identified as potential MPAs based on characteristics such as biodiversity patterns, ecosystem processes, physical environmental features and human activities (figure 1). The boundaries of these broad regions will be refined or confirmed over the next 12 months as more detailed information becomes available.

Scientists from Geoscience Australia are collaborating with researchers from the Australian Antarctic Division to improve our understanding of the habitat characteristics within each of the regions. This includes providing information about the seafloor environments within and adjacent to each of the proposed MPAs based on new bathymetry compilations, an analysis of all available sediment data, and the interpretation of seismic sections. The new bathymetry grids, together with the seismic analysis, provide a much clearer picture of the seabed morphology and geology, and the sediment data help to delineate different substrate types. By identifying features such as submarine canyons, rocky substrate, seamounts and sediment drifts, we can build a better picture of the distribution of distinct benthic communities. This fundamental environmental information will also improve our understanding of the physical processes that shape the seabed environment and inform the development of representative marine protected areas.

The November 2011 meeting of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) reached an historic agreement which means that specific MPA proposals will be considered by the Commission from 2012. This follows from their declaration of the first MPA, within the convention Area, south of the South Orkney Islands in 2009. Australia already manages two Southern Ocean MPAs around Heard and Macdonald Islands and Macquarie Island.

For more information

email ausgeomail@ga.gov.au

in brief

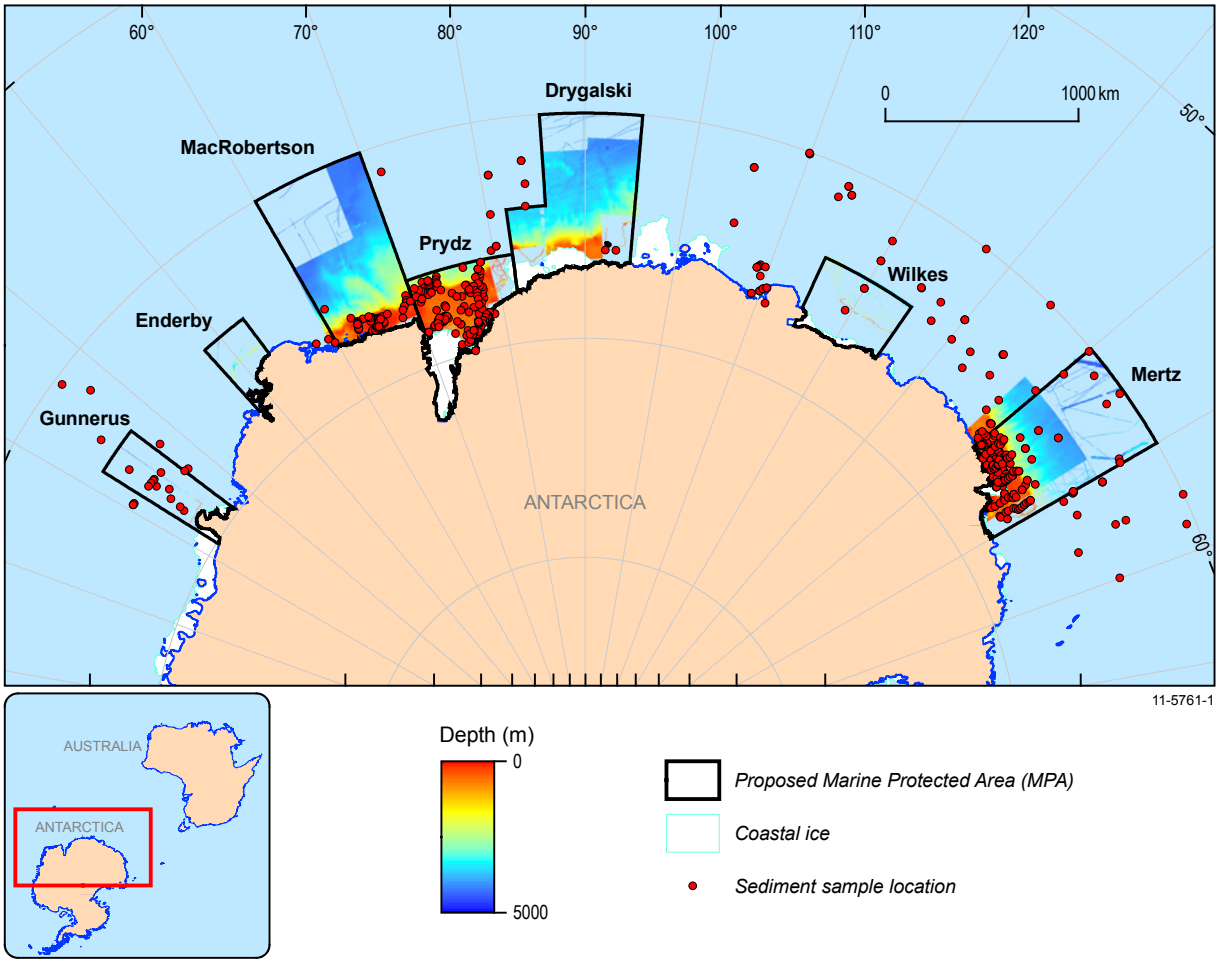

Figure 1. The seven regions identified as potential marine protected areas (MPAs) showing new bathymetry grids and the location of sediment samples within and adjacent to them.

Related articles/websites

Geoscience Australia's Antarctic Geoscience Project
www.ga.gov.au/marine/projects/antarctic-geoscience.html

Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)
www.ccamlr.org

Bowen shaken after recent earthquakes

After what was a relatively stable year in 2010 (Glanville 2010) earthquake activity in Queensland substantially increased in 2011. There have generally been fewer major earthquakes in Queensland than in other parts of Australia such as New South Wales (Newcastle 1989), Northern Territory (Tennant Creek 1988), and Western Australia (Meckering 1968). Only 12 earthquakes with a magnitude greater than 5.0 have been recorded in Queensland between 1900 and 2010. One of the largest earthquakes, which occurred in 1913 near Ravenswood, was a magnitude 5.7 earthquake.

This all changed on Saturday 16 April when residents of central Queensland were shaken by a magnitude 5.3 earthquake at 3.31 pm in the afternoon. The epicentre was located 50 kilometres west of Bowen in a sparsely populated area south of Cape Upstart (figure 1). The shake shocked and surprised residents from Townsville, Ayr,

in brief

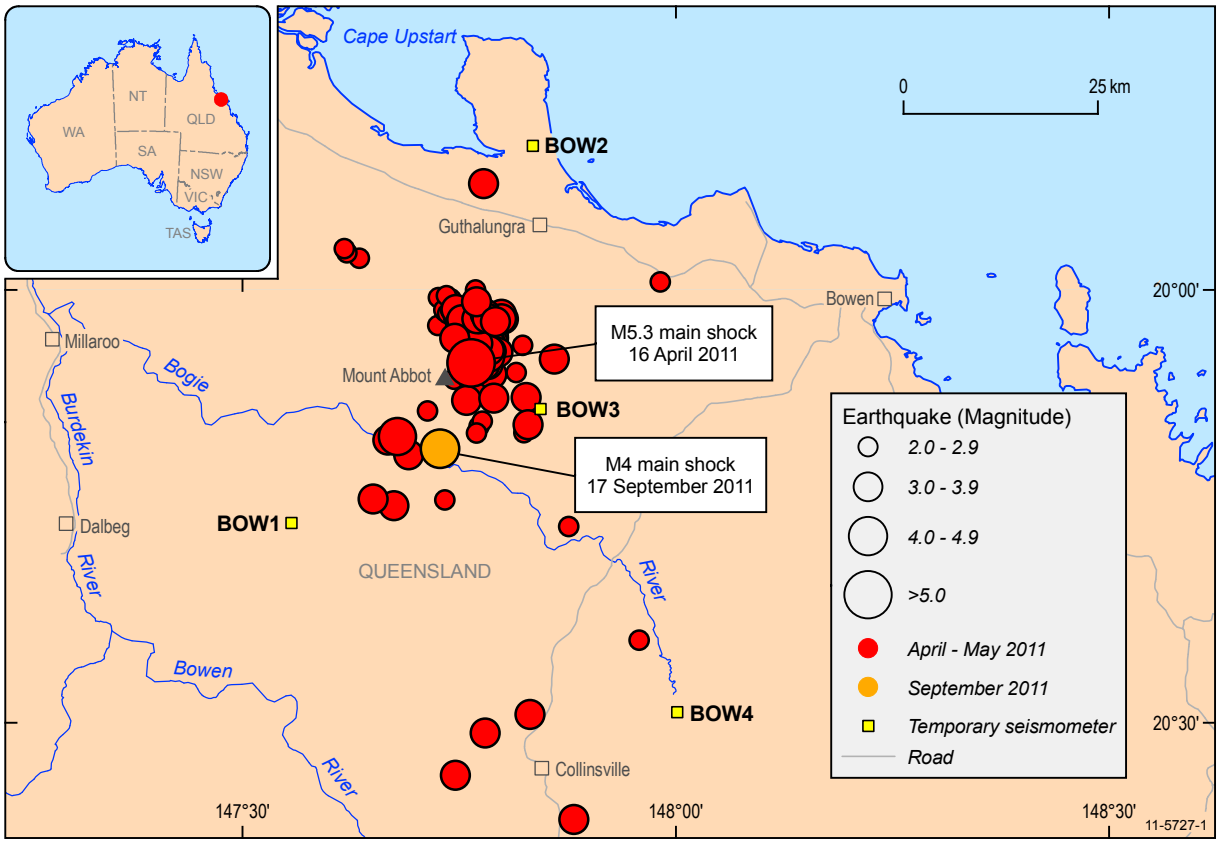

Figure 1. The April 2011 (magnitude 5.3) and September 2011 (magnitude 4.0) earthquakes both occurred near Mount Abbot, west of Bowen. This diagram also shows the location of aftershocks that followed the main shock on 16 April as recorded on temporary seismometers. These temporary recording sites (BOW1-BOW4) are shown in yellow.

Bowen, Airlie Beach, Mackay and Rockhampton, who reported the event to Geoscience Australia's Earthquake Hotline. More than 500 felt reports were submitted from residents of the central Queensland region.

The unexpected earth movement produced by the main shock was followed by several smaller aftershocks, and there was an immediate response by Geoscience Australia to record the aftershock activity. Scientific and technical staff quickly mobilised to install temporary seismometers in the Bowen region. Once in the area, staff travelled to the four pre-selected sites around the epicentre of the 16 April main shock. Local farmers allowed access to their land so that the equipment could be installed at suitable locations. The equipment consisted of a portable seismometer connected to a recording device which was recharged daily by a solar panel to ensure continuous operation. The recorders were left in place for a period of six weeks (between 19 April and 2 June) with a site maintenance trip to download data after three weeks of operation.

Aftershocks were recorded as soon as the equipment was installed. A review of the data revealed that multiple aftershocks occurred daily over the six weeks following the main shock with a gradual decrease in activity over time. Over 550 small aftershocks were recorded during this period, with the maximum number of aftershocks in a single day reaching 56 events on 21 April, soon after the recorders were installed. Following the earthquake activity in April and May, the same area was shaken by a magnitude 4.0 earthquake on 18 September at 2.28 am (figure 1).

Geoscience Australia seismologists will continue to monitor earth movements in the Bowen area through continuous earthquake monitoring carried out at the agency's headquarters in Canberra. The recent cluster of earth movements near Bowen resulted in many aftershocks, which is a typical sequence of events, as the continental crust readjusts after the initial release of

in brief

stress following the main shock. This activity, like earthquake activity across the continent, is related to the build up of stresses within the Australian tectonic plate as it moves northward.

References

Glanville DH. 2010. Australian Seismological Report 2010. Geoscience Australia Record 2011/16. Available at: https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=71806

For more information

email ausgeomail@ga.gov.au

Related articles/websites

Earthquake Basics (information on earthquakes):

www.ga.gov.au/hazards/earthquakes/earthquake-basics.html

Earthquakes@Geoscience Australia

If you have felt an earthquake, you can find earthquake information and fill in an online felt report at:

www.ga.gov.au/earthquakes/ or you can contact the Earthquake Hotline on 1800 655 739.

Inventory system assists disaster research

Emergency managers, researchers and urban and environmental planners will have improved opportunities to investigate the after-effects of natural disasters more quickly following the development of a new information collection system. Known as the Rapid Inventory Collection System, the vehicle-mounted equipment and associated computer programs have been developed by Geoscience Australia as part of its Earth monitoring and hazards program. These programs evaluate the aftermath of earthquakes, floods, and cyclones.

The Rapid Inventory Collection System operates with up to four cameras mounted on a vehicle and connected to a user-friendly, consistent and intuitive computer-based interface. It uses open source software and displays the images obtained with relevant GPS data as well as incorporating a notepad for including comments.

Figure 1. The Rapid Inventory Collection System vehicle gathering data in north Queensland in the aftermath of Cyclone Yasi.

The equipment has been used to gather images in the aftermath of the Brisbane floods (January 2011) and tropical cyclone Yasi in Queensland (February–March 2011), the earthquakes in Kalgoorlie, Western Australia (April 2010) and Christchurch, New Zealand (September 2010). The system has also captured imagery of the Darling River in New South Wales for ecological research.

Following a magnitude five event below the Kalgoorlie suburb of Boulder in 2010 scientists from Geoscience Australia, The University of Adelaide and The University of Melbourne used the Rapid Inventory Collection System to obtain 230 000 street view images and conducted a detailed assessment of the effects of the earthquake on more than 400 buildings of various ages.

That research revealed that older unreinforced masonry buildings were particularly vulnerable to the nature of the ground motion experienced during the event. While buildings

in brief

of more contemporary cavity brick construction experienced less damage than older buildings they suffered greater damage than wooden-framed buildings of equivalent age.

The data obtained with the Rapid Inventory Collection System will help government planners to minimise risk of damage by developing a better understanding of the vulnerability and retrofit options for buildings and other infrastructure.

For more information

email ausgeomail@ga.gov.au

Related articles/websites

Geoscience Australia's Rapid Inventory Collection System (RICS)
www-approval.ga.gov.au/hazards/our-techniques/data-collection/data-acquisition/rapid-inventory-collection-system.html

The University of Adelaide
www.adelaide.edu.au

The University of Melbourne
www.unimelb.edu.au

National Waste Management Sites Spatial Database

Geoscience Australia's new National Waste Management Sites Spatial Database contains basic location information for approximately 1700 waste management facilities across the Australian continent and external territories. This data coordination and capture has been a cooperative effort involving all state and territory governments, local councils, Australian Government departments and agencies and industry bodies.

The database has been developed as an authoritative geographic information source on landfill sites, waste reprocessing facilities and waste transfer stations. Data sources used to identify and verify waste management sites included Geoscience Australia's satellite imagery and information from a number of waste-related industry and government databases as well as consultation with state and local government agencies which provided the source information.

Figure 1. Sample output from the new National Waste Management Sites Spatial Database showing landfill sites, waste reprocessing facilities and waste transfer stations in the area around Hobart, Tasmania.

A unique site identification number links the Database to data maintained by state and local government agencies and industry bodies. This enables Geoscience Australia to both maintain the database and provide the other agencies with a link to cross-reference and access waste facility information through Geoscience Australia's database.

This 'first of a kind' public database is a valuable national asset that will have significant importance for Australia's waste management industries, community interest groups and all levels of government (figure 1). Clients of the agency, including Australian Government agencies and industry bodies, are already using the database to assist in evidence-based scientific studies as well as inform government policy development and decision-making. Current applications include:

in brief

- Spatially verifying waste management information underpinning departmental publications on *National Waste Policy* and *Australian Waste Classifications* for the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC)
- Undertaking assessments on the proximity of waste and recycling facilities to communities. These assessments will potentially guide policy decisions on the expected influx of analogue television sets and radios into the waste cycle as Australia moves to digital broadcasting
- Assisting the assessment and analysis of emissions from solid waste disposal sites in Australia's National Greenhouse Accounts, as part of Australia's reporting obligations under the United Nations Convention on Climate Change and Kyoto Protocol
- Informing government policy decisions regarding the centralisation of waste sites (landfills to waste transfer stations)
- Assisting with the identification and management of hazardous waste sites
- Spatially analysing results for future Australian Bureau of Statistics Environmental-Economic Account reports (Waste Account)
- Improving the assessment of waste catchment areas
- Spatially assessing facility longevity
- Assisting studies of sites that may be suitable for methane power generation.

Geoscience Australia is currently in the final phase of completing the second release of the National Waste Management Sites spatial database. Scheduled for release in mid-December 2011, the updated version will include updated site information, improved spatial location accuracy for sites previously assigned a low spatial accuracy confidence, and an additional 300 facilities identified following stakeholder consultation. Future updates will be available through Geoscience Australia's website.

For more information

email ausgeomail@ga.gov.au

Related articles/websites

National Waste Management Database

https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=72592