

## Geoscience research

Australia has the third largest ocean territory in the world but only 12 per cent of the sea floor in our Exclusive Economic Zone has been fully mapped. Much of our deep ocean remains unexplored and unknown.

*Investigator* is equipped with advanced geoscience equipment to take a range of measurements of the sea floor and beneath.

Attached to the ship's hull is a steel housing called a gondola, which contains advanced sonar technology. Acoustic signals are emitted in a beam that is 30 km wide in water depths to 11.5 km to reveal, in 3D, seafloor features such as deep sea canyons and mountains.

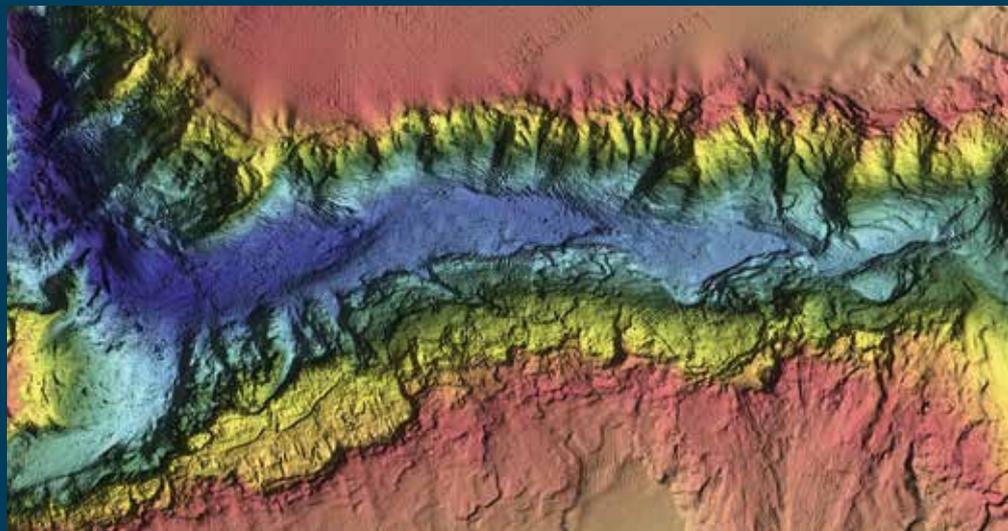
*Investigator* has sophisticated equipment to probe the make-up of the seabed and below. The sub-bottom profiler, contained within the gondola, sends sonar pulses that can penetrate up to 100 m into the sea bed to reveal the geological composition below.

The gravity meter on board *Investigator* will allow researchers to study large geological features in the earth below our oceans.

Geoscientists will also use towed camera systems to record geological images up to six kilometres below the ocean's surface. The cameras are equipped with lights and flashes to capture video and photographic images to examine seafloor features such as hydrothermal vents and other deep sea habitats.

Further research can be undertaken by taking samples of the sea floor and sea bed, and geologists use many different devices to do this.

A Sherman sled can be towed behind the ship to collect biological samples, sediment and small loose rocks.



The Smith McIntyre grab works like two hands scooping up to collect a sample of the top few centimetres of sea floor. The multi-corer collects mud and the small animals living in the first 50 cm of the sea floor with little disturbance. It has six thick polycarbonate tubes that can collect small cores. The vibro-corer is a long steel tube that vibrates to push it up to six metres into the sea floor. It is used on sandy sediments where other corers are not effective. The long and short sediment corer can take samples of other sediments up to 24 m in depth.

Cores must be kept at 4°C for long term archival and storage. They are used by scientists to look back in time over hundreds of thousands, and sometimes millions of years, to understand changes in the Earth's oceans, land, and atmosphere.

Equipment can also be towed behind the ship to collect data, such as a marine magnetometer, which is used to find magnetic anomalies created by minerals such as iron (including ship-wrecks) and a side scan sonar that can be towed within a few metres of the seafloor to provide detailed images of dunes and rocky reefs, and plants and animals.

Creating maps of the sea floor helps us understand ecosystems, discover canyons, mountains and ancient river systems, and other geological features.

Geoscience research will also help provide a greater understanding of the changing dynamics of the ocean floor such as the movement of tectonic plates, which can trigger tsunamis.

# Equipment capability

## Autonomous sea surface temperature (SST) radiometer

The SST radiometer uses infrared radiation measurements to determine the temperature of the sea's surface.

## Corer boom

A starboard boom from the deployment of equipment from the side of the vessel, with a load limit of 20 t. It can be used for deploying long and short sediment corer, benthic grabs, bongo nets etc.

## CTD

A device used to profile the conductivity and temperature of the water column. Extra sensors can be added to measure other variables such as phytoplankton, oxygen fluorescence and turbidity.

## 24 bottle carousel and frame

A cluster of 24 water sample bottles and sensors that is attached to a CTD.

## 36 bottle carousel and frame

A cluster of 36 water sample bottles and sensors that is attached to a CTD.

## Trace metal CTD system

Including a trace metal clean winch 12 bottle trace metal CTD. Trace metal clean chord to 300 m which can be connected to further wires to an ultimate depth of 6,000 m.

## CTD deployment boom

The CTD laboratory is a complete system for CTD deployment and recovery.

## Dissecting microscopes and peripherals

Dissecting microscopes for general laboratory use.

## Forward looking drop keel camera

A drop keel mounted camera for monitoring scientific equipment and marine life.

## Full ocean depth multibeam system

The Kongsberg/Simrad EM122 is a deep water 3D sea floor mapping system, capable of working to full ocean depth.

## Gravity meter

The Lacoste and Romberg L and R Air-Sea Gravity System II is a gyroscopically stabilised instrument used to measure variations in the Earth's gravitational field.

## Long and short sediment coring system

A complete long sediment coring and winch system that collects cores 6–24 m in length. The 3.5 t corer is deployed by winches and a dedicated handler on the starboard side of the main deck. It can be deployed as a piston corer, or as a gravity corer.

## Magnetometer

A geophysical instrument used to survey the Earth's magnetic field, the SeaSPY Marine Magnetometer, weighs 18 kg and comes with 50 m of tow cable housed in a freewheel wireless cable spool. Available by negotiation with Geoscience Australia.

## Multibeam scientific and fisheries echo sounder system

The Kongsberg/Simrad ME70 is a fish biomass sonar system located in the gondola, which spreads a signal in a fan shape to 120°, collecting data to 500 m depth and 3,000 m wide.

## Multicorer

The K-C multicorer 70.000 is a coring system that takes multiple core samples to a sediment depth of approximately 50 cm with each deployment.

## Multi-frequency hydrophones

Four hydrophones are mounted in different locations along the keel, which are used to detect and record underwater acoustics, including the noise made by the vessel as well as noise from the ocean.

## Multi-frequency scientific split-beam echo sounders

The EK60 system with transducers working at 18kHz, 38kHz, 70kHz, 120kHz, 200kHz and 333kHz.

## Milli-Q systems

An ultra-pure filter for water in the laboratories. The outlets are located in the Hydrochemistry, Preservation, Clean Wet and Dry Laboratories, and water is also available for use elsewhere onboard.

## Rock dredges

Consisting of a metal frame attached to the mouth of a chain bag, the rock dredge is deployed behind the moving ship and used for sampling larger rocks on the ocean floor.

## Shallow water multibeam scientific echo sounder system

The Kongsberg/Simrad EM710 is a high resolution seabed mapping system with a flexible configuration for acquiring bathymetry and back scatter data down to 2,000 m.

## Sherman sleds

Two epibenthic sleds can be used to sample benthic organisms over rough areas of sea floor such as seamounts.

## Side scan sonar

The Edgetech 4200FS series side scan sonar with hydraulic winch is available by negotiation with Geoscience Australia.

## Smith McIntyre grab

This is a sampling device that uses bucket-like jaws to collect ocean sediments in a discrete sampling area.

## Sound velocity probe

The sound velocity probe is located in the drop keel and is an integral part of the sea floor mapping sonar systems. It is used to measure the speed of sound.

## Sub-bottom profiler integrated with 12kHz multibeam

The Kongsberg SBP120 is a sub bottom profiler used to investigate composition below the sea floor. It can be operated with both the EM710 and the EM122.

## Thermosalinograph

Continually measures surface temperature and salinity along the track of the ship using the underway seawater system originating in the drop keel and the output is located in the CTD laboratory.

## Trawl monitoring systems

A system to report on the status of a towed trawl net. The system reports the height, width and depth of the mouth of the net.

## Ultra short baseline (USBL) acoustic positioning system

The USBL system that determines the position of instruments deployed off the side or the stern of the ship, reporting their position relative to the ship.

## Underway water analysis instruments

These instruments are located in the underway seawater laboratory and measure pCO<sub>2</sub>, O<sub>2</sub>, and chlorophyll, and they include bio-optical sensors.

## Vibro-corer

Used to retrieve continuous, undisturbed core samples. Available by negotiation with Geoscience Australia.

