A new ship for polar research

South African research has a new ship. **Mike Lucas** tells us about the new polar research and supply ship, SA *Agulhas II*.

After nearly 35 years of service, South Africa's well-travelled and much-loved but aging polar research and supply vessel, SA *Agulhas*, was retired in April 2012 after its final voyage to Marion Island, 2000 km south towards the Southern Ocean. Affectionately known as 'the little red taxi' that rolled and plunged its way through the tempestuous Southern Ocean, SA *Agulhas* has been replaced by SA *Agulhas II*, a vastly more modern, larger and more powerful R1.3 billion state-of-the-art polar supply and research vessel. Built in Finland, the new ship was handed over to South Africa's Department of Environmental Affairs (DEA) at the Rauma yard on 4 April 2012. She arrived at the V&A Waterfront, Cape Town on 3 May. SA *Agulhas II* is managed by Smit Amandla Marine (PTY) Ltd.

SA *Agulhas II* is world-class, so how can such a ship and her price-tag be justified here? The answer to this question lies in our rich heritage as well as our geographical and historical ties to the Southern Ocean, Antarctica and the sub-Antarctic Prince Edward Islands, a South African maritime outpost.

South Africa occupies an almost unique geographical position as one of the three major 'gateways' to Antarctica, along with South America and Australia/New Zealand. South Africa is also an original signatory to the Antarctic Treaty, which was signed on 1 December 1959 and ratified in 1960. The treaty's purpose is to set aside and protect Antarctica, its surrounding sub-Antarctic islands and the Southern Ocean (mostly south of 60°S) solely and permanently for peaceful purposes and for cooperative scientific research.

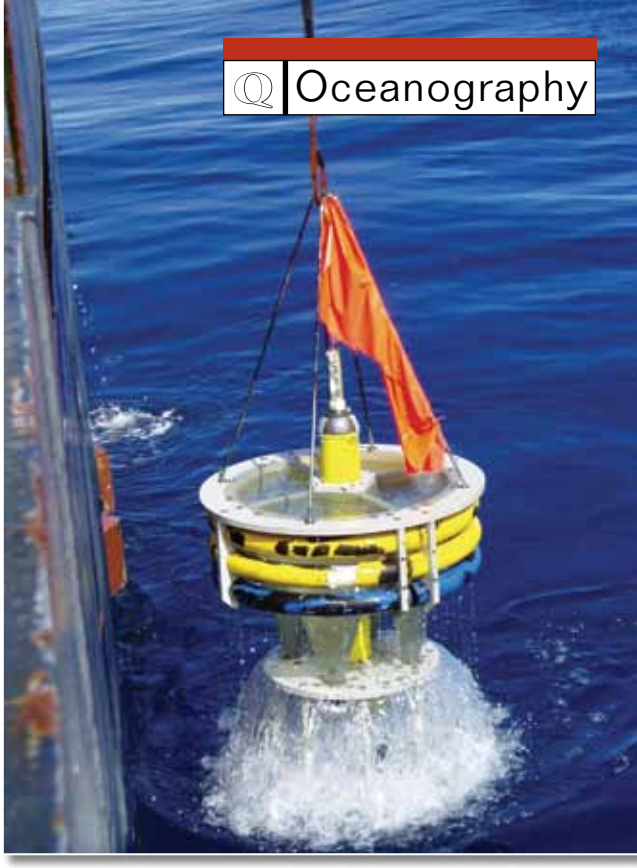
One of the conditions of being part of this treaty is that we must maintain a base on Antarctica (SANAE IV) and engage in cooperative research activities. The South African National Antarctic Programme (SANAP) fulfills this role by maintaining a presence on Marion Island that includes managing Marion and Prince Edward Islands and the surrounding 200 km exclusive economic zone (EEZ) as South African territory.

SANAE IV conducts various forms of cutting-edge research in the fields of astronomical, atmospheric, meteorological, geological and life sciences research throughout the year. An important meteorological station is also supported on Gough Island.

SANAP's brief includes providing logistical support for oceanographic research and weather observations in the Southern Ocean, particularly in the context of marine living resources and climate change.

The SA *Agulhas II* will serve as a mobile scientific research laboratory for oceanographic and biological research, while continuing in its predecessor's role of deploying and collecting weather buoys as part of an international collaborative effort to provide a national and global weather prediction service. The new ship will also support the research base on Marion Island as well as servicing the South African meteorological station on Gough Island in the southern Atlantic Ocean, a UNESCO World Heritage Site that is leased to South Africa by Britain.

The capability of the new SA *Agulhas II* is far superior to its predecessor. Capable of a maximum speed of 18 knots (using 40 tonnes of fuel a day), SA *Agulhas II* (134 m length x 22 m width x 7.7 m draft and 12 897 gross tonnage) has a range of 15 000 nautical miles (27 000 km) at 14 knots (using 14 - 25 tonnes of fuel a day) and can stay at sea for 90 days. The ship has considerably



Above: SA Agulhas II *at its V & A Waterfront berth in Cape Town.* Image: Mike Lucas

Left: SA Agulhas II *undergoing sea-trials during winter in the Baltic Sea.* Image: STX

Right: PELAGRA is a free-floating sediment trap developed at the National Oceanography Centre, UK. It can be programmed to sink to any depth to about 400 m or so where it captures sinking particles known as 'marine snow'. Image: Mike Lucas

in South Africa

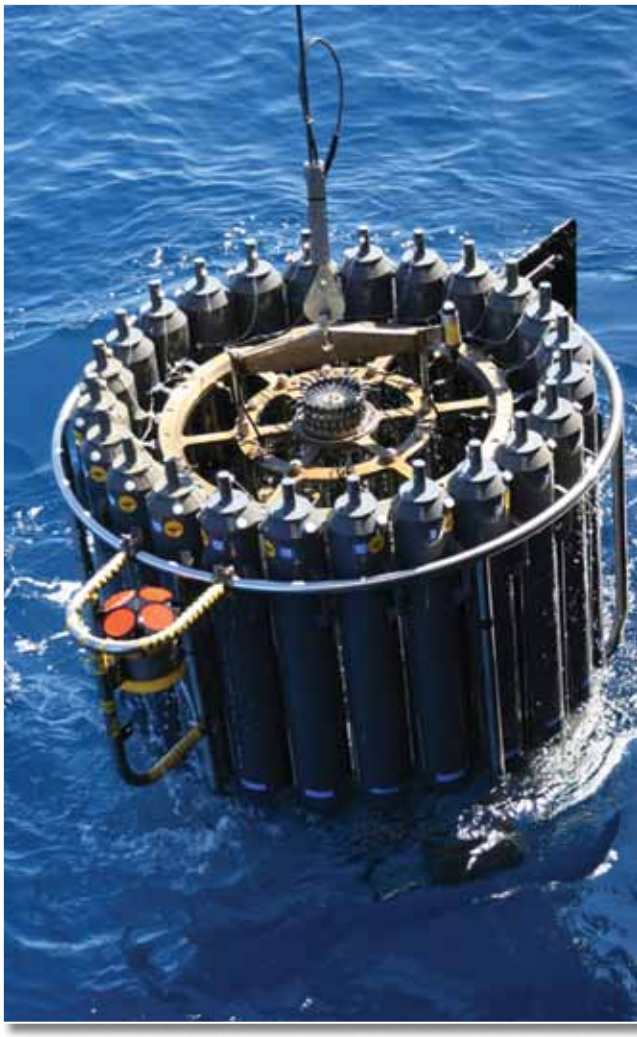
better ice-breaking capability (DNV Ice 10, PC 5) than the old SA *Agulhas* and is able to break through 1 m thick ice at 5 knots. It manages this because of its powerful diesel electric propulsion system (4 x 3 000 kW main engines) that delivers more than double the power of the old SA *Agulhas*, combined with a bow and underwater ice-knife design that allows it to operate even in winter sea ice conditions. Powerful bow and stern thrusters easily manoeuver the ship sideways or backwards and a computer-controlled dynamic positioning GPS system allows the ship to accurately maintain position, or be programmed to steam to any designated way-point.

The ship carries up to 98 passengers (including 35 scientists) and 52 officers and crew in comfortable one-, two- and four-berth cabins, each with internet, satellite TV, bunk(s), day-chairs and desk(s). Passenger facilities include an internet-connected 'business centre', a serviced dining room, a number of lounges, numerous bars, a library, a lecture theatre, a gym, a hospital and even a sauna.

Passengers and scientists can be transported ashore either by semi-rigid ski-boats, or in the two Oryx helicopters that the ship carries, which are also used for cargo transport.

As a floating science platform, the ship is almost unmatched, with eight permanent laboratories covering 800 m^2 of floor space, and six portable and fully serviced 8.5-metre container laboratories that can be secured beneath the heli-deck. A completely novel feature is the 2.4 x 2.4 m 'moon pool' – rather like a lift shaft – which extends from the 'scientific environmental hanger' down through three decks and through the ship's hull.

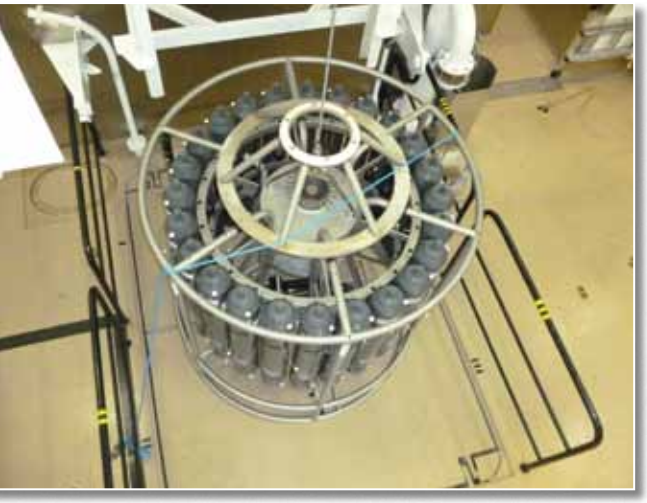
This allows large sampling instruments to be lowered into the ocean even when the ship is surrounded by ice, or in heavy weather when conventional over-the-side instrument deployments are risky. Another innovative feature is a 'drop keel' carrying sensitive echo-sounders that can be lowered 3 m beneath the hull, where it is acoustically quiet, to track the ocean floor or to measure ocean currents and the presence of fish and other small organisms. In the large environmental hanger, winches with 6 000 m of steel conducting cable allow deep-water instruments to be lowered to the ocean floor to make real-time measurements of the ▷▷



A rosette of filled (24 x 20 litre) water-sampling bottles is hoisted on-board with a steel conducting cable. The orange instrument is an upward looking Acoustic Doppler Profiler (ADCP) that measures current velocities by tracking particle movements in the water. Image: Mike Lucas

Left: SeaGlider, developed at the University of Washington, USA, is a freely roving craft that can be deployed at sea for many weeks. Undulating from the surface to depths of about 500 m it travels slowly through the ocean and transmits data back to a lab at sea or on-shore via satellites. Image: University of Washington.

Left below: A rosette of 24 x 20 litre water-sampling bottles stands on top of the trap-door access to the 'moon pool'. The circular 'docking head' on top ensures the rosette can be carefully lowered through the hull below the ship. Image: Mike Lucas



The lecture theatre on SA Agulhas II. Image: Mike Lucas

A well-equipped gym for passengers offsets the effects of too much good food! Image: Mike Lucas

physical properties of seawater (e.g. temperature, salinity, oxygen content), while also capturing water from any desired depth using electronically triggered closing bottles.

Experiments and measurements using retrieved water samples can be made in the permanent on-board labs as well as in the portable container labs.

The stern of the ship has a telescopic 'A-frame' that allows instruments, including nets and dredges, to be deployed, retrieved or towed from the stern. These capture biological specimens that allow biodiversity to be assessed, a good indicator of the 'health of the oceans'. Remotely controlled or free-diving underwater vehicles (ROVs), including floats and 'gliders' that measure various ocean parameters, are also deployed from this position and later transmit recorded data back to the ship via satellites.

Sea-bed sediments can also be sampled at depths down to 5 000 m using deep-corers – rather like pushing a piece of plastic rainwater drain-pipe into the ground. By examining sediment layering and preserved microscopic organisms called foraminifera, such cores can provide a 'window' into Earth's past climate.

Right at the top of the ship, perched above the 'navigation bridge' 24 m above sea-level, there is an enclosed observation tower that allows scientists to observe and record the numbers and movements of birds, seals and whales. Happily, Southern Ocean whale populations are recovering after the devastation caused by unregulated whaling activities over 60 years or so from the 1900s to 1965.

One of the main functions of the ship is to re-supply SANAE and the other island bases. This is where the ship doubles up as a cargo vessel, with a capacity for 4 000 m^3 of cargo – a volume equivalent to two Olympic-sized swimming pools. The ship can also carry 2 600 tonnes of diesel for the bases, as well as 30 tonnes of lubricant and 250 tonnes of fresh water. To renew this supply, the ship makes its own fresh water from an on-board desalination plant. Equipment and materials can be lifted ashore with a crane on the foredeck capable of gently putting a 35 tonne load onto a 20 m high ice-shelf 25 m away. Alternatively, materials can be flown ashore by helicopters.

The first short sea trials cruise to test key scientific equipment took place from 14 to 18 June 2012, mostly in False Bay. Apart from the usual teething problems, all the ship's equipment performed well, allowing SA *Agulhas II* to go on a subsequent three week shake-down cruise down to the ice at nearly 60°S in July 2012, where the first oceanographic data were collected along the GoodHope monitoring line. As with any new ship, some teething problems remain that can, however, be resolved. The challenge now for DEA and SANAP is to effectively manage and accommodate the often conflicting demands of logistical support, supply and science on a multi-user ship. What is clear, however, is that SA *Agulhas II* will maintain South Africa's leadership position over the next 20 – 30 years as a global player in Antarctica and the Southern Ocean. In doing so, it will provide a platform to educate and train the next generation of national and international polar research scientists. ❑

Associate Professor Mike Lucas is employed within the University of Cape Town's Zoology Department. The ship-building project was led by Project Manager, Mr. Alan Robertson, Deputy Project Manager, Ms. Sharon 'Shaz' du Plessis and a team of specialist technical (Mr. Eric Walker), nautical (Captains David Hall and Freddie Ligthelm) and scientific advisors from DEA and a number of South African institutions.