

Fieldwork on the seafloor: we are getting close

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Marine scientists studying the seafloor always have to deal with the fact that the research vessel they are sailing with will be separated from the object they wish to study by several kilometers of water. Technological developments are helping IFM-GEOMAR scientists to overcome this problem and producing astounding results.

Imagine asking someone to describe the environment and culture of the Alps while at the same time forbidding them to go within three kilometres of what they should describe. Ridiculous, you might say. But it is exactly the situation faced by scientists studying the seafloor. Even making a decent map of the seafloor is a difficult task - the best ship-mounted sonars in the world cannot overcome the physics of sound travelling in water so the resolution of such sonars (the "pixel size") is at best in the range of 10's of metres.

The only solution is to use deep submergence technology to bring sensors close to or onto the seafloor where they can study the environment in much more detail. IFM-GEOMAR is using a three-pronged approach to this problem - landers for long term observations at one seafloor site, remotely operated vehicles ("hands and eyes on the seafloor") for carrying out experiments and precise sampling and visual observation of the seafloor and the newest addition to the fleet, an autonomous underwater vehicle ("AUV") named ABYSS.

ABYSS is a cigar-shaped vehicle approximately four metres long and weighing 900kg in air (see photo). It is powered by lithium batteries which deliver about 11kWh of power, allowing the vehicle to operate for up to 24 hours without recharging.

On board the vehicle are numerous sensors for measuring, for example, the seafloor bathymetry (with a resolution of much less than 1 metre), the acoustic hardness of the seafloor (enabling a distinction to be made between soft sediment and hard rock, for example) the temperature, salinity, clarity and Eh (a measure of the oxidizing or reducing nature) of the water. The vehicle can also be re-configured to take still photographs of the seafloor and measure sediment thickness.

The first scientific deployments of ABYSS have concentrated on mapping the seafloor in great detail and have returned amazing scientific results. As the vehicle was acquired as part of the DFG Priority Programm 1144 which focussed on mid-ocean ridge proc-

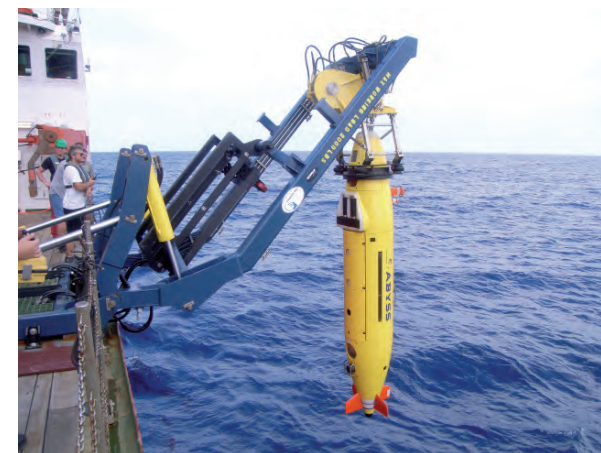


Figure1: ABYSS in its Launch and Recovery System, ready to start a new dive to the seabed.

esses, it is hardly surprising that ABYSS went to the ridge areas first.

The initial scientific dives were in the Atlantic in an area known as Lilliput. This area had previously been mapped by the AUV "ABE" from the Woods Hole Institution and so the area was a good place to go to test just what ABYSS was capable of. The results were astounding. ABYSS collected data with its state of the art RESON 7125 multibeam sonar at both 200 and 400kHz, enabling us to produce maps which for the first time allowed volcanological interpretation of the seafloor based on its bathymetry. An example is shown in Figure 2.

The second scientific mission saw ABYSS deployed in the Woodlark Basin, east of Papua New Guinea. Here again the target was a spreading axis, this time dominated by small

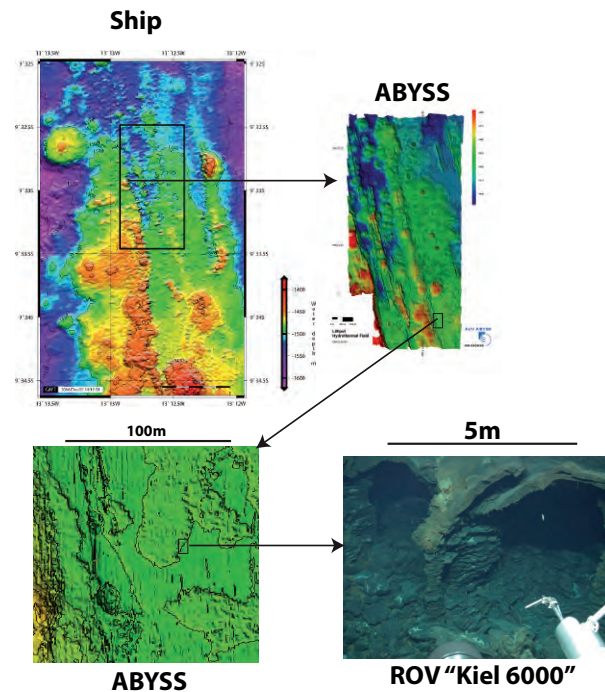


Figure 2: The advantages of getting close to the seafloor: ABYSS's high-resolution map of the seafloor (top right, compare to best available ship-based map, top left) shows unprecedented detail (bottom left, contour interval two metres). The small "steps" visible on the map are in fact collapse structures in sheet lava flows, as seen on ROV images made in the area.

volcanic edifices. One such edifice, Franklin Seamount, was mapped in great detail (Figure 3).

The resulting map shows a volcanic summit plateau about 800 metres across with a central crater. The plateau shows several volcanic features known from land, where they are associated with moving lava flows. The

central crater has irregular margins suggesting it was filled with magma capped by a solidified crust during the eruption and that when the eruption ceased, magma drained back into the sub-surface and the crust collapsed. Towed video observations in the crater show it to be full of volcanic rubble, supporting this interpretation. No evidence to support the prevailing view that such craters are of tectonic origin (and so bounded by ring-faults) was found demonstrating the power of high-resolution mapping in seafloor research.

The discoveries in the deep being made by volcanologists from IFM-GEOMAR continue apace, thanks to these new technologies. We can expect major breakthroughs in the next few years as it really becomes possible to do "fieldwork on the seafloor".

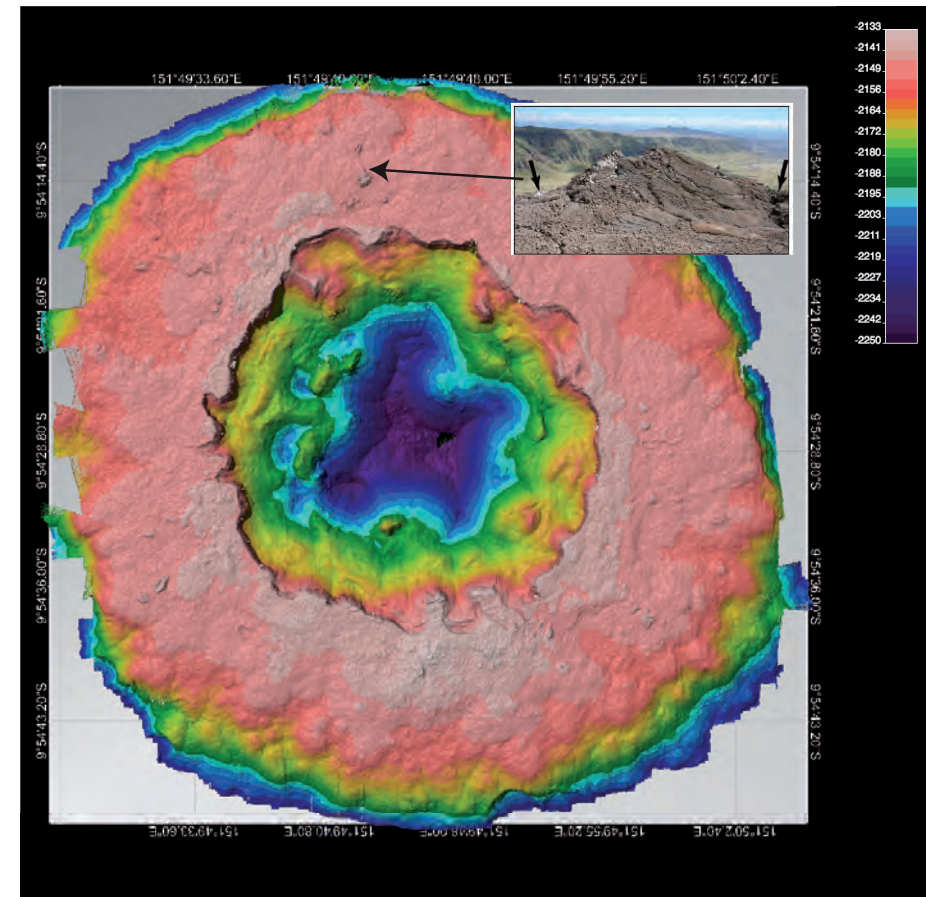


Figure 3: The summit plateau of Franklin seamount. Features such as "tumuli", known from subaerial volcanoes and caused when magma pressure increases below an already hardened volcanic carapace, are clearly visible on the seafloor (see inset).