



Anatomy of a site survey

Combining geophysical and environmental surveys in the Timor Sea

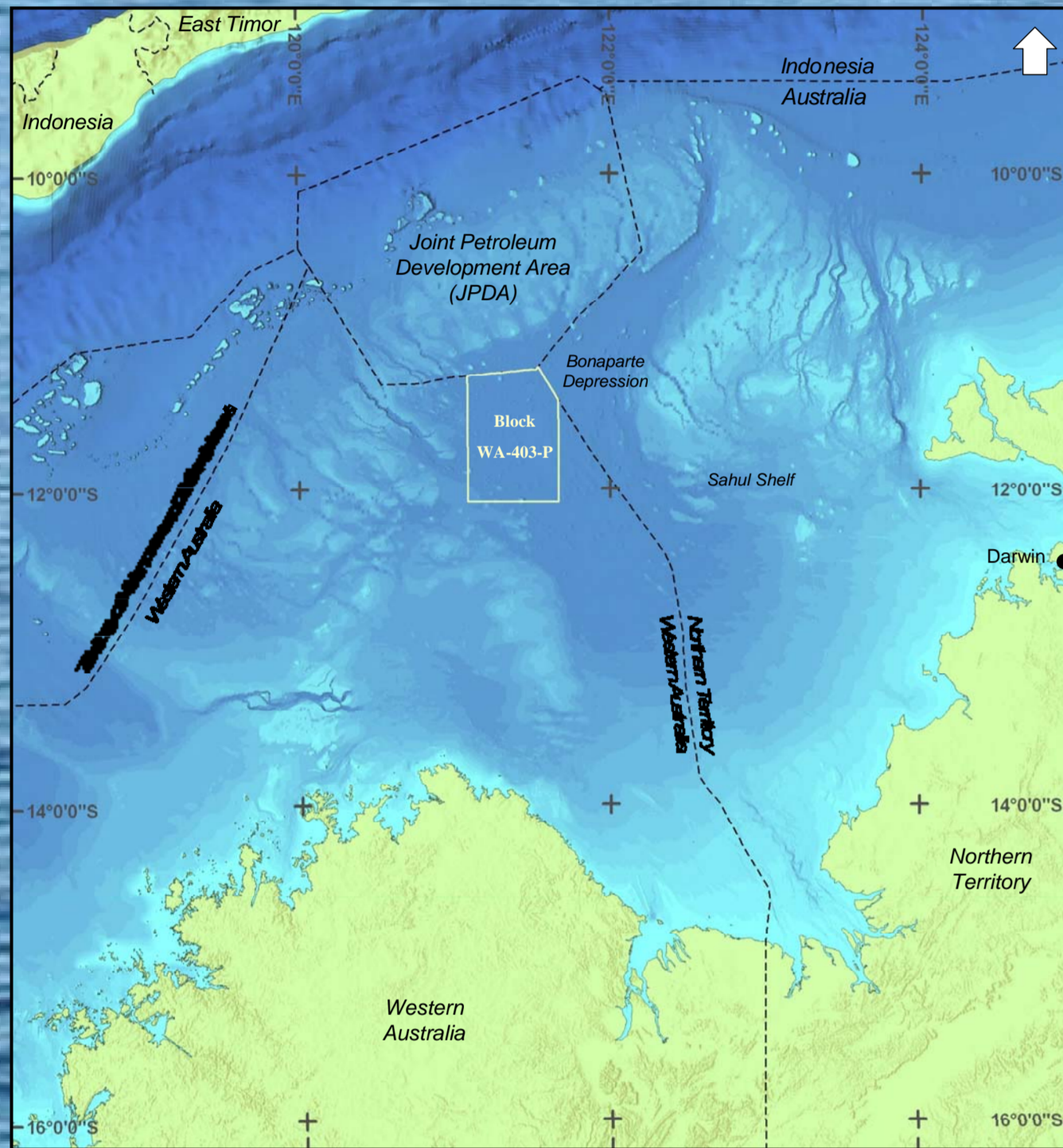


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Fugro was contracted by Total E&P Australia (Total) in 2009 to provide geophysical and environmental baseline surveys prior to a drilling campaign within Block WA-403-P. The block is situated in the Timor Sea, off the northwestern coast of Western Australia.

The geophysical survey work was carried by Fugro Survey Pty Ltd in Perth. The environmental survey operations, carried out the same time and from the same survey vessel, were overseen by sister company Fugro Survey Ltd, based in Great Yarmouth, UK. Also involved were Fugro GEOS, who carried out an analysis of observed tides.

This survey is one of many projects in which various Fugro operating companies, ranging from survey to geotechnical, environmental to ROV, by working to common standards and procedures, are able to come together with a minimum of fuss and provide to the client a seamless end-product.



Objective

The objective of the geophysical surveys was to provide information on the seabed and shallow sub-seabed conditions to assist in the planning and operation of a proposed exploration drilling campaign.

The objective of the environmental surveys was to provide a baseline against which to measure the effects of potential future development.

Vessel and Equipment

Survey operations were carried out from the MV Southern Supporter, operating on a 24 hour per day basis. The MV Southern Supporter is a 75 m long vessel, owned by P&O Maritime Service Pty Ltd but on long term charter to Fugro for geophysical surveys and other offshore services.

Geophysical survey equipment consisted of a single beam echo sounder, Reson 8101 multibeam echo sounder, Edgetech 4200FS digital side scan sonar, Edgetech X-Star sub-bottom profiler (Chirp), Applied Acoustics sub-bottom profiler (surface-towed boomer) and a 3 m gravity corer.

An Aanderaa WLR7 tide gauge was deployed for the duration of the surveys.

Environmental survey equipment included a water sampler, multiparameter water profiler, seabed grab sampler and an underwater video and stills camera.

Regional Setting

One of the most interesting aspects of this region of the Timor Sea are the numerous drowned coral reefs, or palaeoreefs. These reefs have grown upwards over a number of sea-level cycles and are likely to consist of both hard coral growth and Halimeda deposits.

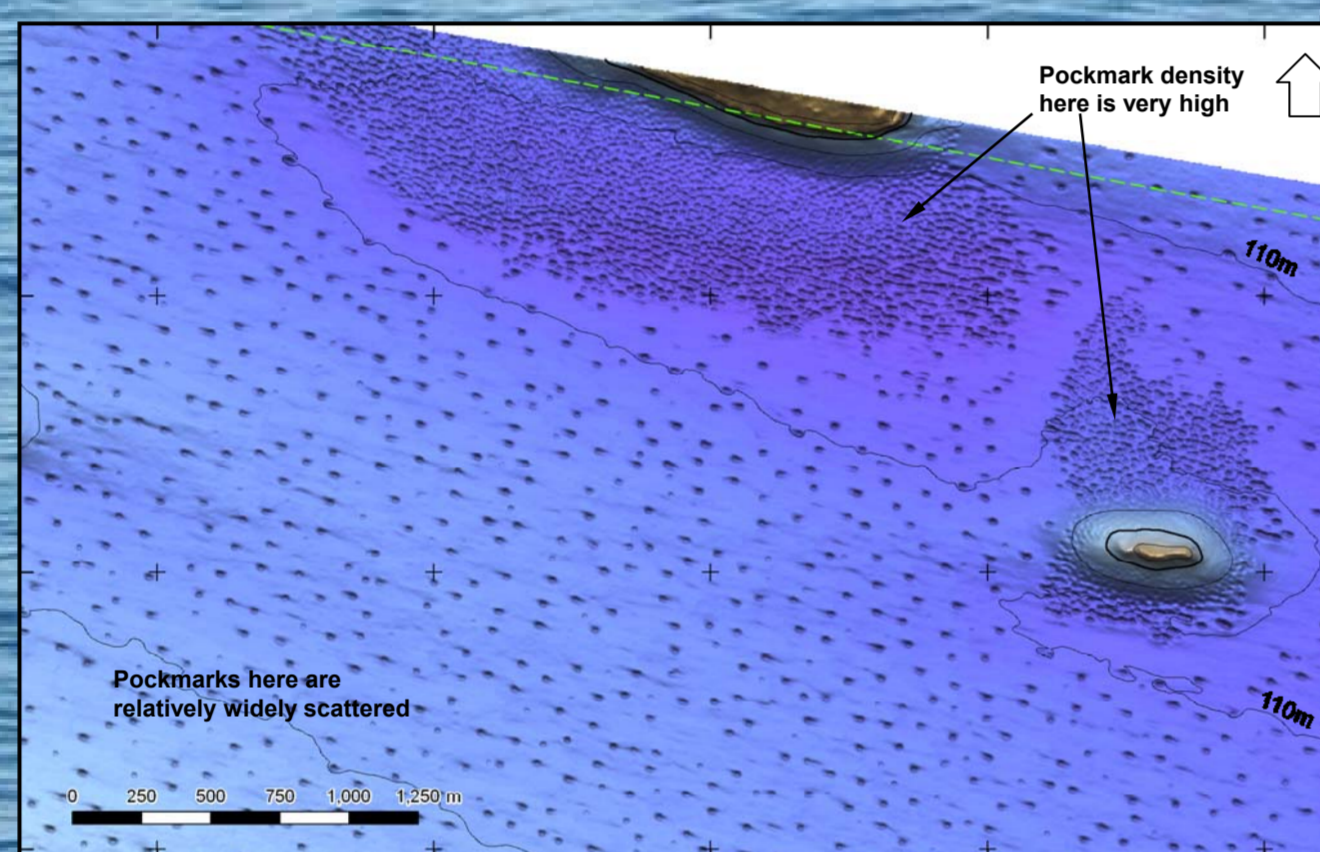
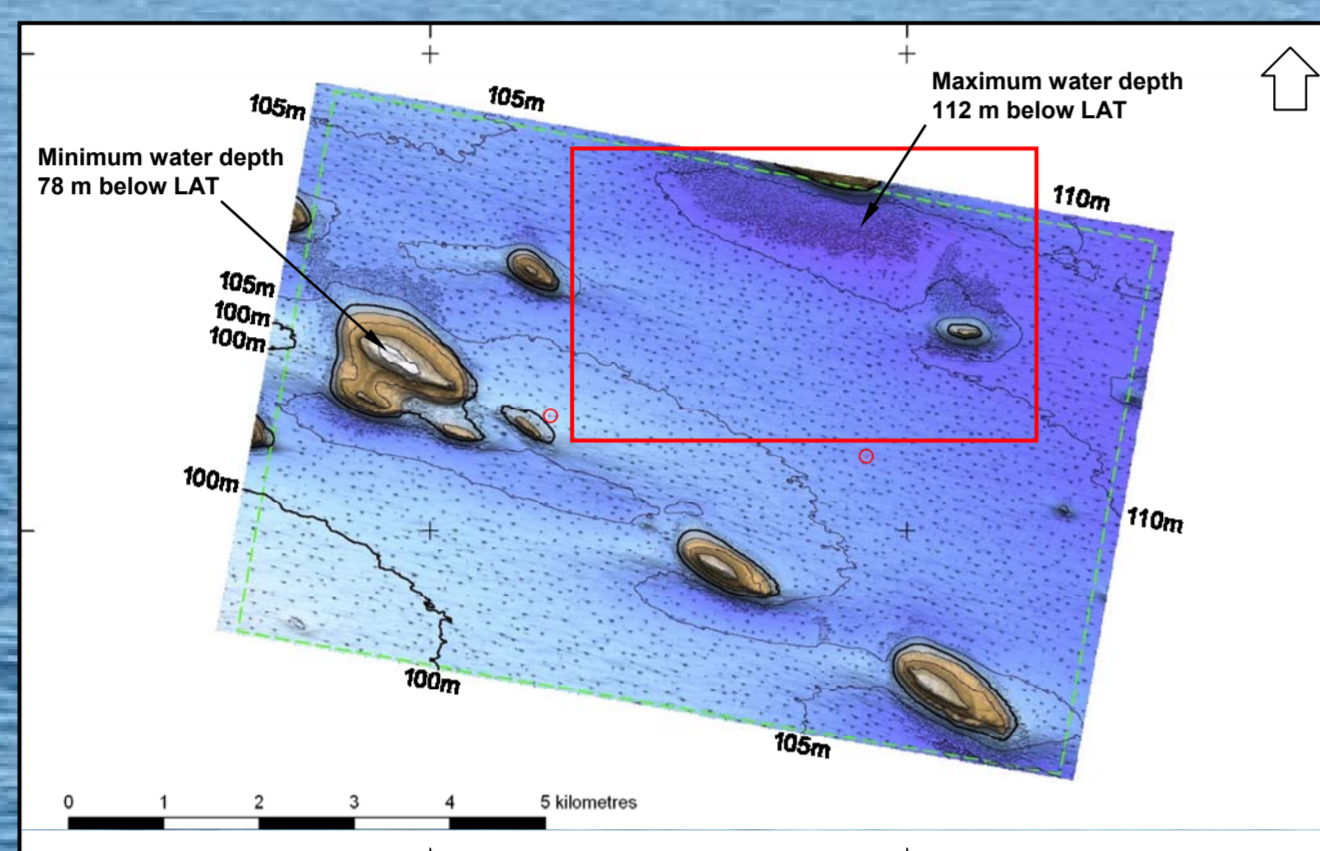
During the last sea level regression the sea-surface dropped by 100 m to 140 m below the present level, resulting in both the sub-aerial erosion and compaction of these features, as well as further growth as the sea level began rising again some 18,000 years before present.

Sea level rose rapidly between 15,000 and 13,000 years before present, inundating the reefs. The present depth of the reefs below the photic zone suggests that they are no longer actively building. Photographs taken of the seabed over top of the palaeoreefs during these surveys reveal a muddy, turbid environment with little evidence of ongoing, hard coral growth.

Bathymetry

Water depth within the site illustrated below ranged from a minimum of 78m below LAT over the large palaeoreef, to a maximum of 112m below LAT.

Typical water depth throughout the main body of the site was 105m below LAT. Images of the bathymetric DTM (digital terrain model) are shown below.



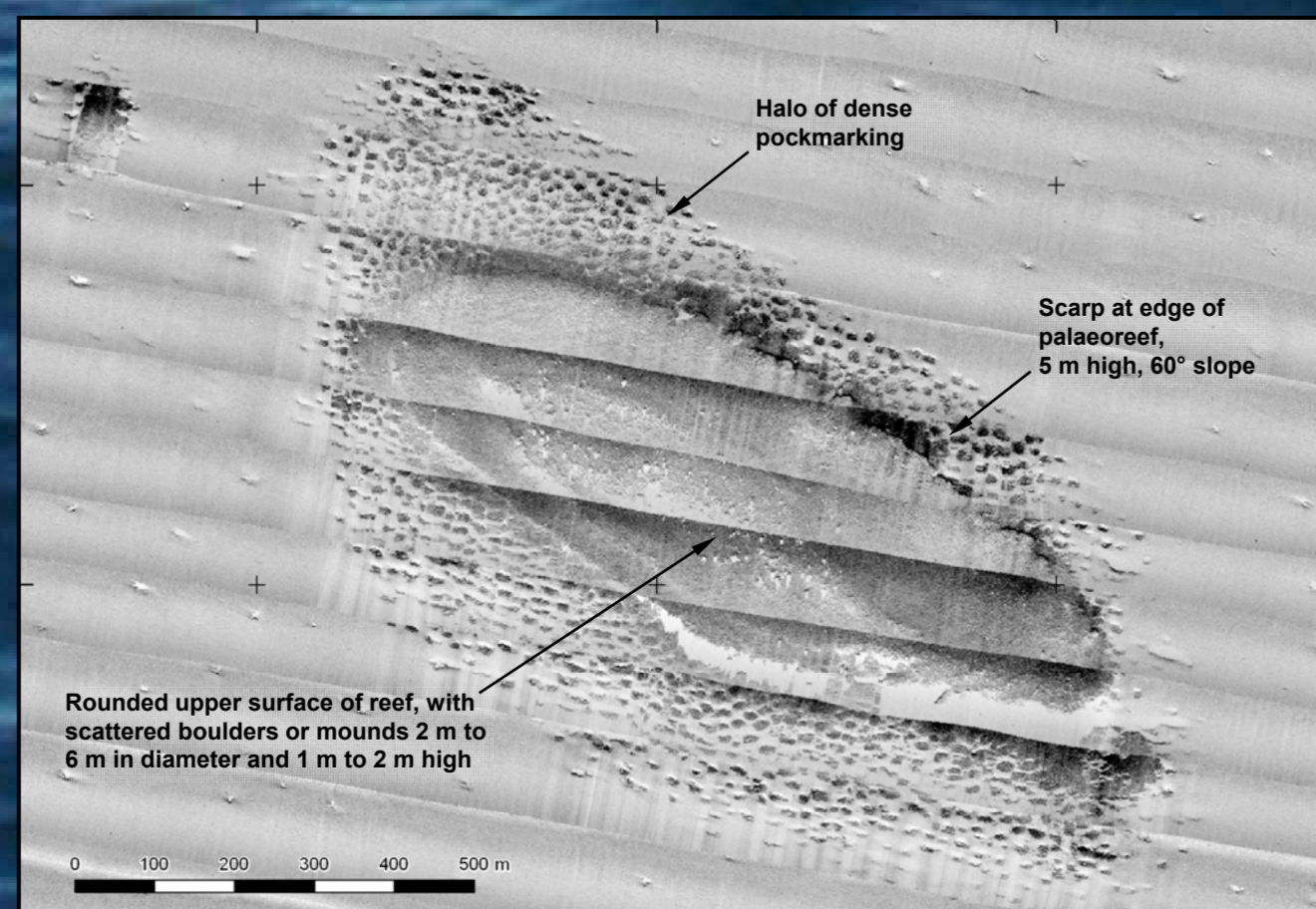
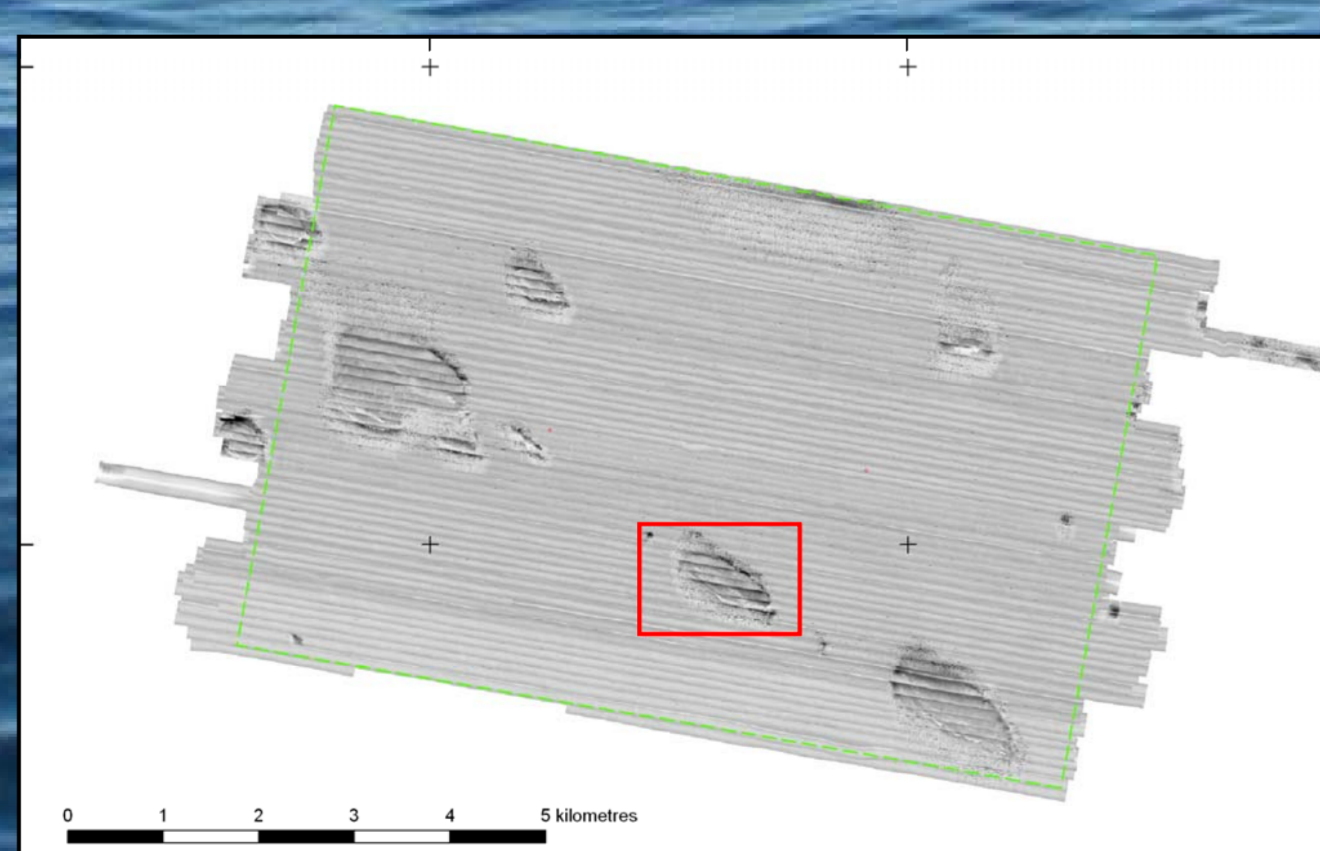
Seabed Features

Based on a number of seabed gravity cores, the seabed within this site was found to comprise predominantly very soft clay.

The main seabed features seen were the relict palaeoreefs and numerous scattered pockmarks.

Pockmarks are shallow depressions in the seabed, in this case between 2m and 60m in diameter and up to 4m deep. To date the origin of pockmarks has still not been fully explained by the scientific community, though general consensus is that they are related to the escape of fluid (water or gas) at the seabed.

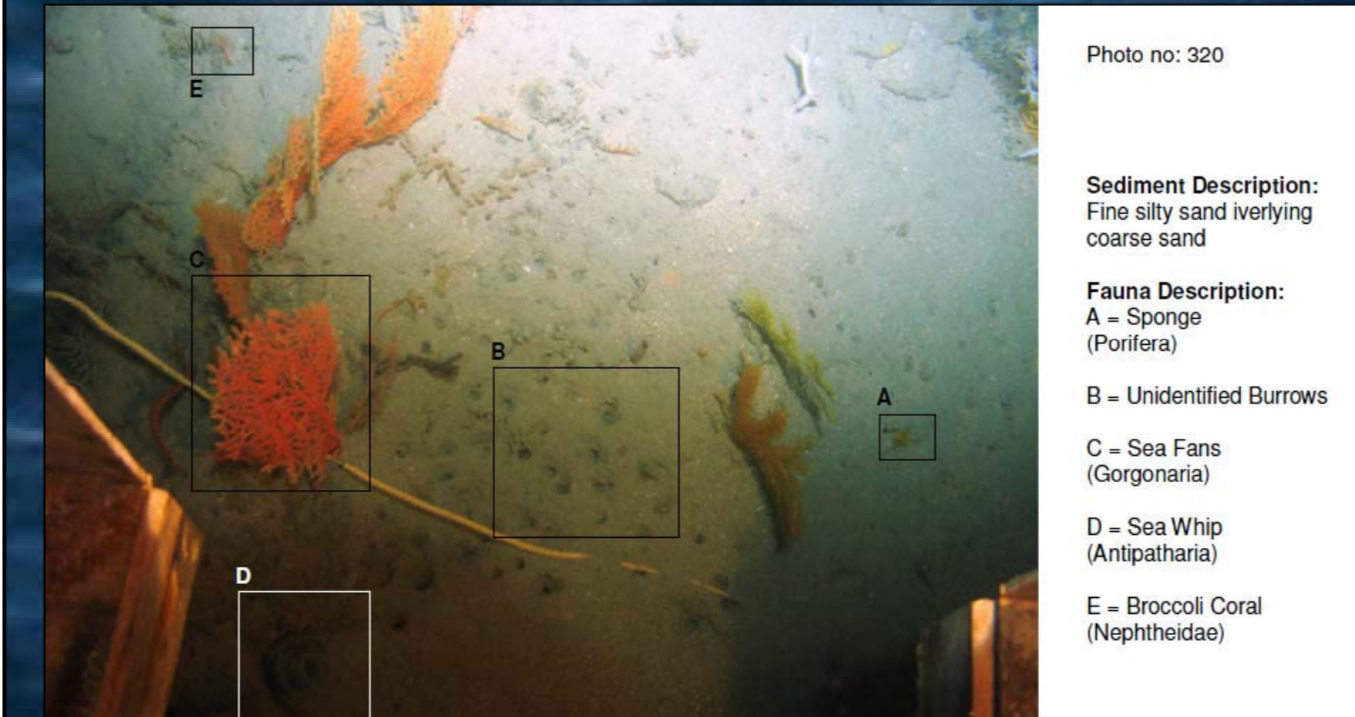
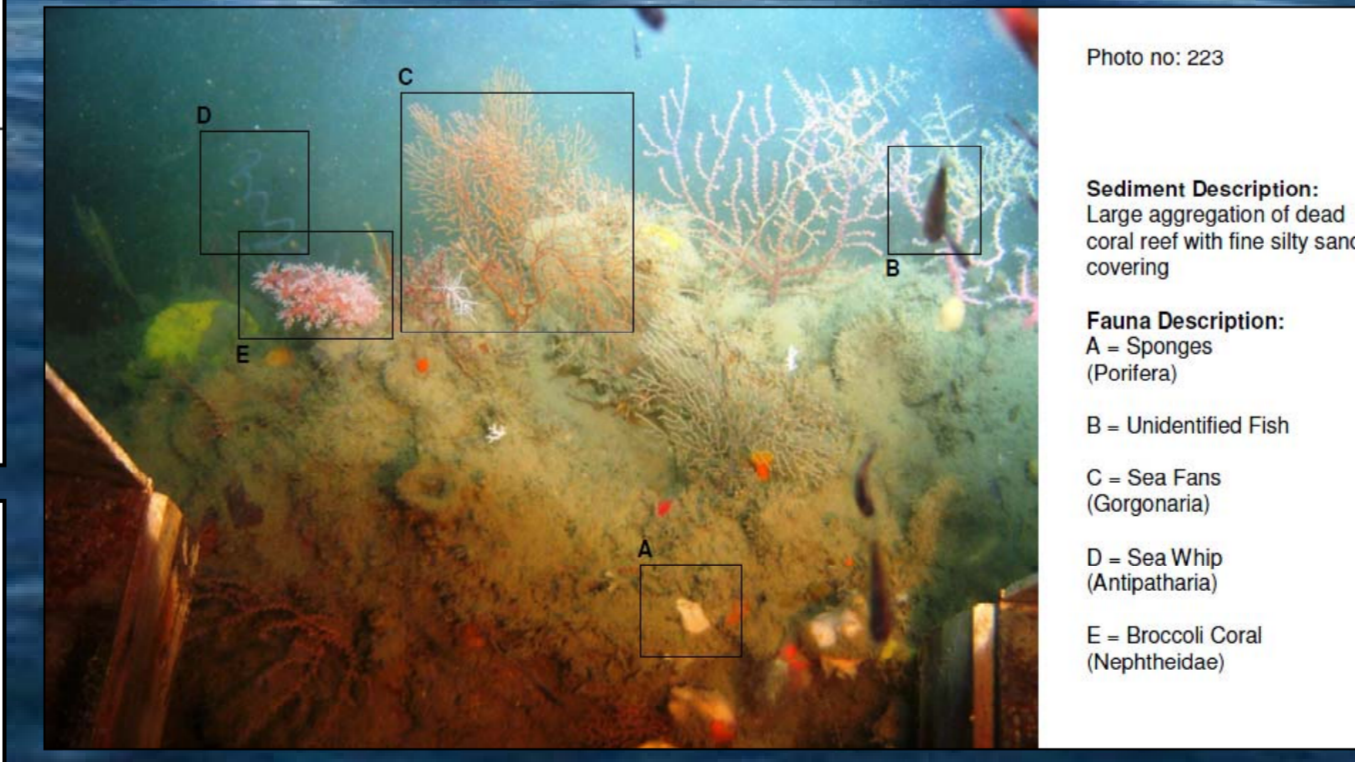
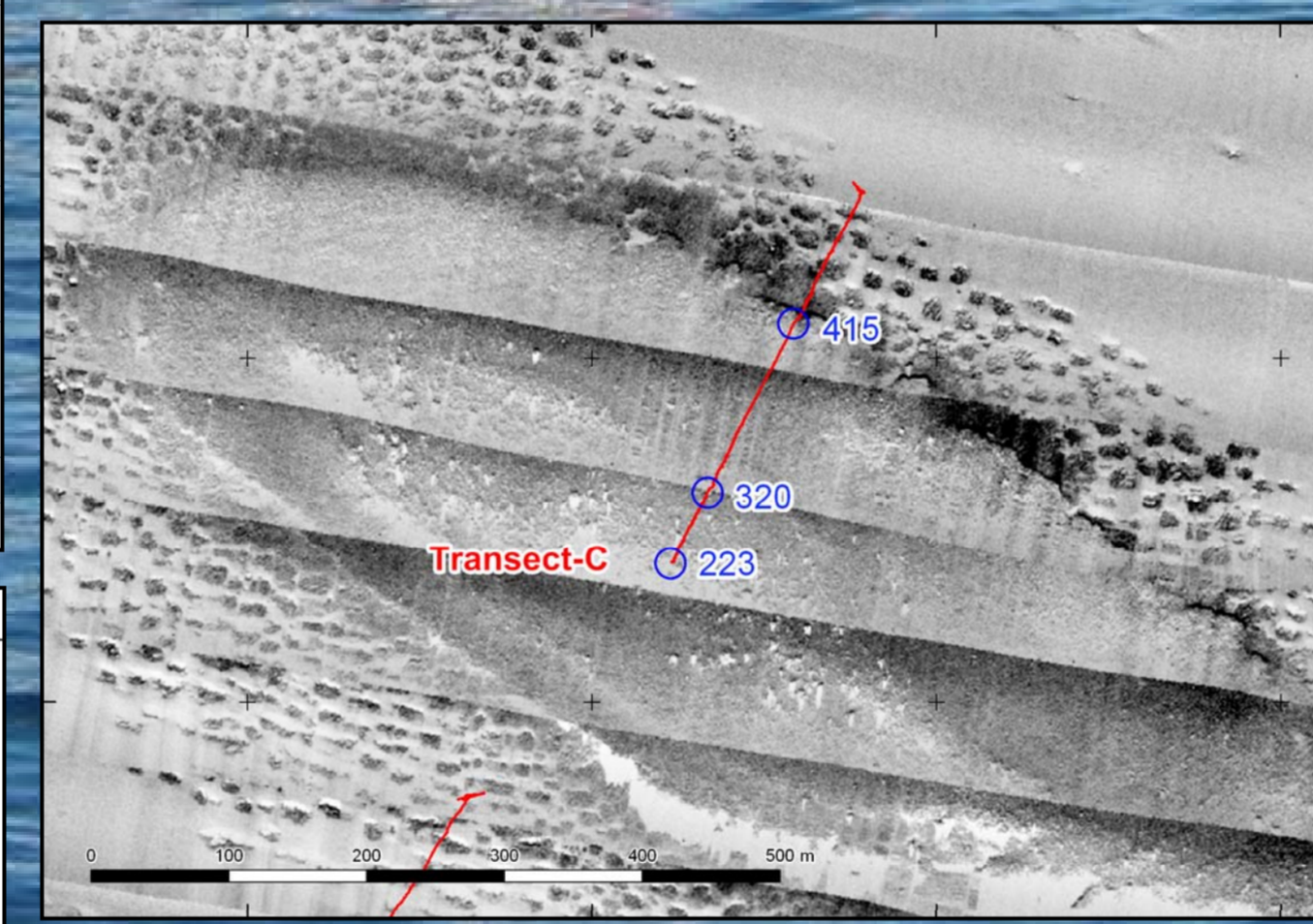
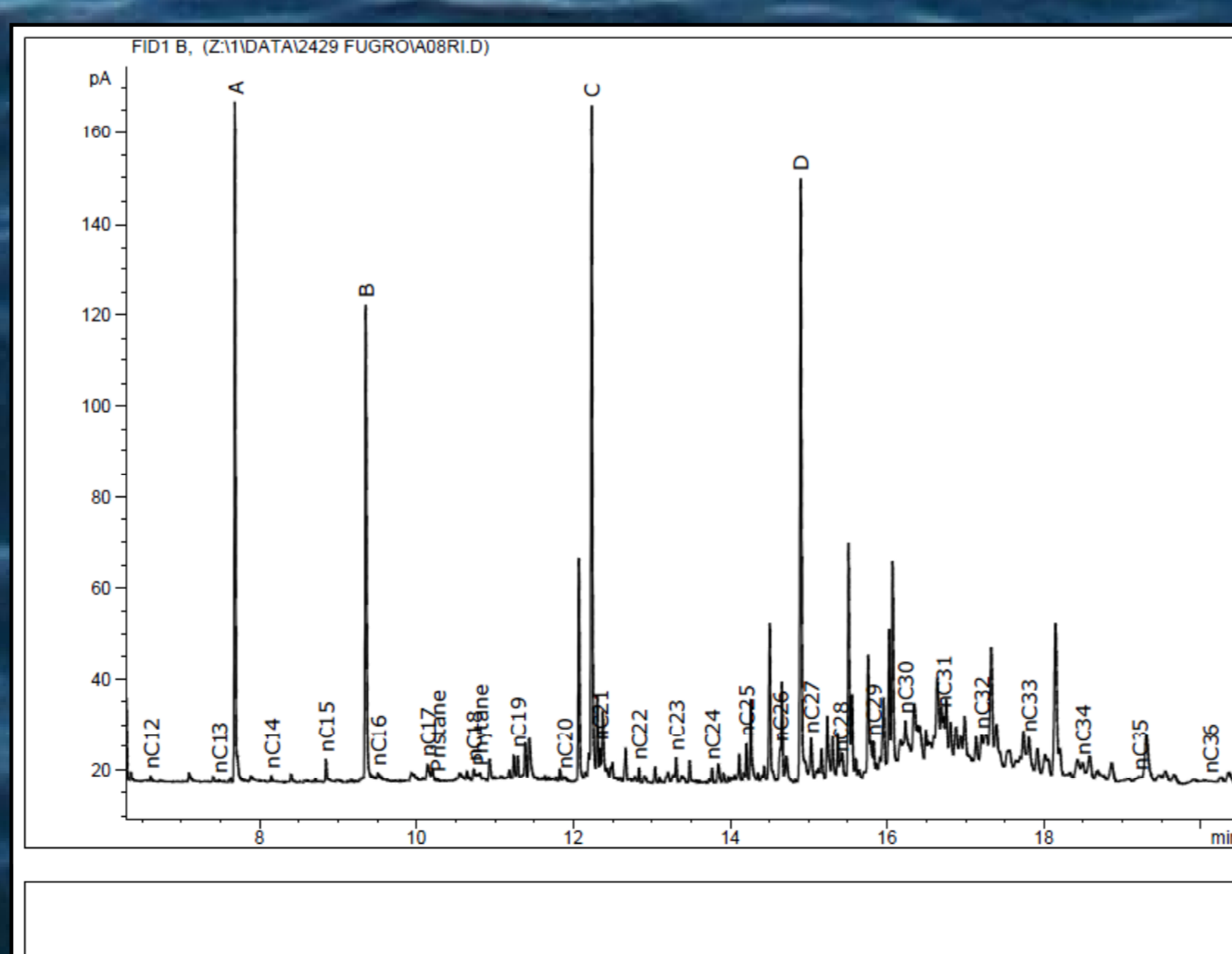
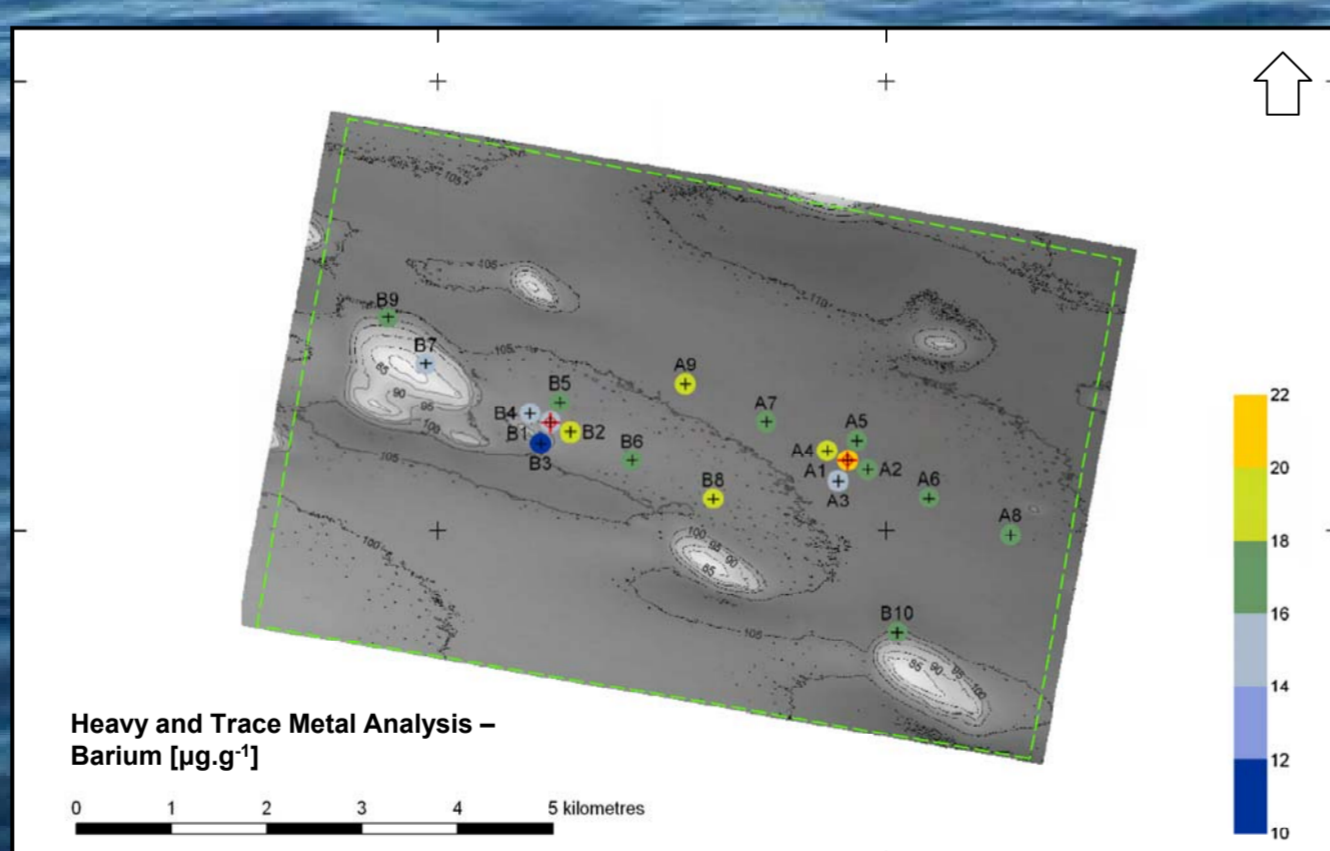
Below is a mosaic created from the towed side scan sonar data.



Environmental Variables

Sampling stations were positioned in a cruciform pattern around proposed locations, aligned with the prevailing current. Seabed samples were analysed for their physicochemical properties, ranging from particle size distributions to hydrocarbon concentrations and heavy metal content. Water samples were analysed for variables such as total suspended solids, turbidity and nutrient content. One unexpected finding was the presence of elevated levels of Zinc in the seawater.

A number of camera and video transects were run within each site, designed in such a way as to sample the various environments as efficiently as possible. Information on sediment variation and macrofaunal distribution was derived from this data.



Shallow Geology

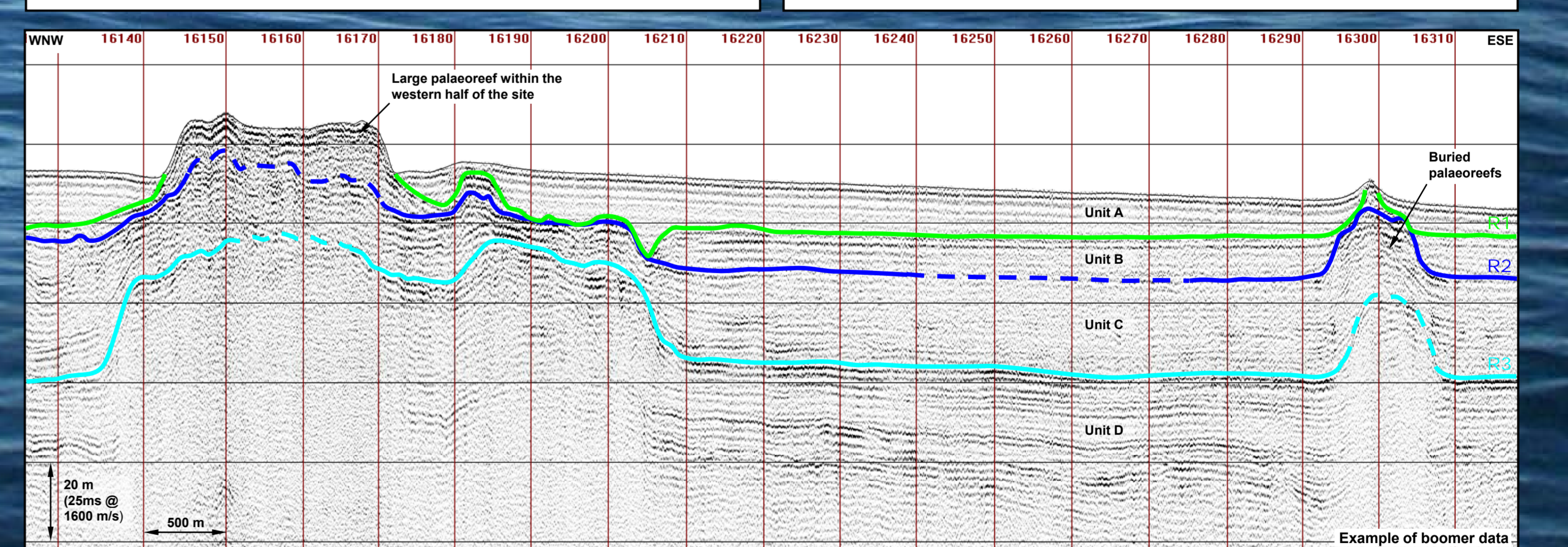
The shallow geological sequence (to approximately 50m below seabed) was divided into four units, separated by three seismic reflectors (R1, R2 and R3). The reflectors are likely to represent erosional surfaces formed during previous sea level lowstands. R1 may be representative of the seabed and / or land surface as it was 18,000 years before present, while reflector R2 or R3 may represent the sea level lowstand of 150,000 years before present.

An example of surface-towed boomer data, running the full length of the site, is shown below.

Mapping the reflectors throughout the site (right) revealed the growth of the palaeoreefs over successive sea level cycles. The larger palaeoreefs outcrop at the seabed, but there are also smaller, buried palaeoreefs present within the site, as well as a large palaeoreef development or carbonate palaeobank within the northern half of the site, buried now 15 m to 30 m below the seabed.

Some degree of compaction and cementation of the surface sediments is likely to have taken place during sea level lowstands, leading to hard bands within the palaeoreefs. The same processes may also have led to the cementation of thin layers of sand and gravel, overlying less consolidated clays and silts, in the areas around the palaeoreefs.

Away from the influence of the palaeoreefs, the shallow geological structure is flat-lying and parallel. Based on gravity cores, seismic character and regional setting, the shallow geological sequence was interpreted to comprise predominantly normally consolidated marine clays and silts.



Conclusions

The site survey in effect produced a high-resolution, 3-dimensional dataset from the seafloor to approximately 100m below the seabed. Together with onshore processing, interpretation, reporting and presentation, this dataset will provide sufficient information for the client to confidently make all necessary assessments and decisions regarding their upcoming exploration drilling program, from choice of surface location to type of drilling unit and precautions required to minimise any environmental effects.

Operational Assessment

The particular site discussed here covered an area of 49.9 square kilometres and entailed the acquisition of a total of 620 line kilometres of analogue geophysical data. Together with coring and environmental survey operations, the site took 8 days to survey. The weather remained favourable and little equipment or vessel downtime was experienced. A total of 14,000 personnel exposure hours were logged during the survey campaign with no recorded lost time or safety incidents.

Acknowledgements

Fugro would like to thank Total E&P Australia for their permission to use these results.

The surveys were carried out from the MV Southern Supporter, a 75m vessel on long-term charter to Fugro

