Preliminary interpretations of seafloor geomorphology from a near-shore multibeam sonar survey; Casey Station, East Antarctica

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The shallow-water (<160m) marine environment around the Australian research station, Casey station (east Antarctica) is a high use area, frequently visited by both large resupply vessels and smaller workboats conducting scientific research in the area. Yet high resolution modern bathymetric data in the area, as well as much of the east Antarctic continental margin, is limited. The Casey nearshore area hosts significant levels of biodiversity, but this knowledge is geographically restricted in scope (i.e. shallow depths, close to shore). This biodiversity faces pressures from human activities and effects of climate change, yet extensive knowledge gaps remain, limiting efforts to conserve and manage it effectively. Improved bathymetric surveying in this region will begin to fill these knowledge gaps by conducting representative mapping and sampling of both the physical environment and biological communities and, in addition, reduce the risk to maritime operations in the region.
During the period December 2014 to February 2015, a collaborative multibeam survey involving Australian Antarctic Division, Royal Australian Navy and Geoscience Australia was conducted in the shallow-water near-shore regions adjacent to Casey station and covered an area of ca. 28 km^2. The survey employed Geoscience Australia's KONGSBERG EM3002 dual head sonar system mounted on an Australian Antarctic Division supplied science workboat, the RV *Howard Burton*.
In total, the surveyed region covered ca. 34 km^2, to a maximum depth of ca. 170m (including a Royal Australian Navy survey conducted in 2013/14 covering an area of ca. 6 km^2). The data was processed in CARIS v8 and a seafloor surface has been gridded at a resolution of 1m. Water column and backscatter data was collected and will be processed and presented at a later date.
Results and preliminary interpretations.
The results reveal the seafloor morphology in unprecedented detail (Fig. 1). Preliminary interpretation of the submarine geomorphology reveal several dominant features which can be simplified into 4 domains as follows: (1) NW and WSW trending fault and channel systems, (2) glacio-fluvial seafloor features (possible terminal moraines) within channel features, (3) bedrock basement highs and (4) 'deep' isolated basins.
The most striking seafloor features evident in the multibeam data are the NW-SE trending channels and linear features that most likely represent brittle bedrock fault systems. These features are present on the north shore of Newcomb Bay, O'Brien Bay, in the bedrock highs along the Beall Reefs region and Robertson Channel. These sub-parallel basement bedrock faults or 'fractures' (or joints in geological terms) have been preferentially eroded and widened locally by glacial action (see below) to form narrow channels, some 200-400 m wide and preserve typical 'U-shaped' profiles, characteristic of glacially eroded valleys seen in the terrestrial environment. A secondary set of SW to WSW trending linear features are characterised by broad eroded channels. These features are less distinct than the NW trending set of channels and are sub-parallel to the regional high-grade gneissic fabric exhibited by the basement rocks exposed onshore. The broad features are evident, for example, between Beall Island and Beall Reefs, the seaward end of Clark Peninsula. The general orientation of the coastline and channels in the Casey region suggest that these linear features fundamentally control the regional coastal and seafloor geomorphology.
Within the NW trending channels, particularly within O'Brien Bay and northern Newcomb Bay, distinct raised narrow curved (convex seaward) seafloor features can be seen. These seafloor features, presumably formed by glacial or glacio-fluvial processes, resemble 'terminal moraines' deposited at the terminus of channelized outlet glaciers that likely formed when the ice sheet locally extended seaward beyond its present day limits. Limited seafloor images show heterogeneous rocky detritus, consistent with diamictite typical of terrestrial moraines. The channels in which these submarine moraine features occur in Newcomb and O'Brien Bays trend NW initially then open out into the broader WSW trending channels and deeper basins further seaward. The 'moraines' are particularly well developed, for example in northern Newcomb Bay, and may be up to 25 m higher than the surrounding seafloor. Many smaller moraines, about 5-10 m high, are also easily discernible.
Bedrock highs are dominated by complex, rugged and variable topography, and dominated by steep knolls that can form small shoals and reefs (e.g. Gibney and Dahl reefs). Regions characteristic of this morphology are the areas seaward (west) of Clark Peninsula and Newcomb Bay and the E-W trending bedrock high of the Beall Reefs-Granholm Rock region near Beall Island. These regions are flanked by deep NW and WSW trending channels also containing terminal moraines. Bedrock highs do not appear (based on nil returns during sediment sampling) to be overlain by significant sediment coverage or basins. Finally, there

are deep (80-100 m) sediment filled basins present in O'Brien Bay, Newcomb Bay and north of Shirley Island. These basins are either enclosed, in that there is no outlet for bottom drainage (north Shirley Island), or have limited drainage through a single channel (O'Brien and Newcomb Bay).

This information will enable a detailed appraisal of regional benthic biological community distribution and composition, facilitating the development of informed and appropriate environmental management for the Casey near-shore region. The bathymetric data will result in more accurate navigational charts and reduce risk to maritime operations in the Casey region. This work was conducted as part of Australian Antarctic Program (AAD3326; 'Hydrographic Surveying and Bathymetric Data Acquisition').

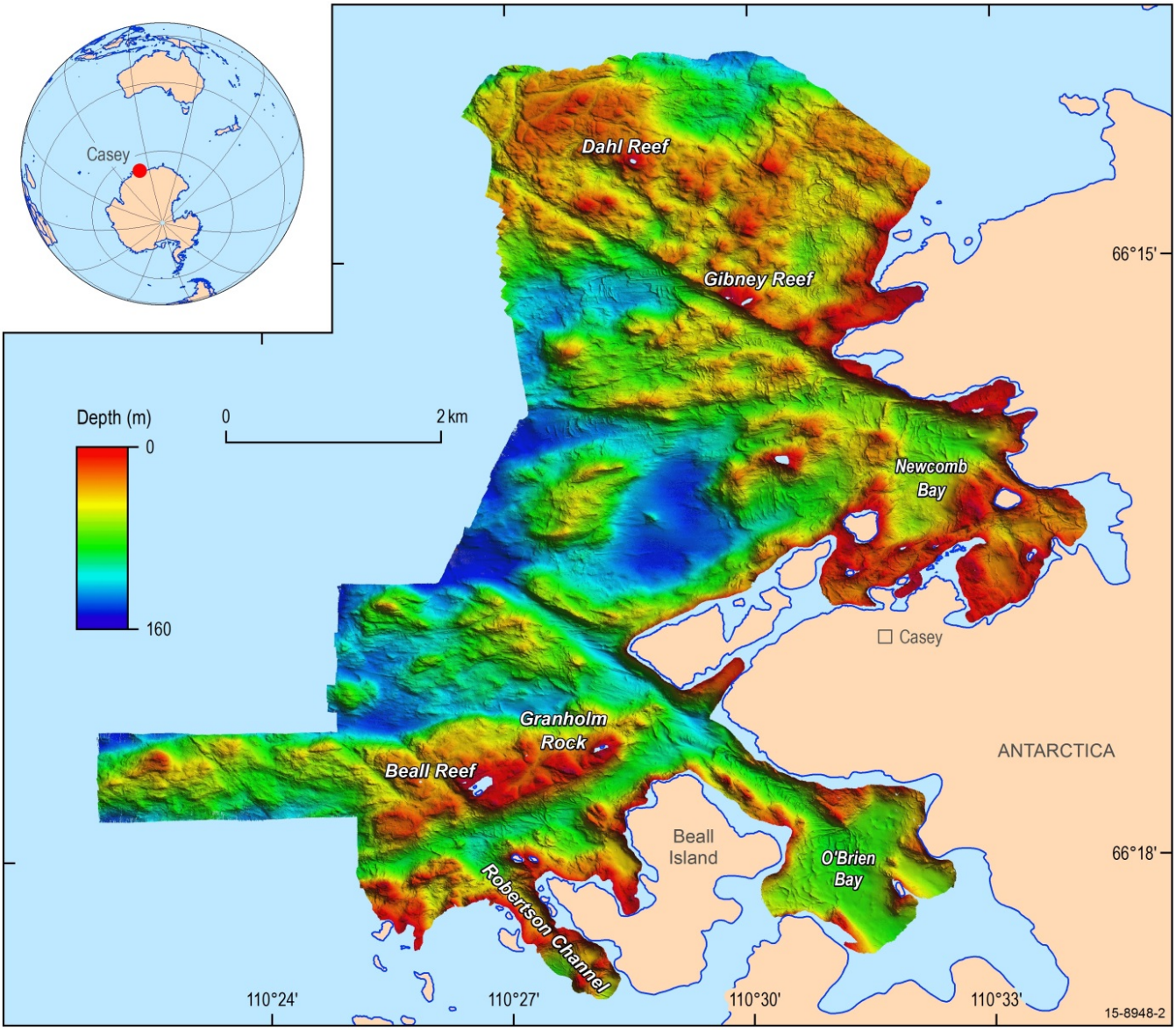

Figure 1. Multibeam sonar bathymetry coverage at Casey Station, showing data from 2014-15 and 2013-14 summer seasons. Major seafloor features, as discussed in text, are highlighted. **Inset:** Location of Casey Station with respect to Australia.