New Exploratory Multibeam Data In The Drake Passage

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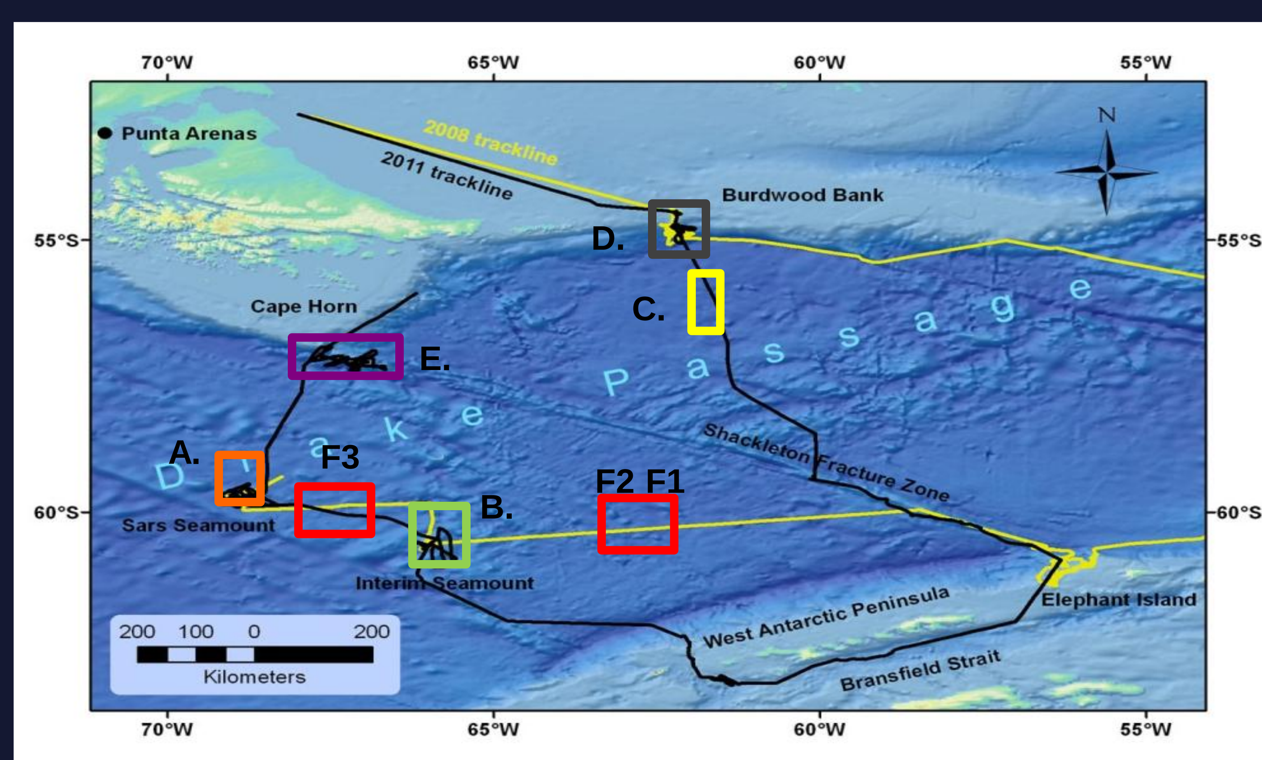
ABSTRACT

RVIB Nathaniel B. Palmer

Transiting through the Bransfield Strait

The seafloor of the Drake Passage between South America and the Antarctic Peninsula has not been well mapped with multibeam sonar, largely because of its remote location and severe weather conditions. During two cruises of the RVIB *Nathaniel B. Palmer* in 2008 and 2011 we used the EM120 multibeam sonar system to map seven areas, ranging from the outer continental shelf and slope to the deep ocean basin, including two seamounts and part of the Shackleton Fracture Zone. The bathymetry provided a context for choosing sample sites for paleooceanography studies as well as valuable insights on the regional geology. The multibeam maps, when compared to existing altimetry-derived bathymetric maps (Etopo1), show significant new detail at all sites. Volcanic structures and faulting related to seafloor spreading were mapped in detail, erosional features created by mass-wasting and/or high currents were discovered, and the depth of Sars Seamount was found to differ by over 100m. Allocating personnel for multibeam bathymetry data collection and processing during cruises of opportunity is a cost-effective way to further our understanding of seafloor geology, particularly in remote regions.

2008 and 2011 Cruise Track



The colored squares relate the figures to their location along the track line.

CRUISE BACKGROUND

During 2008 and 2011 two cruises were conducted on the *RVIB Nathaniel B. Palmer* in the Drake Passage for the project *Historic perspectives on climate and biogeography from deep-sea corals in the Drake Passage.* The main objectives of the cruises were to collect both fossil and live cold water corals for paleoceanographic and biological studies and to characterize cold-water coral habitats. Before sampling, multibeam bathymetric maps were made to aid in selecting promising sites and to avoid damaging deep-towed cameras and other instruments. In some areas we were able to add to existing multibeam datasets; in most cases the areas were previously unmapped. Multibeam imagery from four of the main study sites - Burdwood Bank (D), Interim Seamount (B), Sars Seamount (A) and Cape Horn (E) - and from several transit lines are highlighted here.

METHODS

Acquisition: The RVIB *Nathaniel B. Palmer* is equipped with a Kongsberg EM120 sonar system. The EM120 is a 12khz system with 191 beams per swath. The sonar was run continuously throughout the cruises and data were acquired when the ship was traveling.

Sound Velocity: Sound velocity was collected primarily by using XBTs when needed (generally twice per day or with significant changes in surface water temperature). CTD casts were conducted at 7 sites where water samples were needed for scientific studies.

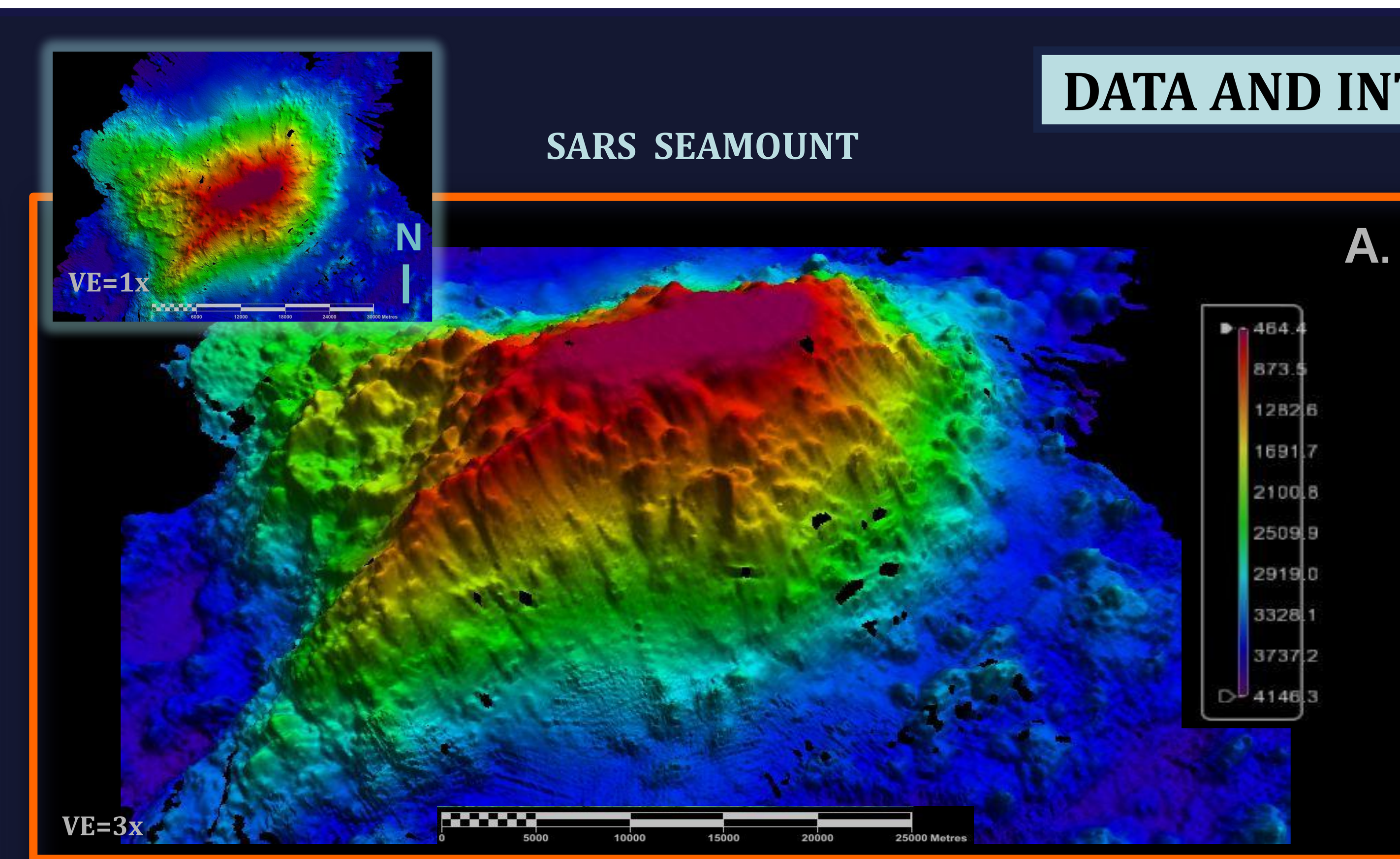
Processing: Processing during the 2008 cruise was achieved using MB-sytems. CARIS HIPS 7.0 software was used for the 2011 cruise.

Acknowledgements:

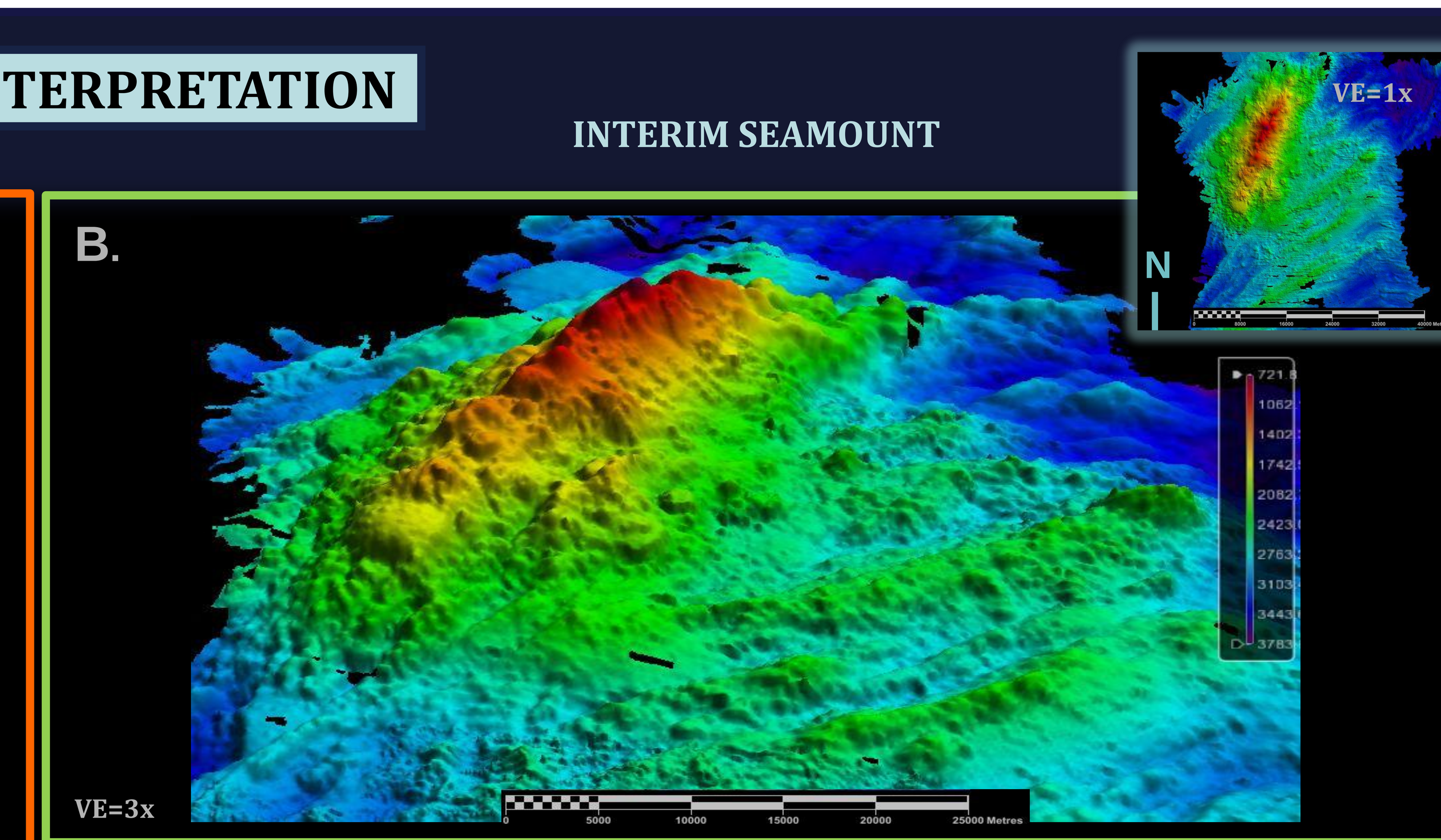
Special thanks to Chief Scientists Laura Robinson (WHOI and University of Bristol) and Rhian Waller (University of Maine) for inviting us to join the research team. CARIS and the SeaMap Program (College of Charleston) provided training in multibeam data acquisition and processing for Hoy and CARIS generously provided funding for Hoy to travel to Chile to meet the ship.

DATA AND INTERPRETATION

SARS SEAMOUNT

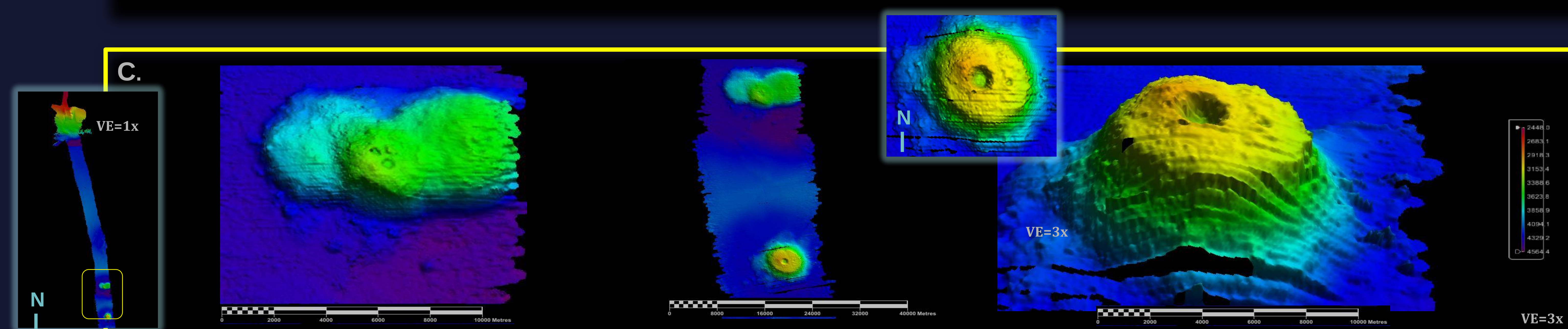


INTERIM SEAMOUNT



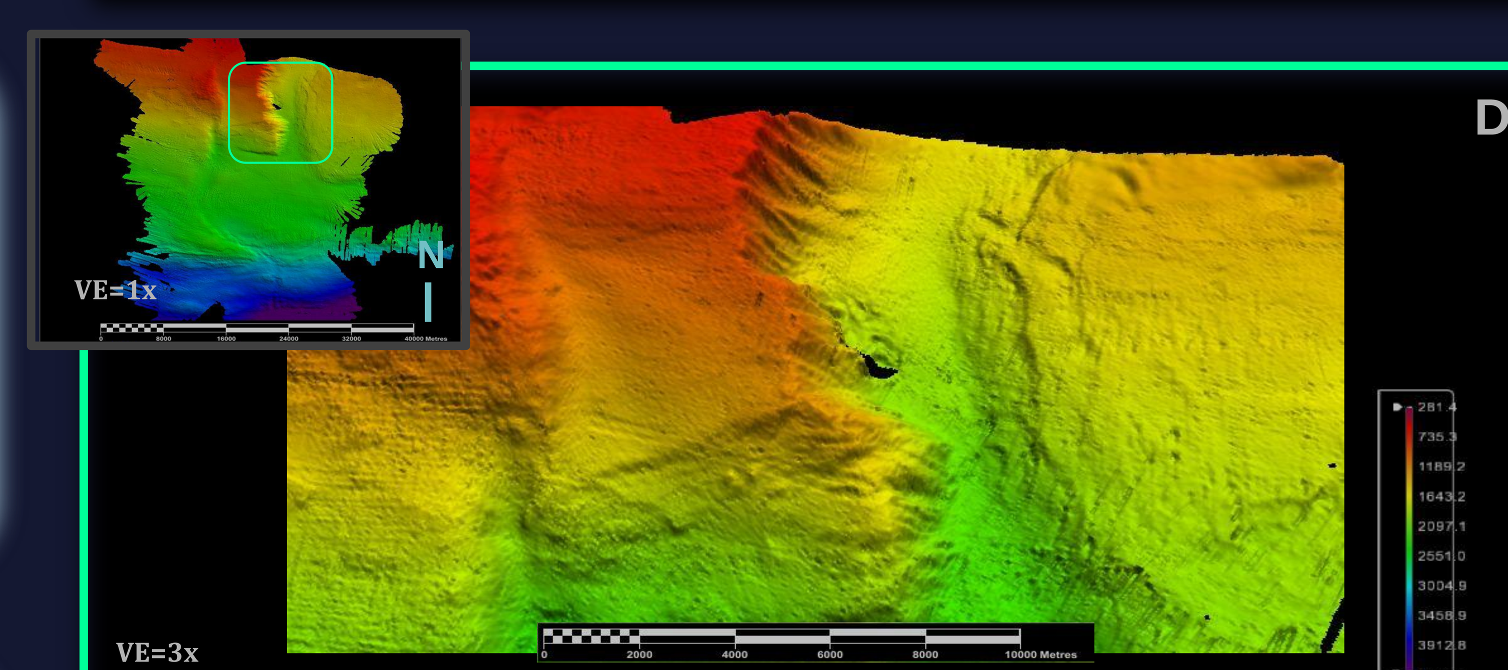
Sars and Interim Seamounts:

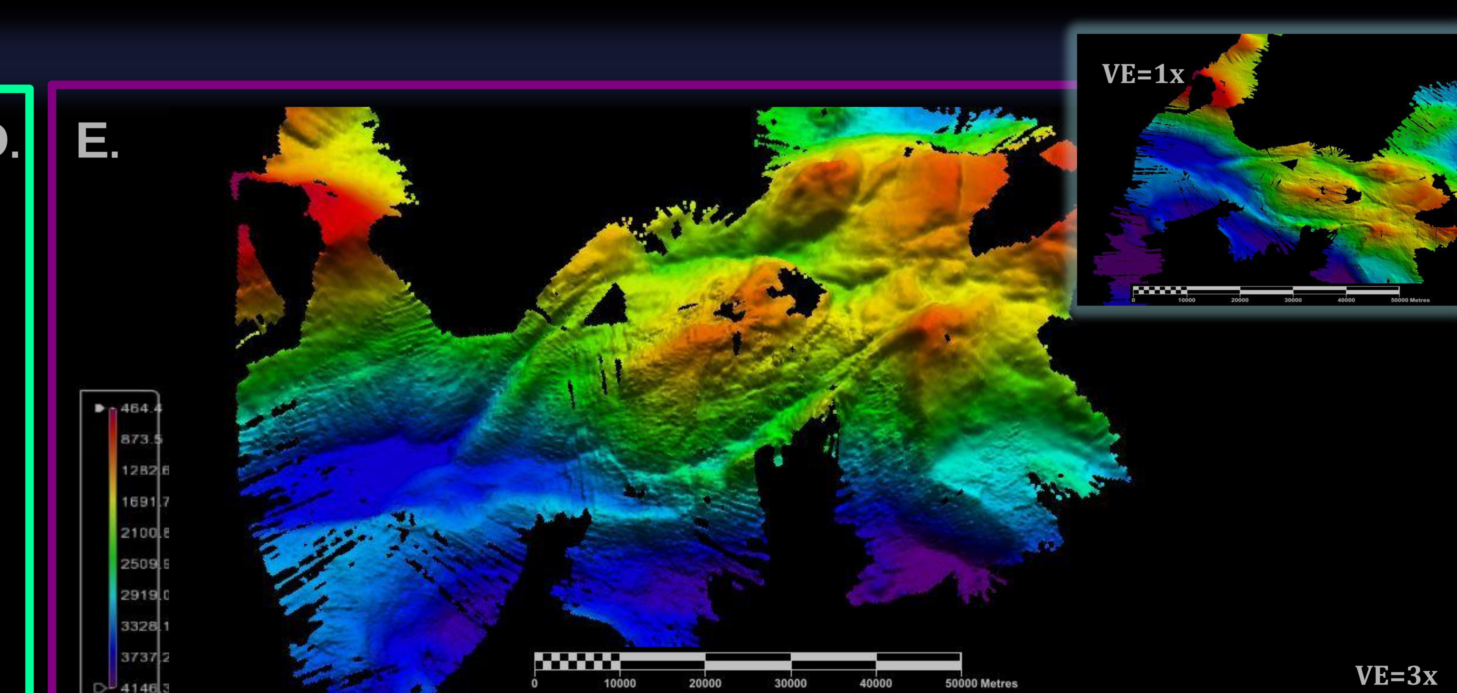
These two seamounts display different morphologies – Interim has an elongate, jagged, ridge-like peak whereas Sars is more equant and flat-topped. We presume these differences are a result of their origins and subsequent history. Interim is situated on a segment of the extinct Phoenix spreading center. Sars stands in mid-plate and was probably created by a hot spot. The top of Sars is currently within 480m below the sea surface, but was likely eroded to its present flatness during sub-aerial exposure, then subsided as it moved away from the spreading center.



Isolated Volcanic Features:

Two isolated volcanic features with topographic moats were mapped during a transit south from Burdwood Bank. One volcano is circular, about 7 km in diameter and rises 1.2 km above the surrounding seafloor. It has a well-developed central crater (1 km in diameter and over 200 m deep). A second feature, about 30 km north of the first, is elongate (9 km by about 14 km), 1 km high, and lacking a clear crater. Moats appear to completely encircle both features, extend outward 8 to 14 kilometers, and are 150 to 400 meters deeper than the surrounding seafloor. In both cases, the moat is deeper on the south side of the feature than it is on the north. These dimensions are consistent with an origin by sediment erosion or inhibition of deposition (R. Pockalny, URI, pers. commun.) .



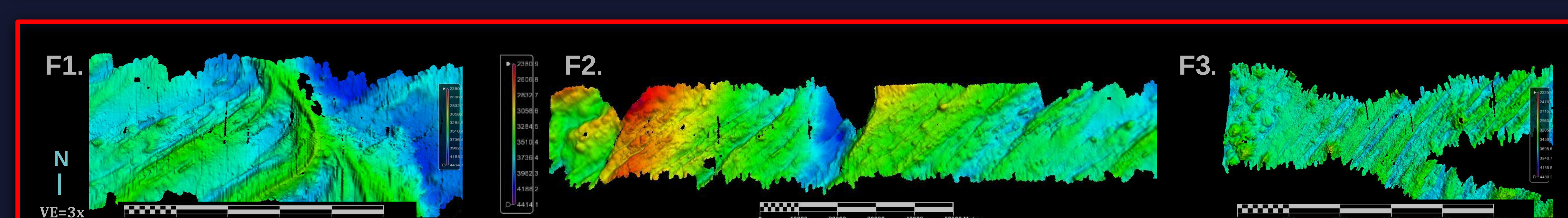


Burdwood Bank Faulting and Mass Wasting:

This site is on the outer shelf and slope, at the southwest corner of Burdwood Bank, near where a fracture zone abuts the continental shelf. Our multibeam data show rectilinear topographic features suggestive of fault control. A canyon-like feature shows evidence of mass-wasting, including gullies along the side walls with deposits at the base on the western side and possible slump scars on the eastern side.

Cape Horn:

The Cape Horn site lies at the intersection of the Shackleton Fracture Zone and the outermost part of the continental shelf off the tip of South America. The bathymetry shows elongate highs parallel to the fracture zone, separated by deep basins. Relief ranges from several hundred meters to 3000 m, with the deepest basin exceeding 4000 m water depth.



Spreading Fabric:

Examples of curved seafloor fabric , from transit areas, related to spreading on the extinct Phoenix spreading center.