

# Bathymetric Analysis of Continental Shelf-Edge Marine Habitat off the Coast of Charleston, SC

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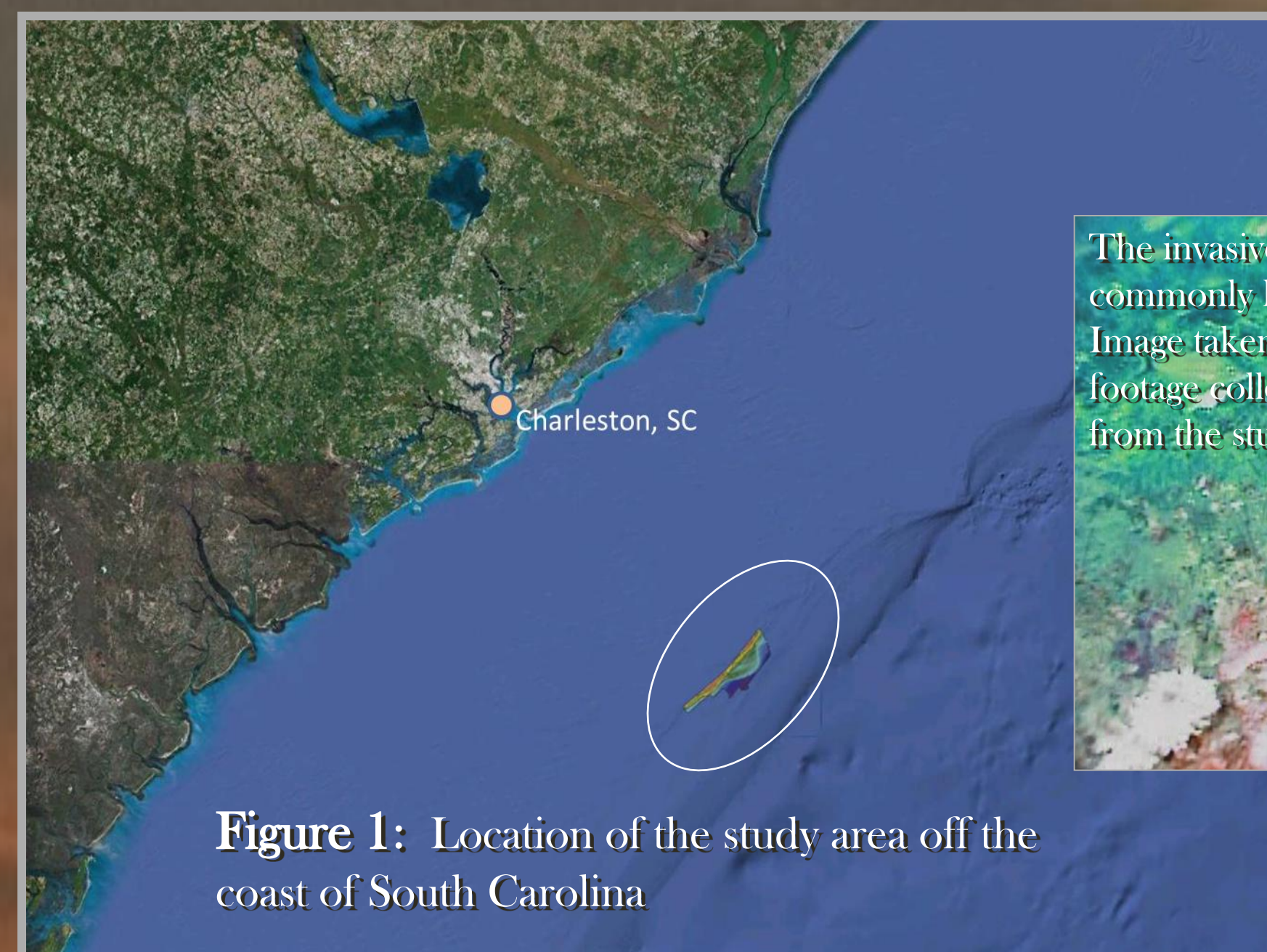
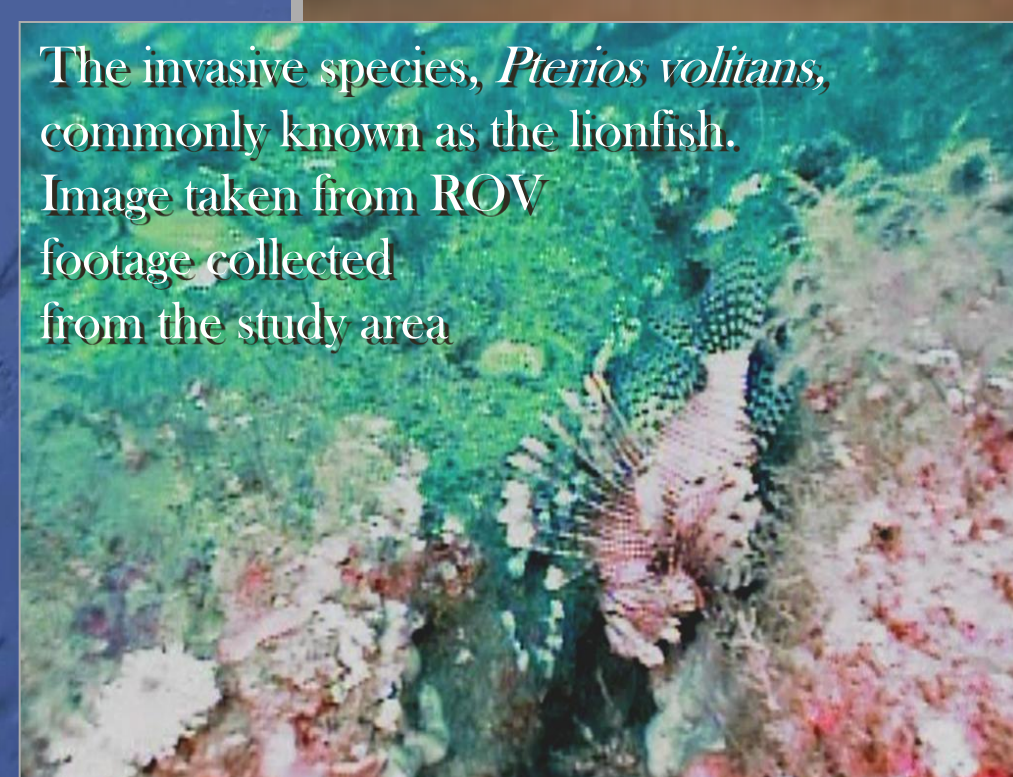


Figure 1: Location of the study area off the coast of South Carolina



The invasive species, *Pterois volitans*, commonly known as the lionfish. Image taken from ROV footage collected from the study area

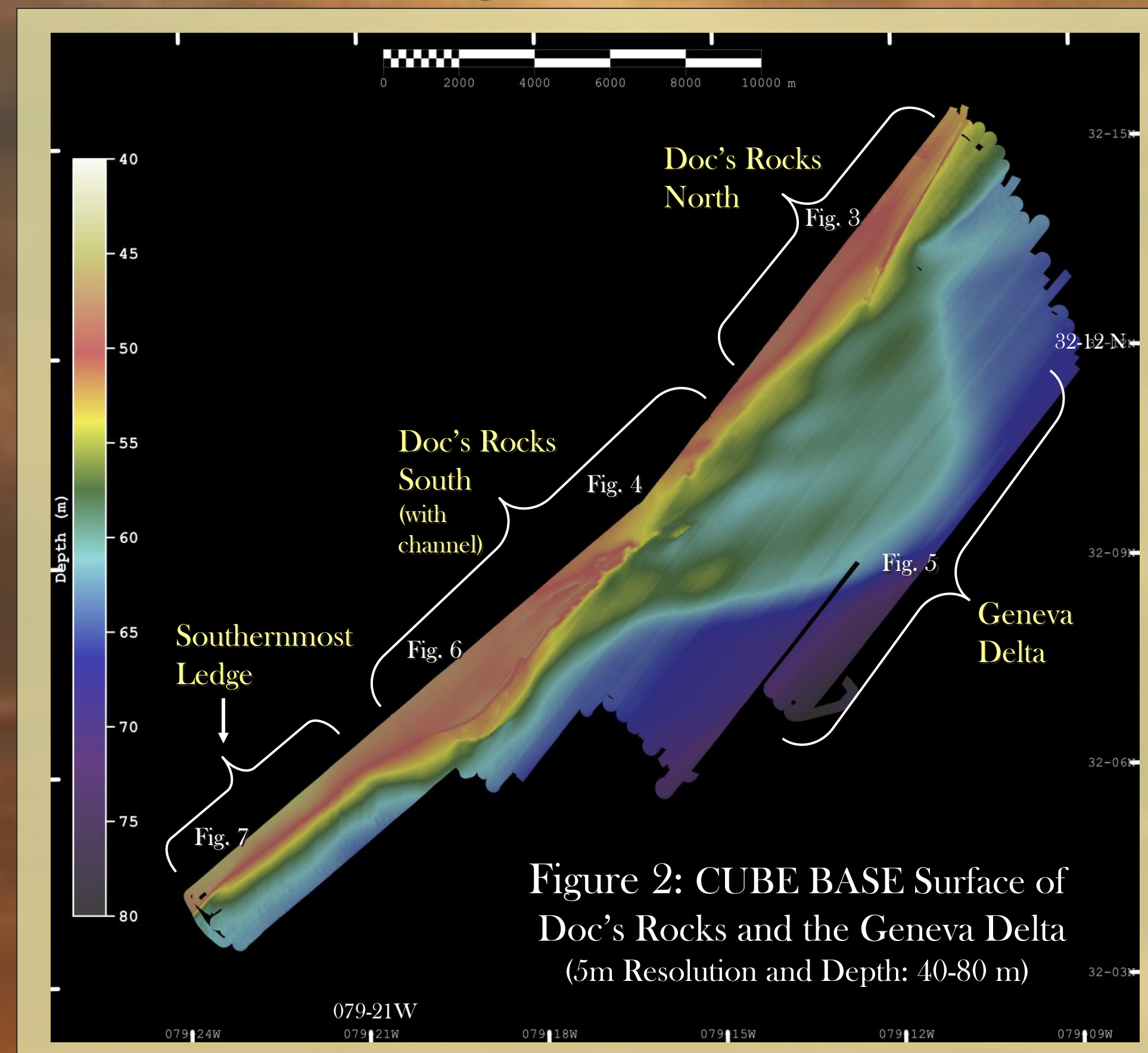


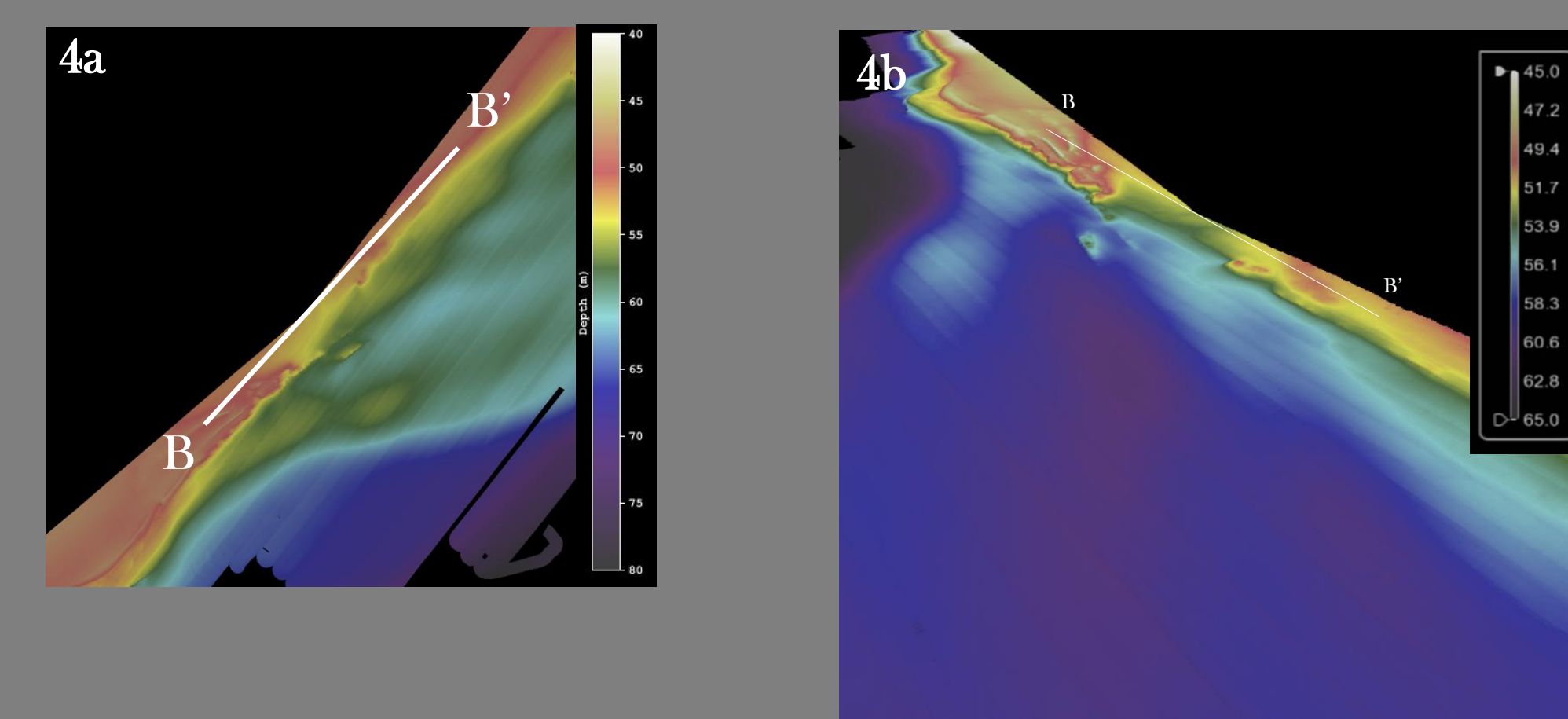
Figure 2: CUBE BASE Surface of Doc's Rocks and the Geneva Delta (5m Resolution and Depth: 40-80 m)

**Methods:**  
- Data collected aboard the NOAA Ship *NANCY FOSTER*  
- Cruise from May 7-12, 2012 led by Co-Chief Scientists Dr. Leslie Sautter and Dr. Scott Harris  
- Raw Multibeam data collected using a Reson 7125 system and HYPACK software  
- Video footage was obtained using a Phantom 300 ROV by Deep Ocean Engineering  
- CUBE surface created in CARIS HIPS 7.1 processing software with 5 m resolution



NOAA Ship *Nancy Foster*

Figure 4: Channel trajectory to the northeast can be observed between two sections of Doc's Rocks South rocky outcrops  
4a) 2D view of channel and profile location  
4b) 3D view of channel from northeastern orientation, with approximate profile location; VE=10x  
\*Note change in depth scale from 3D to 2D views



Profile B-B' shows that despite erosion, the trough shape of the channel remains between 2-5 km

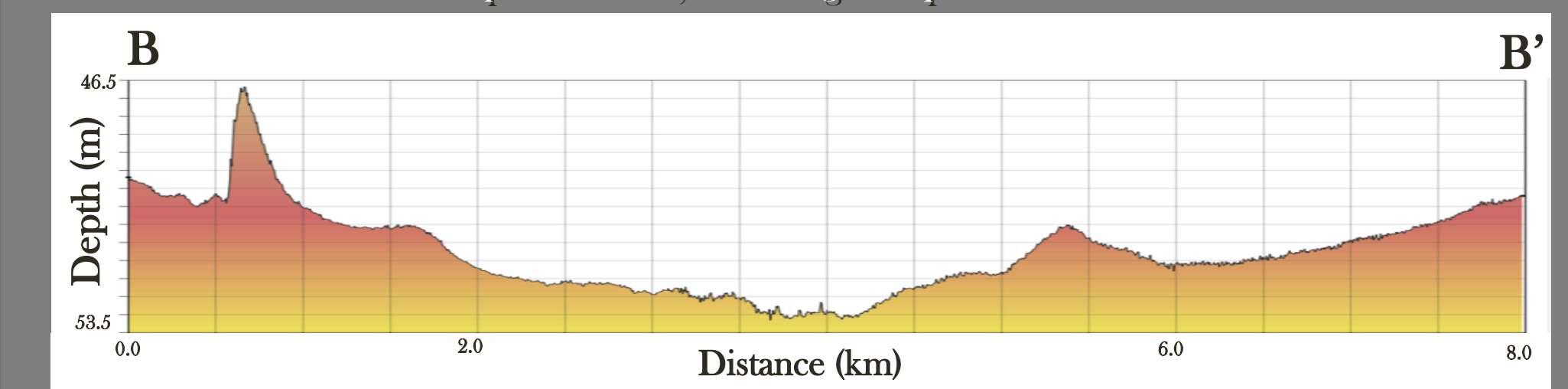
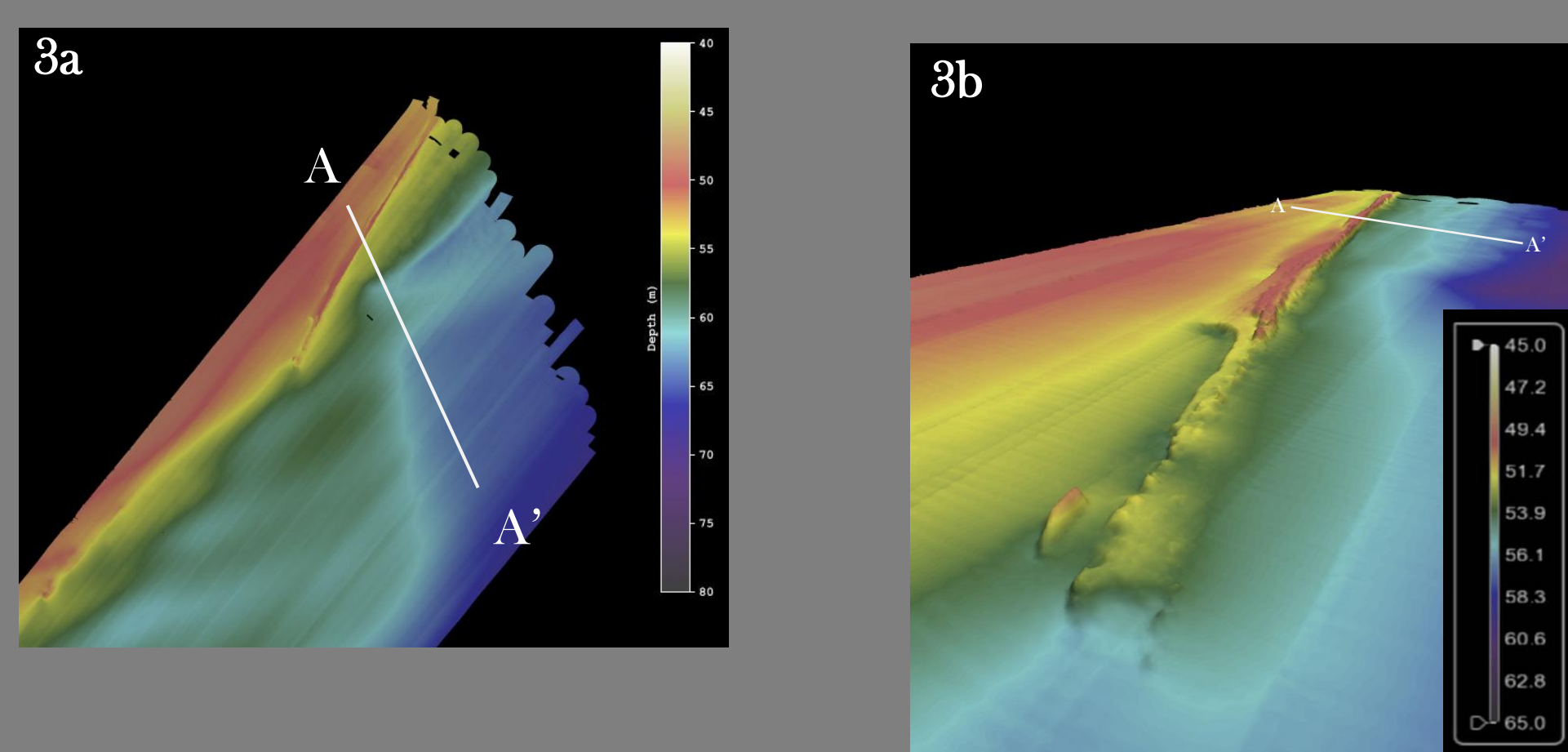


Figure 3: Doc's Rocks North exhibits rocky ledges, which attract a plethora of marine organisms

3a) 2D view of Doc's Rocks North and profile location  
3b) 3D view of Doc's Rocks North from northeastern orientation, with approximate profile location; VE=10x  
\*Note change in depth scale from 3D to 2D views



Profile A-A' has approximately 6 m of relief at the ridge, located at 0.5 km

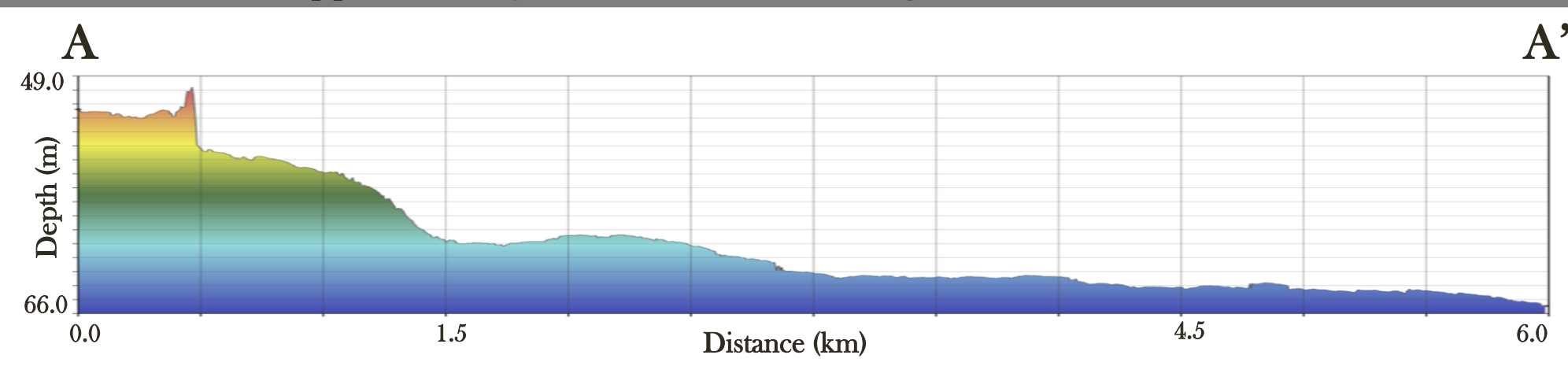
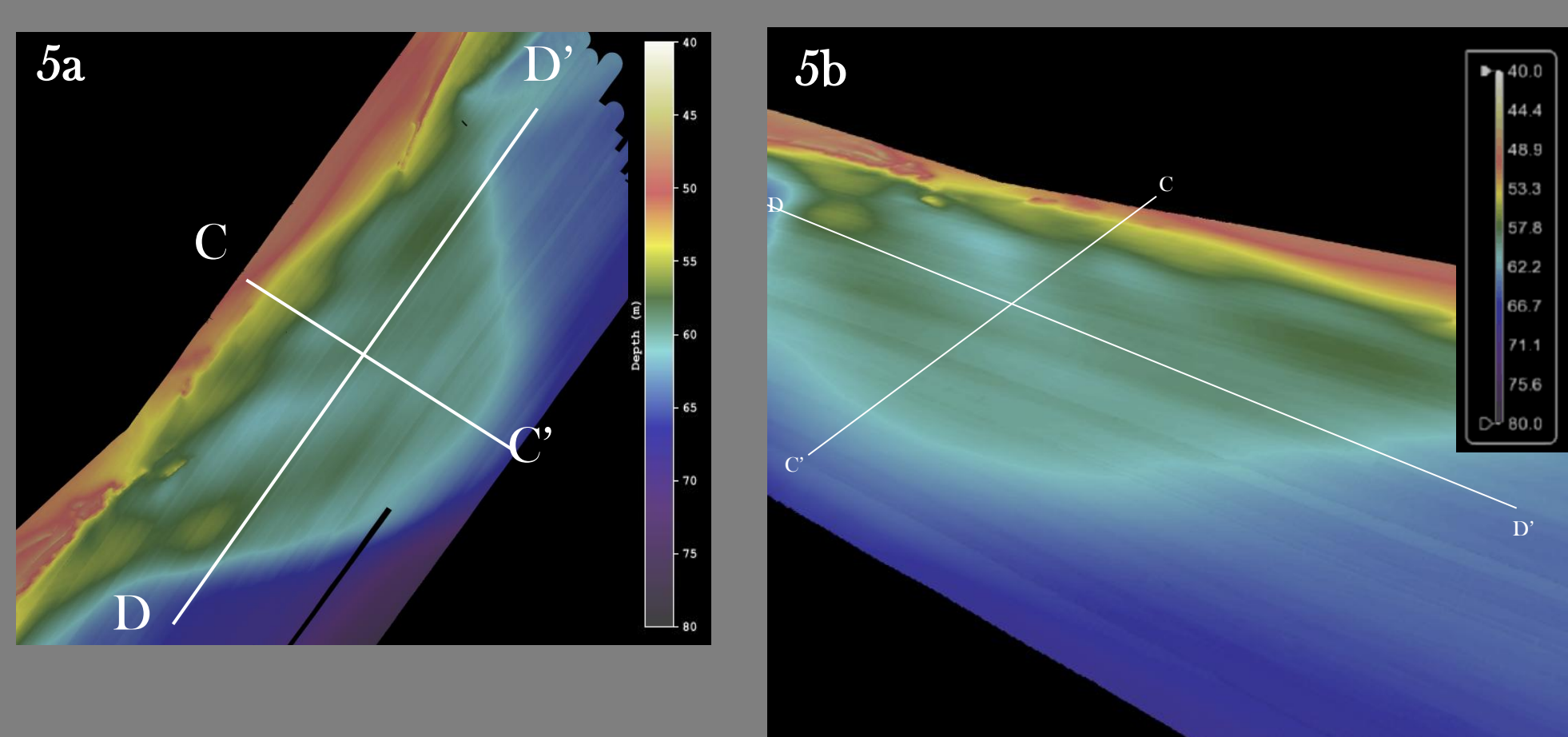
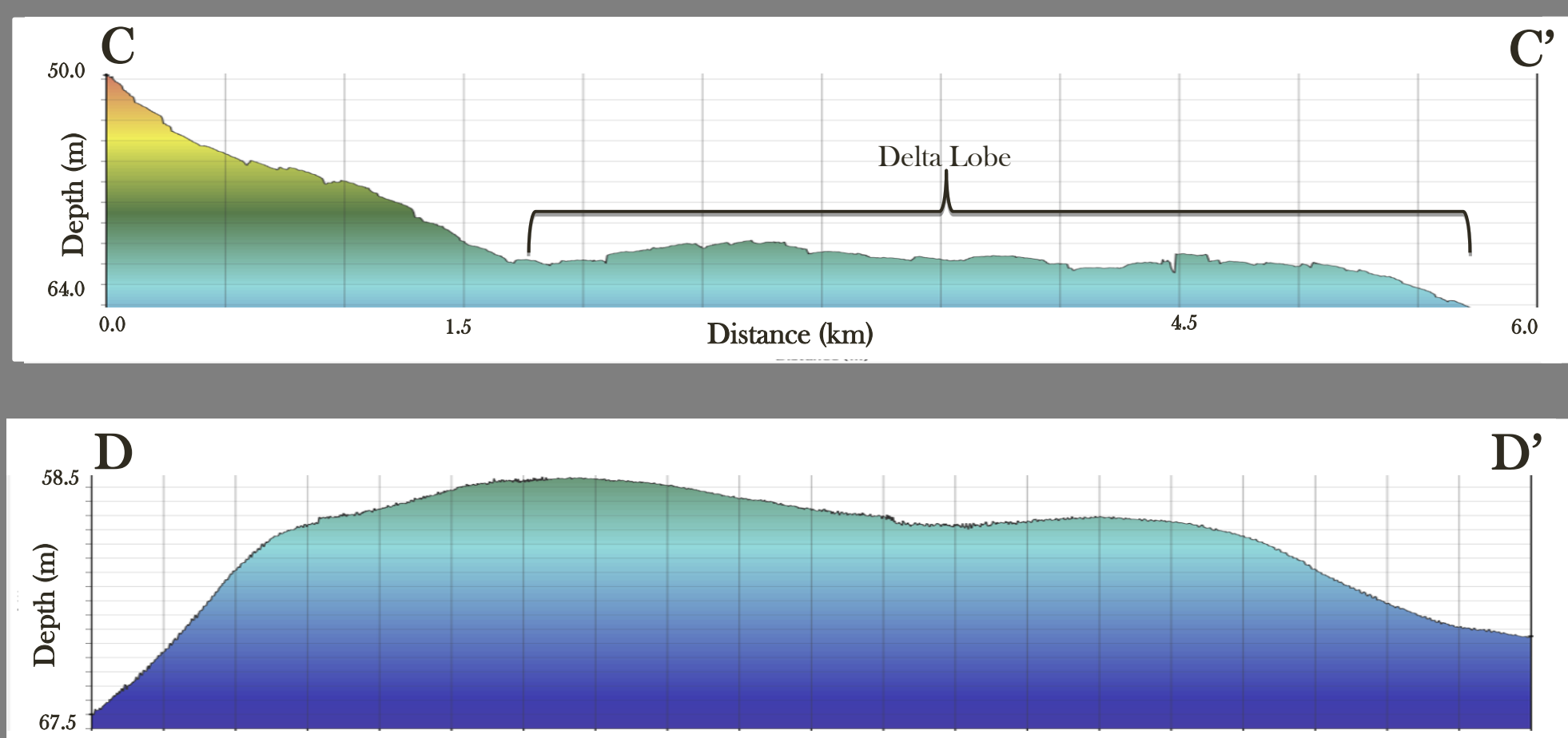


Figure 5: The Geneva Delta shows evidence of a broad depositional lobe from an inlet or river channel, with ~10 m relief around the feature's edge.

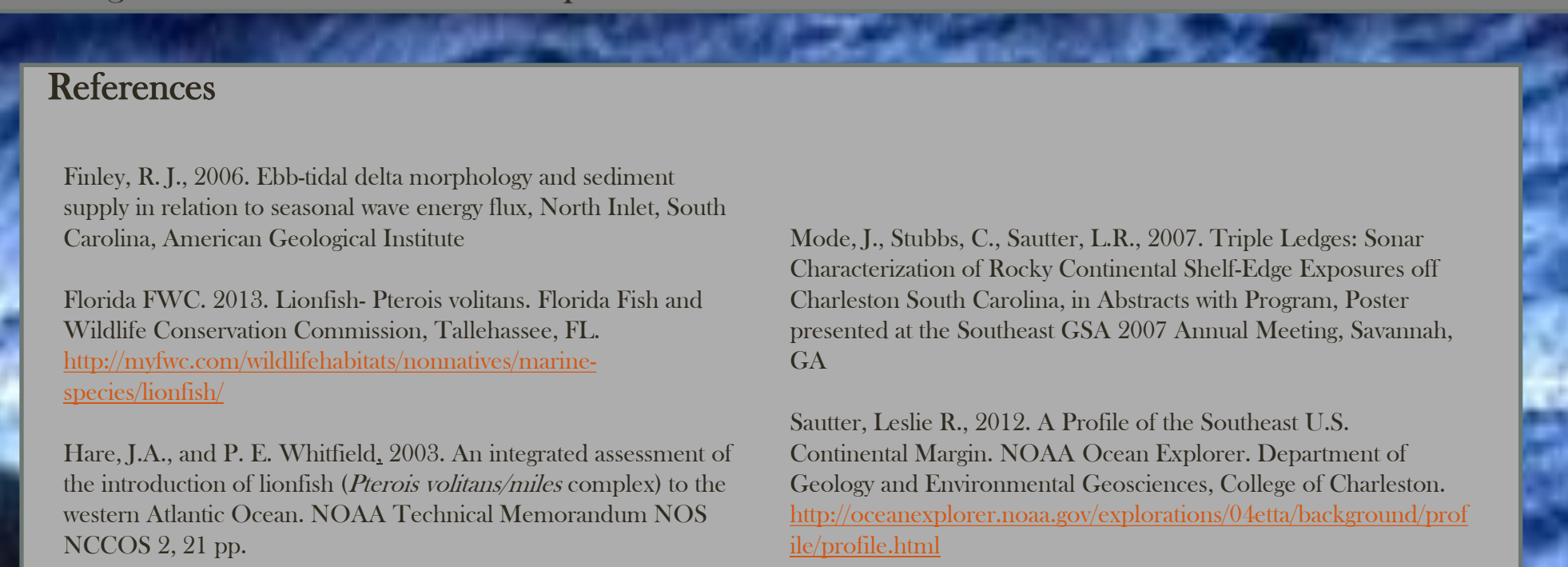
5a) 2D view of delta lobe and profile location  
5b) 3D view of delta lobe from southeastern orientation, with approximate profile location; VE=10x  
\*Note change in depth scale from 3D to 2D views



Profile C-C' illustrates the relief of the delta lobe from the rocky ledges



Profile D-D' shows how the lobe distinguishes itself from the surrounding seafloor through the feature's mound shape.



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## Abstract

A delta-like feature was identified at the continental shelf edge, 85 km southeast of Charleston, SC and named the Geneva Delta. This feature may once have been an active river delta during a lower stand of sea level approximately 30 meters below present day. Bathymetric data were collected by College of Charleston BEAMS Program students during a research cruise in May 2012 aboard the NOAA Ship *Nancy Foster* using a Reson 7125 multibeam system. The survey area ranges in water depths from 40 to 70 meters. Three-dimensional imagery and cross-sectional profiles were generated using CARIS HIPS and SIPS 7.1. Analysis of these images revealed areas of low relief interspersed with rocky outcrops. Additionally, a variety of fish and marine invertebrates was observed, including the invasive species, *Pterois volitans*, commonly known as the lionfish. The morphological features identified indicate habitats that are of particular interest to the commercial fishing industry. These data are crucial to understanding essential fish habitats on the southeast continental margin in order to determine potential locations for establishing Marine Protected Areas.

## Introduction

This study was conducted to further explore the shelf-edge of South Carolina with respect to hard bottom fish habitats. The study area, recently named the Geneva Delta (Harris et al., 2013), is located at the outer continental shelf of the South Carolina continental margin extending across a depth range of 45 to 70 m. The western or landward side of the delta area (depths between 45 and 55 m) is characterized by a series of rocky outcrops known as Doc's Rocks North and South (Harris et al., 2013), which provide hard bottom habitat for numerous sessile invertebrates, as well as for tropical and subtropical fish species (Schobernd et al., 2009). Localized upwelling from Gulf Stream eddies delivers nutrients to the euphotic zone creating high productivity (Schobernd et al., 2009) while providing a suitable habitat on the shelf-edge for a variety of marine organisms, including consumer-favorite, such as billfish, grouper and snapper

(Sedberry, 2012). Given the biodiversity and biological potential for spanning in this area, both the rocky shelf-edge Doc's Rocks and the Geneva Delta are of particular interest to the commercial fishing industry and conservation efforts such as Marine Protected Areas (MPAs). Studies have shown an increase of the lionfish, *Pterois volitans* along much of the shelf edge off the coast of the Carolinas (Hare et al., 2003). The lionfish is an invasive, venomous exotic that kills native species of fish and invertebrates. Research is crucial to understanding the detrimental effect lionfish present to indigenous marine species, in order to prevent their further encroachment. To date, no measures have been taken to control the lionfish population in southeast shelf waters, despite their abundances found off the entire eastern seaboard as far north as New England (Florida FWC, 2013).

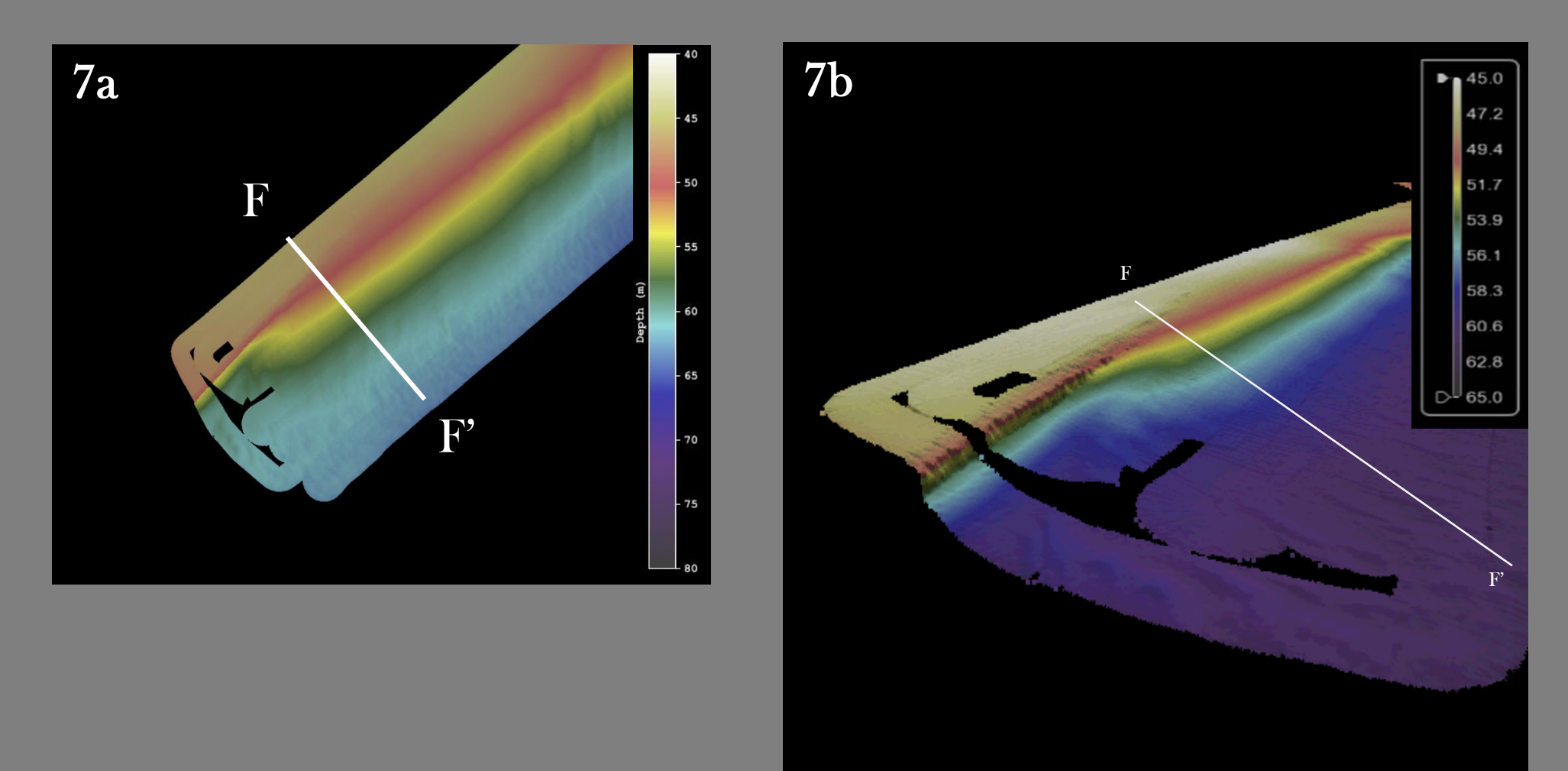
## Results and Discussion

- Depth Range: 40- 70 m
- Geospatial evidence supports identification of lowstand sea level paleodeposits along the Geneva Delta region (Harris et al., 2013).
- Profiles of rocky outer ledges exhibit relief of 2 to 6 m at the intersection of the outcrop.
- Habitat at these locations is of particular ecological and socio-economic interest.
- Benthic marine organisms burrow and adhere to these morphologically complex outcrops, attracting larger predatory fish and contributing to diverse fish assemblages, as can be seen in ROV footage (Kendall et al., 2007).
- A channel with relief of approximately 2.5 m is located within Doc's Rocks South. It was likely an active inlet or river during a lower stand of sea level and significantly contributed to the development of the Geneva Delta (Fig. 4).
- The Gulf Stream modifies the geomorphology of the rocky outcrops in the form of scour marks and pockets of heavy erosion, which trend in a NE-SW direction (Fig. 6b).
- Doc's Rocks, the defined ridges located North (Fig. 3) and South (Fig. 6) of the delta's lobe (Fig. 5), range from 45 to 50 m below sea level. The ridges may be paleo-barrier island features that were preserved due to rapid transgression after a low stand of sea level (Harris et al., 2013).
- The deltaic feature has a relief of 10 m around the periphery, indicating large deposits of sediment during a low stand of sea level (Fig. 5).

The complex hard bottom features coupled with the warm nutrient-rich water delivered by the Gulf Stream result in making the Geneva Delta a prime habitat to a variety of marine fauna. ROV footage revealed high activity of fish assemblages at these locations. There are approximately 80 km of suitable outcrops in the study area, which justify considering the Geneva Delta area with surrounding rocky outcrops as a Marine Protected Area.

Figure 6: Doc's Rocks South hosts a grouping of outcrops known as the Triple Ledges, as well as scour marks along the ridges

6a) 2D view of Doc's Rocks South and profile location  
6b) 3D view of Doc's Rocks South from southeastern, with approximate profile location; VE=10x  
\*Note change in depth scale from 3D to 2D views



Profile E-E' displays the Triple Ledges of Doc's Rocks (between 0-2 km) with relief of ~3 m.

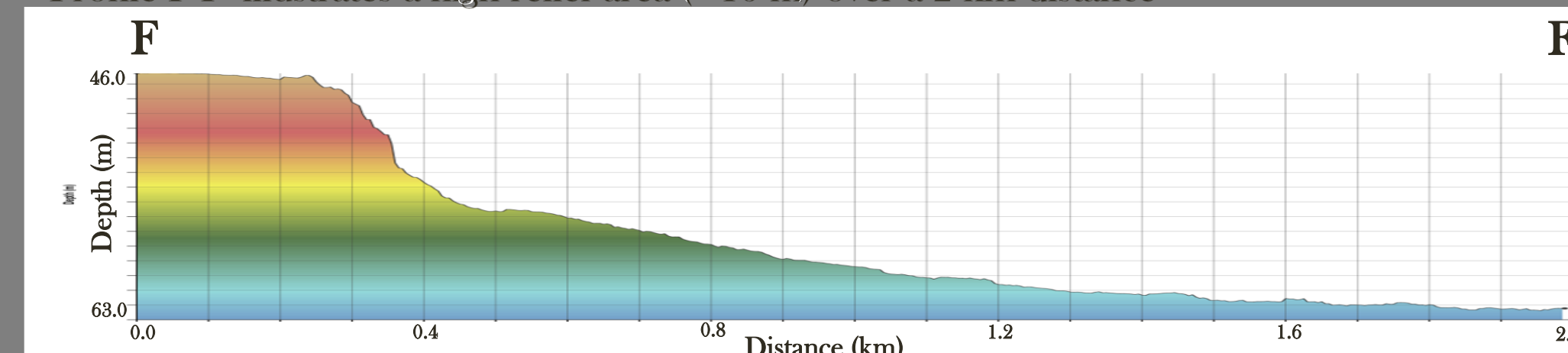
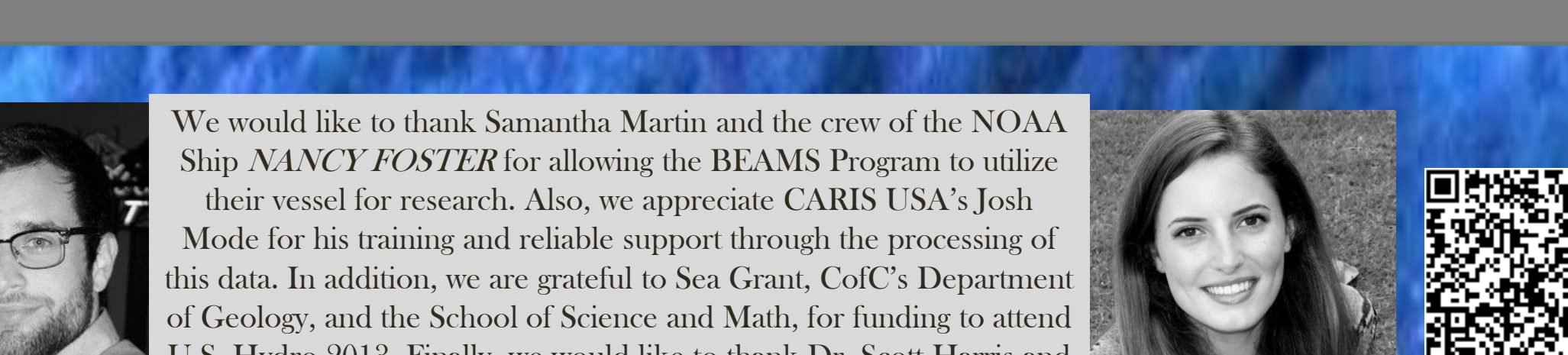
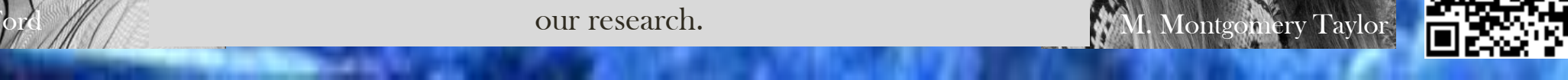


Figure 7: The Southernmost Ledges exhibit the linear structure of the outcrop.  
7a) 2D view of southernmost ledge and profile location  
7b) 3D view of southernmost ledge from southeastern orientation, with approximate profile location; VE=10x  
\*Note change in depth scale from 3D to 2D views



Profile F-F' illustrates a high relief area (~16 m) over a 2 km distance



Kyle W. Ford

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M. Montgomery Taylor

