Surveys conducted by the NOAA Ships Okeanos Explorer during June of 2011 and two sails in November of 2012, and Nancy Foster (June, 2013) during three cruises to acquire high-resolution bathymetric and backscatter data of the continental slope due east of the northern portion of the Outer Banks, North Carolina and southern Delaware coastlines. Kongsberg EM302 multibeam sonar was used, and bathymetric and backscatter data were processed using CARIS HIPS & SIPS 7.1 software. Surveys were run parallel to the shelf edge, ranging in depth from 100 to 3000 m. This area has some of the steepest gradients of the United States East coast. The shelf is well incised by many medium-sized submarine canyons in close proximity of each other as well as the large Norfolk and Washington Canyons that characterize the slope and rise. High-resolution bathymetry can help with predicting areas where tsunamis may occur as a result of major sediment slumping. The continental rise is seldom the focus of mapping projects, but within our data are three examples of sediment travel from shelf to rise.

Methods:

- Surveys were conducted by the NOAA Ships Okeanos Explorer during June of 2011 and two sails in November of 2012, and Nancy Foster (June, 2013) to collect data to be mapped.
- All multibeam and backscatter data was obtained with a Kongsberg EM302 multibeam sonar system.
- Seafloor Information System (SIS) was used to acquire data.
- CARIS HIPS & SIPS 7.1 was used to create a 5 m resolution CUBE surface.

Results:

- The two large canyons, Washington and Norfolk Canyons, incise the continental shelf. Sediment is transported to depths beyond our BASE surface.
- Washington Canyon has a wider channel than Norfolk Canyon, and has a very narrow channel within the main channel (Figure 2, profiles "A" and "C"). This small channel is evident in the center of the Fluvial-Origin Canyons Section (Figure 2, Profile "X", and 3D view).
- Norfolk Canyon has a deeper, narrower channel (Figure 2, profiles "B" and "Y", and 3D view).
- Areas where slumping activity has occurred contain large blocks of sediment. These blocks are deposited further down the slope than the sediment was originally deposited, most likely due to slope failure. The volume of sediment displaced may have been significant enough to produce tsunamis (Fig. 3).
- One area of major slumping appears to have created the heads of several new canyons in our Depositional Section (Figure 3, Profile A-C).
- Multiple inter-canyon channels in the south (Fig. 4) combine to form a single deeper and appears to be a faster channel that transports sediments to depths uncharacteristic of such small canyons.
- Smaller canyons to the south demonstrate evidence of sediment deposition on the slope and upper rise.

References:


Driscoll, R.G., L. Kolla, F., and Driscoll, T.J., 2002, “Role of Submarine Canyons in Trench and Trench Margin Failure: (1) smaller scale failures that either form canyons, or occur within and are channeled by existing canyons; (2) larger scale, catastrophic failures that undermine large areas of canyons and effectively erase preexisting canyon morphology (Driscoll et al., 2000). This slump appears to be a Type (2) slope failure, and has created the heads for future canyons (Profile "C"). The seafloor within this depression is marked by large blocks of sediments that appear as bumps on the surface (shown in all 3D views). Backscatter imagery (Fig. 5) reveals differences in acoustic return intensities between these sediment blocks and the surrounding seafloor. The sediment blocks have a higher intensity return than the surrounding seafloor deposits, likely indicating that they are harder than the surrounding plain of sediments.

The southern, “Slope Origin Canyons Section” is illustrated in Figure 4. It contains several small canyons and areas of potential slumping (shown in all views). Interestingly a large channel is present that allows for sediment to be transported deeper than is usual for canyons of small size. This large channel is the result of several small channels converging (Profiles A-E, F). These small canyons, at lower depths where the channels haven’t yet merged (3D View, Fig. 4).

Each section contains different methods of transporting sediment to greater depths. The northern section, with the two large canyons, allows for coarse sediments to reach the greatest depths. Slumping and channel convergence are two other interesting ways in which sediment can move down the slope. The sediment blocks deposited within the slump area demonstrate how sediment can be transported in packets even when a major slumping event is not taking place.