U.S. Law of the Sea Mapping

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Abstract

The U.S. is conducting multibeam surveys of the U.S. continental margins where a potential exists for a claim under United Nations Convention on the Law of the Sea (UNCLOS) Article 76. The University of New Hampshire's Center for Coastal and Ocean Mapping-Joint Hydrographic Center is directing the surveys as part of its National Oceanic and Atmospheric Administration (NOAA)-sponsored research program. To date, two areas in the Bering Sea, two areas in the Arctic Ocean and a large portion of the U.S. Atlantic continental margin have been mapped.

Introduction

The Center for Coastal and Ocean Mapping/Joint Hydrographic Center, University of New Hampshire was directed by Congress through funding by the NOAA to evaluate current data holdings, identify areas that would benefit from new surveys and to direct multibeam mapping of U.S. continental margins in areas where a potential exists for a claim under Article 76 of the UNCLOS (see www.ccom.unh.edu). Working with a variety of data acquisition partners, our efforts began in 2003 with the mapping of three areas; two in the Bering Sea and one in the Arctic Ocean. In 2004, portions of the U.S. Atlantic margin and an area of the Alaskan Arctic margin were mapped. The required survey areas on the U.S. Atlantic margin will be completed and a large area of the Gulf of Alaska margin will be mapped in 2005 using the University of Hawaii R/V *Kilo Moana*. The mapping objectives in all these areas are to locate the 2500-m isobath and map the

foot of the slope. We have, where possible, been mapping the entire area between the ~1000-m and ~4800-m isobaths.

We are using multibeam echosounders (MBES) to map these areas. The MBES systems we are using are capable of producing maps with at least 100-m spatial resolution and a vertical precision of <1%of the water depth. Navigation on all cruises has been inertial-aided DGPS navigation. All of the MBES systems used produce backscatter as well as bathymetry, although the quality varies considerably. The processed data are posted on http://www.jhc.unh.edu/unclos/html/index.htm within a few months of the completion of each cruise.

Bering Sea

The north flank of Bowers Ridge and a portion of the southern Beringian margin (Fig.1) were mapped in 2003. A hull-mounted 12-kHz Reson 8150 MBES operated by Thales Geosolutions (now Fugro Pelagos) of San Diego, Calif. on R/V *Davidson* was used for the survey.

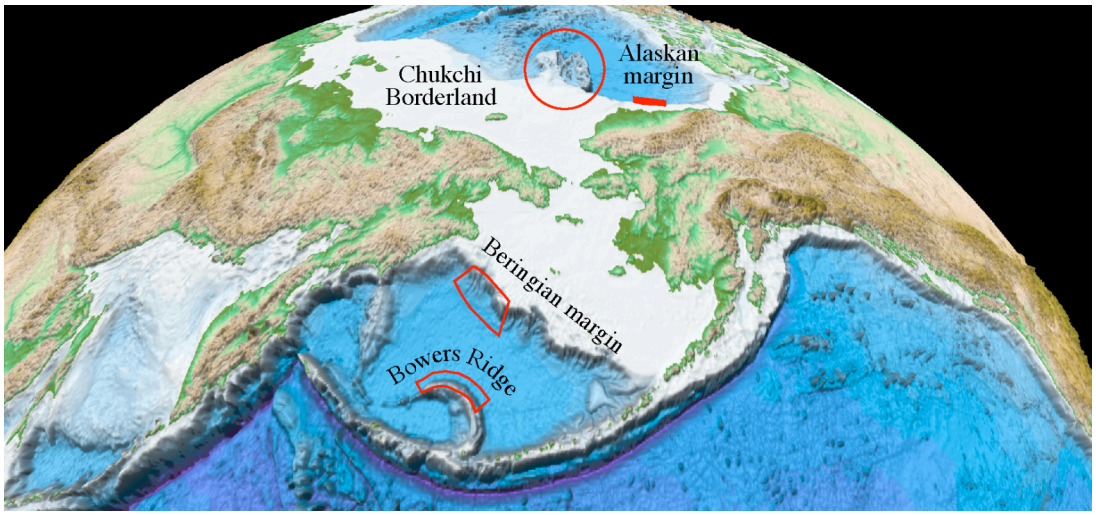

Figure 1. Red lines are areas mapped in the Bering Sea and Arctic Ocean.

The new mapping reveals the northern flank of Bowers Ridge as steep (~20˚), heavily incised, and complex with an abrupt foot of the slope. The flank is dissected by numerous canyons and channels, presumably cut into bedrock. The mapping discovered a series of three plateaus along the northern flank, two of which have eastward-projecting ridges (Fig. 2) that are located about 15 km north of the main flank margin and follow the general curvature of Bowers Ridge. One of the ridges is more than 50 km long. The mapped area of the Beringian margin (Fig. 1) lies between Pervenets and St. Matthew Canyons. The new data show that even with a similar geological history as Bowers Ridge, the Beringian margin has a considerably different morphology (Fig.3).

The Beringian margin is composed of a series of seaward-projecting sediment tongues or drifts, some of which extend more than 40 km beyond the steep margin. These features occur every 5 to 10 km along the length of the margin and some have heights of more than 150 m above the surrounding seafloor. The individual sediment tongues have relatively sharp crests and are deeply eroded only on their south-facing flanks.

Arctic Ocean

Two cruises, one in 2003 and another in 2004, were conducted in the Chukchi Borderland and the Alaskan Margin in the Amerasian Basin of the Arctic Ocean. The "natural prolongation" of the Chukchi Borderland from mainland Alaska as well as the thick accumulation of sediment in the Amerasian Basin makes this region a viable target for an extended shelf claim under UNCLOS Article 76. Severe constraints imposed by pervasive ice in this region have thus far limited our mapping to the 2500-m isobath. We have not yet begun to map the area between the 2500-m isobath and the foot of the slope.

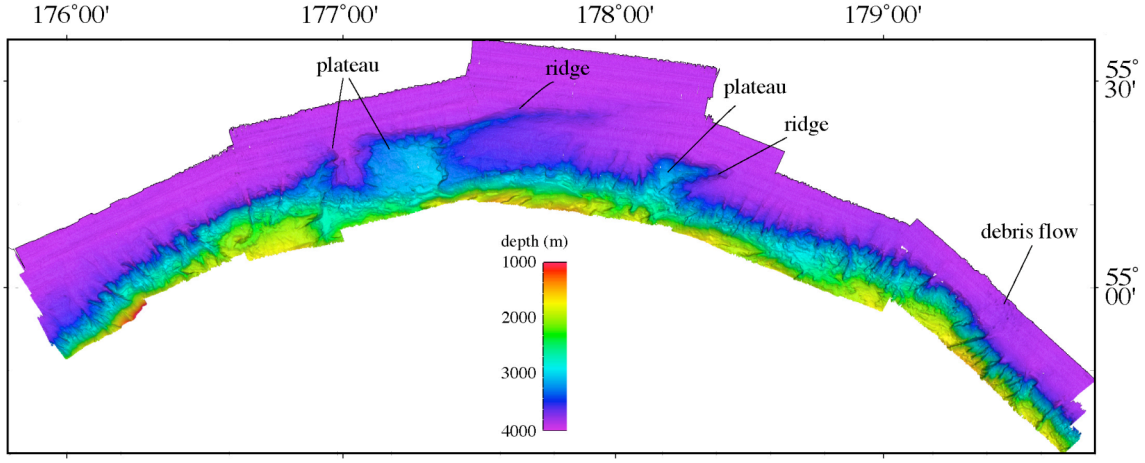

Figure 2. Color-coded shaded relief map of northern flank of Bowers Ridge. Note the plateaus located north of the flank margin as well as the eastward-projecting ridges.

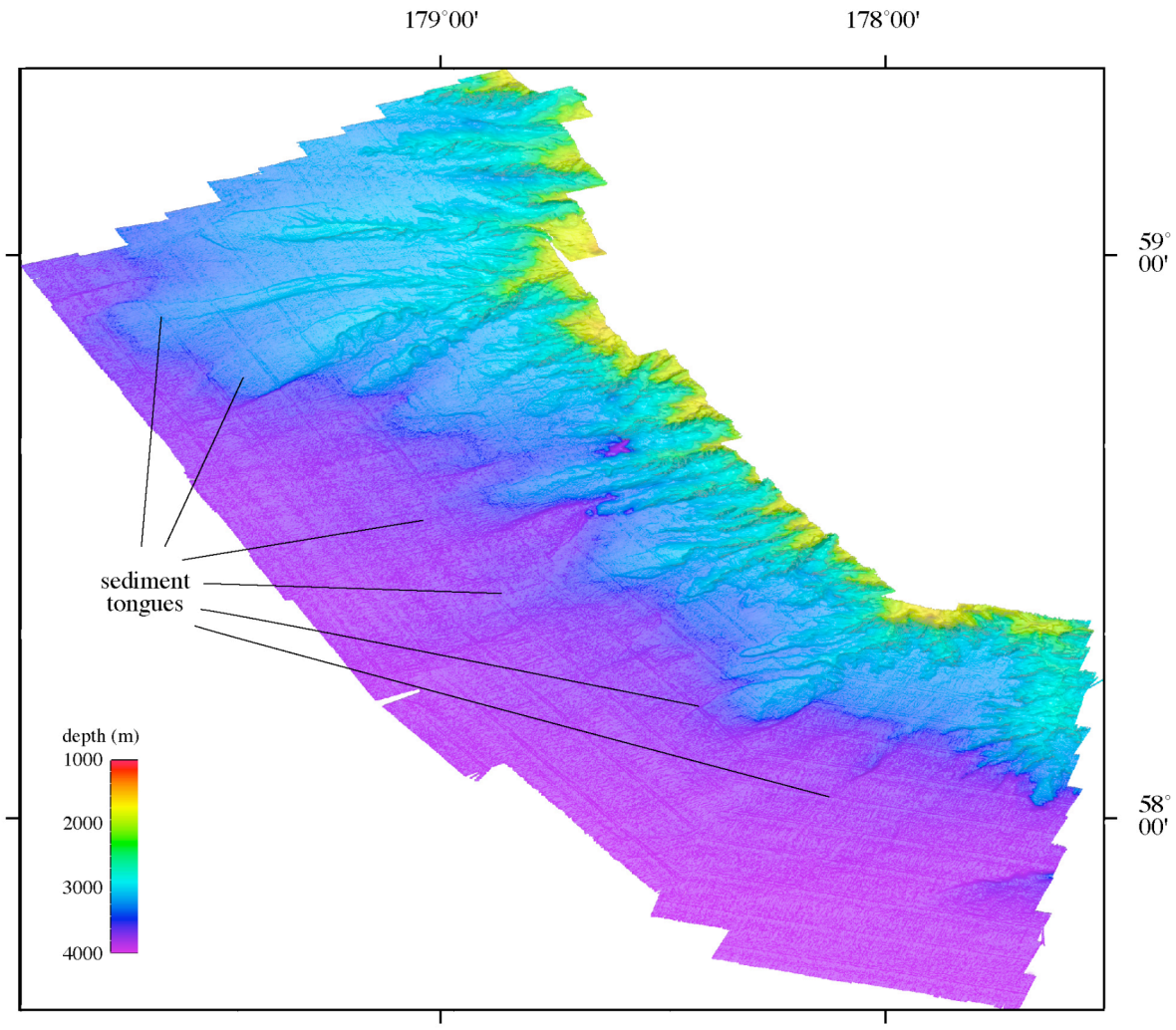

Figure 3. Color-coded shaded relief map of NW Beringian margin. Note the large sediment tongues extending far out onto the basin floor.

Both Arctic Ocean cruises were conducted on the U.S.C.G Icebreaker *HEALY* using its hull-mounted 12-kHz Seabeam 2112 MBES system. Our first cruise, during August and September 2003 was designed to explore the feasibility of using an icebreaker-mounted MBES system to locate and follow critical bathymetric targets in this region. Our exploratory mission demonstrated the viability of this approach because in 10 days we were able to collect about 3000 km of MBES bathymetry along the 2500-m isobath

and reach 79°30'N in 8/10 ice conditions. The collection of these data substantially changed the mapped position and complexity of the 2500-m isobath, found further evidence for pervasive ice and current erosion (flutes and scours) in deep water, found evidence for gas-related pockmarks and discovered a previously unmapped seamount rising more than 3000 m above the surrounding seafloor. The limited time available prevented us from collecting more than one or two swaths over any area of the margin, with the exception of the seamount that we fully mapped and named "Healy Seamount."

A 20-day Arctic cruise aboard *HEALY* in 2004 had the objective of completing the mapping the 2500-m isobath and locating the foot of the slope on the Chukchi Borderland. This cruise was conducted later in the season (October and November) and encountered very heavy ice (9/10 to 10/10). We were able to progress to 78°45'N in these ice conditions and added an additional 370 km to our mapping of the 2500-m isobath but we were unable to survey the foot of this slope. As a fallback, we proceeded to completely map an approximately 18,500-km^2 region of the Alaskan margin northeast of Barrow that encompassed a depth range from approximately 800 m to 3700 m (Fig. 4).

The MBES coverage of the Barrow margin shows a remarkable set of parallel, asymmetric ridges and valleys spaced ~10 km apart and rising >500 m high (Fig. 5). The ridges consistently have gentler eastward-facing slopes and steeper westward-facing

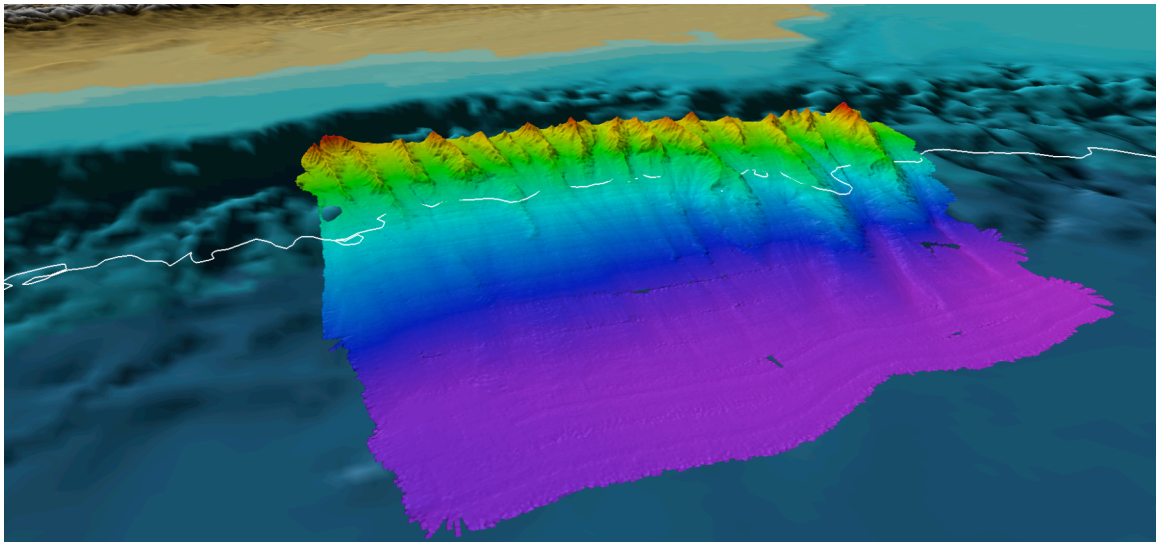

Figure 4. Perspective color shaded relief view of the Barrow margin, Arctic Ocean. Background bathymetry is from IBCAO (Jakobsson, 1999). White line is 2500-m isobath. Vertical exaggeration 6x. View is looking south.

slopes. High-resolution subbottom profiler records show that the gentler, eastward-facing slopes are typically covered by well-stratified sediments whereas the steeper slopes are not, implying that sediment has been transported from east to west with sediment accumulation on the current-facing slopes.

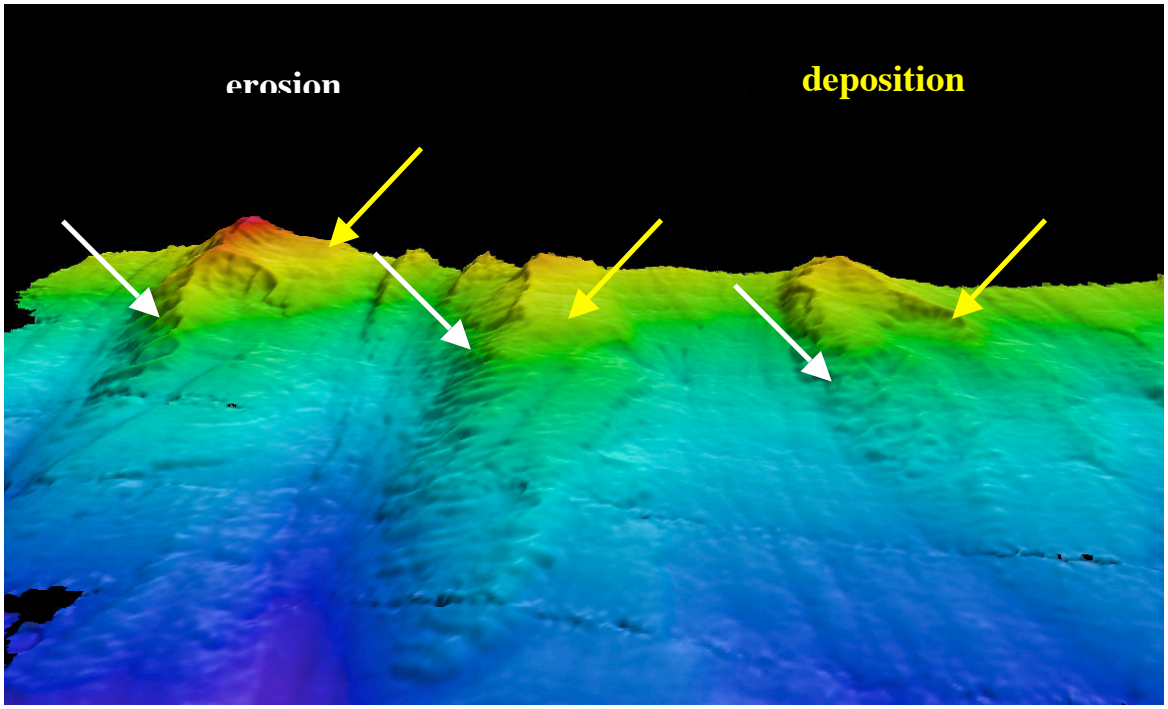

Figure 5. Perspective color shaded relief view of a small portion of the Barrow margin, Arctic Ocean. White arrows point to erosion, yellow arrows point to sediment deposition. Vertical exaggeration 6x. View is looking south.

U.S. Atlantic Continental Rise

About 75% of the U.S. Atlantic continental rise was mapped in 2004 (Fig. 6) using a hull-mounted 12-kHz Kongsberg Simrad EM121A on USNS *Hensnon* (T-AGS 63), a survey ship operated by the Military Sealift Command in support of Naval Oceanographic Office (NAVOCEANO) programs. NAVOCEANO personnel carried out the data acquisition and SAIC of Newport, RI was contracted to process the bathymetry data. The objective was to map the continental margin between the ~1000-m isobath and the foot of the slope.

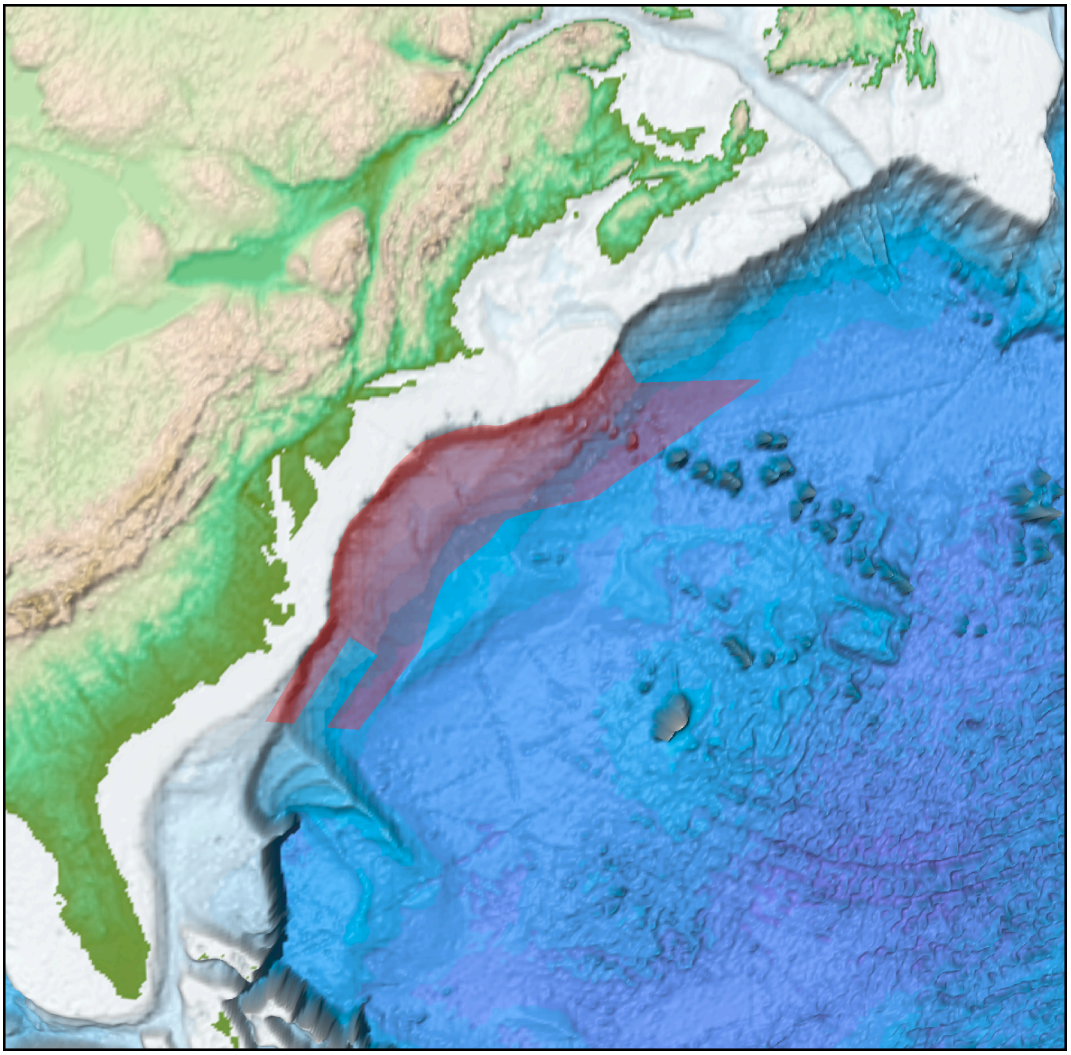

Figure 6. Red polygon is area of the U.S. Atlantic continental rise mapped in 2004.

The major features revealed in more detail by the new bathymetric data include the numerous submarine canyon channels, most of which have been known for decades, the western portion of the New England Seamounts, also some of which have been previously mapped, and the broad areas of sediment failures that blanket the present seafloor (Fig 7).

The upper continental rise has a dense network of submarine canyons and canyon channels that have fed sediments to the margin for millions of years. There are several

areas on the lower continental rise where channel heads abruptly appear, with no upslope continuity with any observable feature. These features may represent fluid seeps.

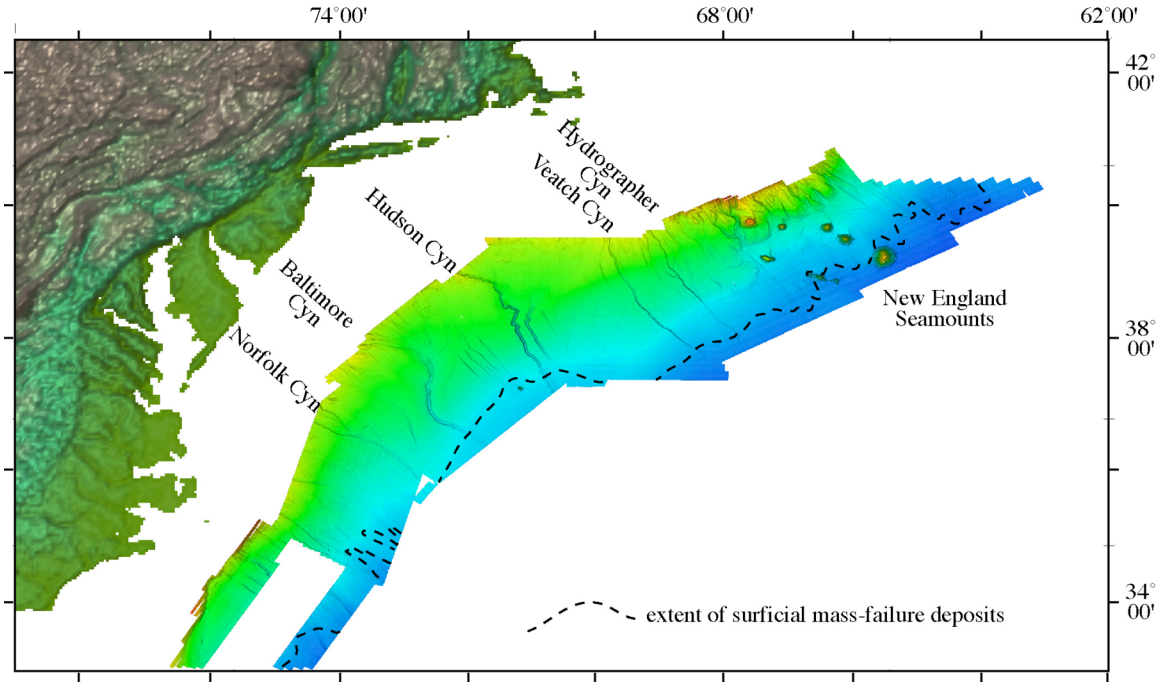

Figure 7. Multibeam color-coded bathymetry of the U.S. Atlantic continental rise. Only a few of the submarine canyons have been labeled. Dashed line shows approximate extent of surficial mass-failure deposits.

The entire mapped length and about 80% of the mapped width of the continental rise is mantled by landslide deposits. The landslides NE of Hydrographer Canyon form tongues of sediment that stream to the SE for more than 100 km over slopes <0.2°. Southwest of Hydrographer Canyon, the landslides form a continuous wedge of sediment that extends to the limit or beyond the mapped area.

(Note: Contact author for references)