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AUV and Multibeam Survey on the South Florida Escarpment

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Abstract

Florida Escarpment is the steep, rugged, western edge of the Florida carbonate platform. It is a poorly-surveyed but geologically complex feature. A small portion of the southern escarpment was surveyed as part of a project funded by the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration to better understand the geology and habitats of the escarpment. The mapping was carried out by C&C Technologies, Inc., using a surface multibeam echosounder and an Autonomous Underwater Vehicle (AUV), whose instrumentation included a multibeam echosounder, side-scan sonar, and chirp subbottom profiler. Surface multibeam bathymetry data cover 734 km^2 and reveal three northeast-trending canyons incised into the southeast-trending escarpment, which is 750-1300 m in height. Multibeam backscatter data show strong returns from the canyon walls and from talus at the escarpment base. AUV data cover 66 km^2 at the escarpment base and on the platform, the escarpment wall being too steep for the AUV to survey. AUV data show vastly higher resolution with features <5 m in diameter visible in sonar backscatter images. These data indicate that the summit platform is mantled with sediment and contains numerous small mounds similar to carbonate bioherms imaged in other locations. The mounds are typically several tens of meters in diameter or less and can be up to tens of meters in height. Some are isolated, but many occur in clusters and mound fields. AUV data from the platform show a remnant ridge, blocky terrain, and headwall scarps at the platform edge adjacent to the canyons. At the escarpment base, side-scan sonar images show many rock outcrops protruding from sedimentary aprons. These outcrops have a large range in height and complexity, with some barely emergent. Many are linear and nearly perpendicular to the escarpment. Some appear to be piles of rock from mass-wasting of the escarpment face. On both the platform and at the escarpment base, AUV data show current scour or sediment sorting features trending northwest, indicative of strong currents from the southeast. Acoustic images suggest these currents are particularly strong and potentially erosive at the escarpment base.

Introduction

The Florida Escarpment is one of the outstanding bathymetric features of the Gulf of Mexico, a steep declivity standing in places more than a mile (1.6 km) high above the abyssal seafloor and stretching about 390 miles (622 km) from DeSoto Canyon at 29.5° N to the Straits of Florida at 24° N (Figure 1). Florida Escarpment is the western edge of the Florida carbonate platform, a thick accumulation of calcareous sediments deposited as a reef-bounded system mainly during the Cretaceous period[1-3]. Slopes on the escarpment are frequently greater than 40° and vertical or near vertical cliffs are not uncommon[4]. Outcropping platform interior sediments imply that erosion has cut into the platform edge by several kilometers[5-6]. South of approximately 27°N, the platform edge is incised by numerous canyons that appear to have an erosional origin, perhaps owing to corrosion by groundwater seeping out the platform edge[7-9].

Although the gross morphology of the Florida Escarpment has been known for some time, detailed geologic data are few because of the inaccessibility of the feature owing to its distance offshore and depth beneath the sea surface. A small number of submersible dives have allowed scientists to examine the geology and biology at a few locations along the escarpment[4,10]. Those observations show that in many places the escarpment provides a hard limestone surface onto which organisms can attach themselves as well as crevices in which they can hide. Furthermore, groundwater seeping from the platform can provide a source of methane to support chemosynthetic organisms and associated ecosystems[11]. The escarpment is near the location where the Yucatan and Florida surface currents form a loop (the "Loop Current") that extends into the Gulf of Mexico[12]. These currents transport a large amount of water southward past the escarpment in the exit leg of the loop. The escarpment thus may be a hard sea bottom substrate extending into nutrient-carrying currents, which could make it a favored location for filter feeding organisms.

Because the geology of the Florida Escarpment is poorly known and the geology and location seem conducive to seafloor ecosystems, this project was designed to obtain high-resolution geophysical data as a possible prelude to other detailed exploration. Funding was provided by the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration to collect multibeam echosounder bathymetry and backscatter data from a surface ship and high-