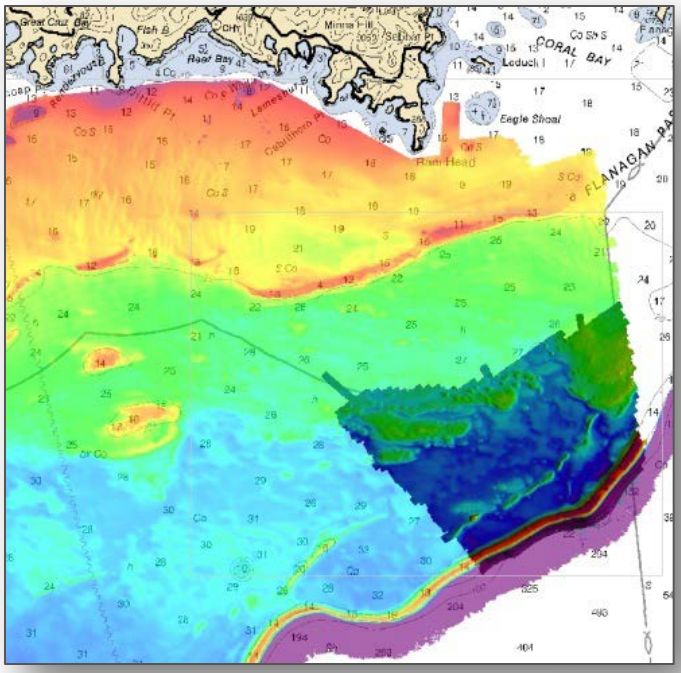
NOAA CORAL REEF CONSERVATION PROGRAM

Sea Floor Characterization of the U.S. Caribbean
2011 Field Season
Day 19: April 15, 2011

All Good Mapping Must Come to an End

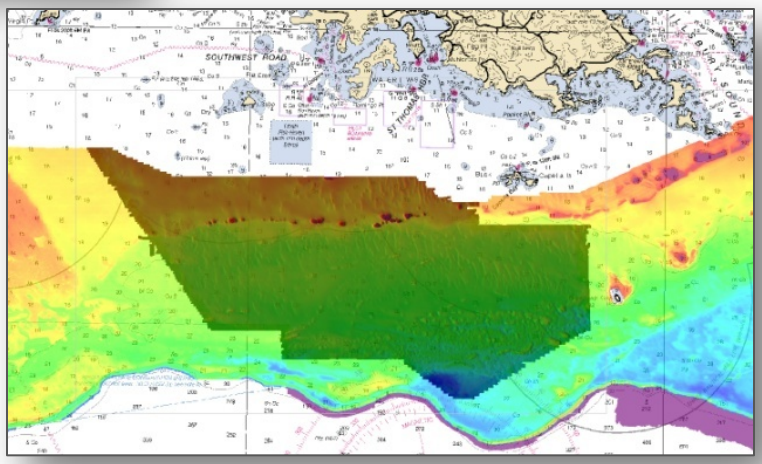
The Beam Teams wrapped up the mapping at midnight on April 14th, so that Team Fish Acoustics could start tracking fish continuously over 48 hours. They planned to compare differences in fish distributions during the day and the night, and possibly detect movement across habitat during what are thought to be the peak times for activity – around sunrise and sunset. Since then the Beam Teams have been wrapping up their processing and developed some figures that highlight some of the accomplishments.



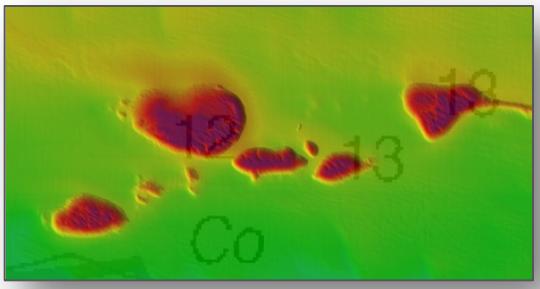
The map to the left reflects the area south of St. John that has been mapped using multibeam acoustic technology. The paler colored areas were mapped via seven separate efforts prior to this cruise, some by NOAA and some by other federal agencies. The darker shaded area in the bottom, right corner, represents the area mapped during the first leg of the cruise. The warmer colors reflect shallower areas and the cooler colors reflect deeper areas. The green clusters are coral reefs and the purple represents where the shelf drops off steeply to ~ 2,000 feet.

The map below reflects the area south of St. Thomas that has been mapped. Like the previous map the darker colors represent the area mapped during this cruise. The deep red spots are shallow coral patch reefs.

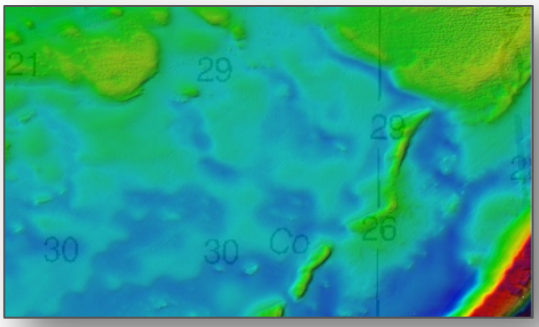
Above: Nautical chart of the shelf south St. John (top left corner) overlaid with the last 7 years of multibeam mapping (paler shaded colors) and the area mapped during this cruise (deeper shaded area)



Nautical chart of the shelf south of St. Thomas (top) overlaid with previous years of multibeam mapping (paler shaded colors) and the area mapped during this cruise (deeper shaded area)



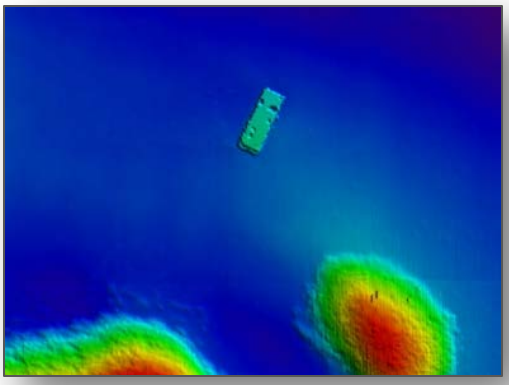
Zoomed in area of the shelf south of St. Thomas to highlight patch reefs (in red)



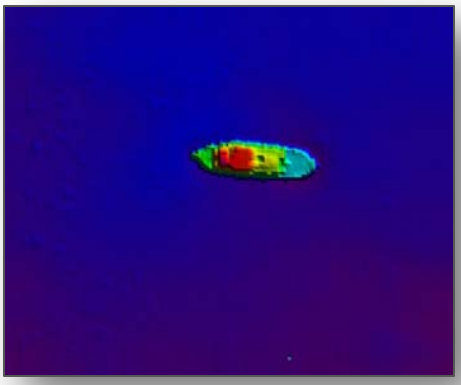
Zoomed in area of shelf south of St. John to highlight coral reef features (in yellow-green)

The two images above are zoomed in areas of the shelf mapped during this cruise, and underscore some of the secondary uses for this data. The left image clearly shows shallow patch reefs in red overlaying a nautical chart, with the depth information. As you can see, the areas marked as shallow (12, 13, and 18 ft) coral (Co) reefs on the chart line up fairly well with the shallow (red) areas detected by the multibeam. In contrast, in the right image, the shallow areas on the nautical chart don't line up as well to the coral reef features, especially the one in the top right corner. This new, groundtruthed information will be useful for updating the nautical charts!

Below are two multibeam sonar images capturing two of the six uncharted wrecks discovered while mapping on this cruise. The image on the left depicts some kind of barge, but the team did not have the time to send the ROV to video this wreck. The image to the right is of a tugboat, and we did do an ROV dive for the tug. As you can see in the image, the boat has three decks of different heights (since different colors indicate different depths).



Multibeam sonar image of a wrecked barge



Multibeam sonar image of a wrecked tugboat

Since the dive was done at sunset, the wreck was ~ 130 feet below the surface, and the water wasn't completely clear, we did not get a good still photo of the entire wreck, but below are some close-ups of the tugboat, which was surprisingly intact.

How did the Virgin Islands form?

The U.S. Virgin Islands are part of a chain of volcanic islands tracing the eastern boundary of the Caribbean tectonic plate. This chain of islands, known as the **Lesser Antilles Volcanic Island Arc**, extends from the Virgin Islands in the north to Grenada in the south. The Lesser Antilles Volcanic Island Arc was formed between 120 million and 35 million years ago as a result of the North American plate sliding under the Caribbean plate in a process called **subduction**.

Map of the Caribbean, depicting the locations of the North American (tectonic) Plate and the Caribbean Plate

What happens during subduction? As the Caribbean plate moves eastward and the North American plate moves westward, the leading edge of the more dense North American plate is forced to slide beneath the less dense Caribbean plate; the Caribbean plate is subducting the North American plate. The boundary between the two plates occurs at the Puerto Rico Trench, which is over five miles deep.

As the oceanic lithosphere of the North American plate plunges down into the deep mantle beneath the Caribbean plate, the seawater trapped within the crust rises into the overlying mantle. This lowers the pressure, and thus the melting point, of the surrounding rock, causing pockets of magma to form. Since magma is less dense than the surrounding rock, it rises towards the surface and eventually erupts at the seafloor, where it cools into rock. As these eruptions took place over and over again over millions of years, a whole range of undersea volcanoes developed along the eastern edge of the Caribbean plate, directly above where the leading edge of the North American plate continues to dive down. Through the combination of volcano growth and changes in sea level, eventually some of these volcanoes poked above the surface of the ocean and became the island chain known today as the Lesser Antilles Volcanic Island Arc. Years and years of weathering on the exposed rock produced enough soil to support the first plant life on the islands. The volcanoes that formed the Virgin Islands are no longer active today; however, farther south in the island chain seventeen volcanoes are still active.

What about St. Croix? Although it is part of the Virgin Islands, the island of St. Croix has a different geologic story. Unlike the other islands, St. Croix was never a volcano. The hills on St. Croix are thought to have been composed of volcanic debris from nearby activity. Limestone exposed in the flatter parts of the island suggest that most of the island is the remains of an ancient shallow water coral reef.