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Gulf Stream variability in western North Atlantic off Cape Lookout, North Carolina

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Cold-water coral mounds are common on the SE slope of the US (SEUS) from Florida to Cape Hatteras between depths of 400-600 m. The coral areas lie in the vicinity of the Gulf Stream, which is characterized by strong currents transporting relatively warm water northwards along the SEUS slope. Thus far little is known about the environmental conditions inside the SEUS coral communities and particularly the effects of the nearby Gulf Stream.

Near Cape Lookout (North Carolina margin) cold-water corals have formed mound structures, which have a teardrop shape with a sediment tail at the lee side of the mounds, indicating the presence of a strong uni-directional current. The mounds were found to be partly covered with living Lophelia pertusa colonies and partly with sediment and dead coral framework. A 3.4 m long piston core was collected in 2010 during a cruise with the RV Pelagia. This pistoncore was used to determine the changes of the current strength in time in the study area. Different measurements including foraminiferal counts, stable oxygen and carbon isotopes, XRF and magnetic susceptibility were carried out to determine the changes in current strength in the area. Furthermore, cold-water coral fragments were dated with U/Th and foraminifera from the same depth intervals were dated with C14. Datings show that all corals have the same age around 5500 years. However, the sediment in between the corals showed ages ranging between 4700 and 13000 years.

Based on the foraminifera data three zones could be observed in the core. Zone 1 ranges between 13000 and 10000 years, zone 2 between 10000-7200 years and zone 3 between 7200-4700 years. These zones all show the gradual onshore movement of the Gulf Stream, that can be related to a rapid rise in sea level as a response to the last deglaciation. This movement has gradually widened the band of the Gulf Stream, thereby compressing the surface and deeper water masses. The strength of the current decreased when fresh water outflow to the North Atlantic weakened the thermohaline circulation, which was especially clear in zone 2. Around 8200 years the thermohaline circulation was even more reduced, due to a meltwater pulse of lake Agassiz and Ojibway. At this time the foraminifera indicate that the current at Cape Lookout was very weak.