ENDEAVOR 214 CRUISE SUMMARY: THE GULF STREAM--DEEP WESTERN BOUNDARY CURRENT CROSSOVER

Robert S. Pickart (WHOI) and William M. Smethie (LDGO)

In late June a 15 day hydrographic cruise aboard R/V ENDEAVOR was undertaken to investigate the manner in which the deep western boundary current (DWBC) crosses under the Gulf Stream. Five sections were occupied: two upstream of the crossover, one at the crossover, and two downstream.

A total of 41 bottom casts were made (plus three additional casts to 1500 m on the last section). To identify the DWBC cores, measurements of oxygen, freons and nutrients were carried out. In addition, an acoustic transport float (POGO float) was dropped at the end of each CTD cast to obtain a measurement of the upper layer transport. This information will be used later to reference the geostrophic velocities. The shipboard acoustic doppler current profiler (ADCP) was running throughout the cruise as well. At each section an attempt was made to cross both the deep current and the Gulf Stream. While in the Gulf Stream XBTs were dropped between the CTD stations for increased resolution. As it turns out the Gulf Stream was not completely crossed on the southern two sections (where it is still near the continental shelf). Figure 2 shows the complete set of POGO vectors which were processed aboard ship. The Gulf Stream is clearly evident at each section (it should be noted that the inshore-most Gulf Stream vectors on sections 4 and 5 are only to 400 m and 200 m respectively). At the northern sections the upper layer transport inshore of the Gulf Stream is to the southwest as is the offshore transport south of the crossover (although the vectors at section 5 are more disorganized and two values are missing). How much southward transport (deep or shallow) turns around and gets recirculated with the Gulf Stream versus passing under it will be investigated.

The various chemical data will aid greatly in determining the fate of the northern waters as they encounter the Gulf Stream. The deep component of the DWBC is easily detected by its core of high oxygen, high freons and low silicate, while the shallower component is characterized by a second freon maximum. Figure 3 shows the vertical sections of freon-11 for the five sections; both cores were present at every section. North of the Gulf Stream the shallow core was near 700-800 m (Figures 3d, 3e), south of the crossover this core was near 1300-1400 m (Figures 3a, 3b). In the section right at the crossover (Figure 3c) one sees this transition as the plume of high freon dives to greater depths following the isotherms of the Gulf Stream front. Note that the lower freon core extended somewhat deeper south of the stream as well. It will be enlightening to make lateral property maps on density surfaces as well as compute the geostrophic transports within the different layers. It should be mentioned that the ability to obtain absolute geostrophic velocities (using the POGO floats) is extremely valuable; both the deep Gulf Stream and DWBC have the same sense of thermal shear so it is not obvious from the density alone whether the deep flow does in fact reverse.

Section 3 near the crossover point coincided with the central mooring line of the SYNOP Inlet Array. This line contains five bottom current meters positioned between inverted echo sounders (IESs). The hydrographic stations were occupied at the IES sites. This newly collected density and tracer data will aid in interpreting the moored results (and vice versa). The use of the upper layer POGO vectors to reference the geostrophic velocities will be compared with using the bottom current meter velocities and ADCP velocities.