ACCESS NUMBER: 30501

STUDY TITLE: Ship of Opportunity Hydrographic Work in the NW Gulf of Mexico

REPORT TITLE: Ship of Opportunity Hydrographic Data from the NW Gulf of Mexico from R/V Gyre Cruises 94G-11 and 95G-01

CONTRACT NUMBER: 14-35-0001-30501

SPONSORING OCS REGION: Gulf of Mexico

APPLICABLE PLANNING AREAS: Western, Central, and Eastern Gulf of Mexico

FISCAL YEARS OF PROJECT FUNDING: 1990, 1991, 1992, 1993, 1994, 1995

COMPLETION DATE OF REPORT: September 1995

COSTS: FY 1990: $40,200; FY 1991: $40,000; FY 1992: $40,000; FY 1993: $40,000; FY 1994: $40,000; FY 1995: $40,000

CUMULATIVE PROJECT COST: $240,000

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KEY WORDS: Western Gulf of Mexico; Central Gulf of Mexico; Eastern Gulf of Mexico; Loop Current; eddies; rings; LATEX; ship of opportunity; hydrographic data; CTD; XBT; nutrients; salinity; oxygen; chlorophyll; dynamic topography; geostrophic transport

BACKGROUND: In September 1989, the U.S. Minerals Management Service (MMS) and the Department of Oceanography of Texas A&M University (TAMU) entered into a 4-year Cooperative Agreement 14-35-0001-30501 for TAMU Marine and Electronics Technicians to collect CTD, XBT, and other Ship of Opportunity Program (SOOP) hydrographic data from the Gulf of Mexico, as sciences/station schedules allowed, while they were at sea on research cruises. SOOP hydrographic data were collected on 11 cruises from Nov 1989 - Apr 1992 in the Western, Central, and Eastern Gulf of Mexico prior to the start of fieldwork for the Texas-Louisiana Shelf Circulation and Transport Processes Study (LATEX), and SOOP data collection was continued on 12 more cruises from May 1992 - Sep 1993 separately but concurrent with cruises fielded by LATEX. This MMS-TAMU SOOP Cooperative Agreement 14-35-0001-30501 was continued and extended twice: (1) for a fifth field year from Oct 94 - Jun 95 to allow data to be collected concurrent with the final LATEX field work, and subsequent to LATEX in 1995 in cooperation with Mexican Navy survey work in the Yucatan Channel.

OBJECTIVES: (1) To collect XBT, CTD, and bottle data as science/station schedules allowed from deepwater and continental margin environments of the Western Gulf of Mexico in order to extend the existing knowledge of seasonal and geographic variability there; (2) to extend this hydrographic data collection into the Central and Eastern Gulf of Mexico, on transits of opportunity through these regions while research vessels deadheaded between Galveston, Texas, and the Straits of Florida or Yucatan Channel; and (3) to compare differences in sea surface height and other hydrographic characteristics of "young" Loop Current eddies encountered in the Central Gulf with those of "old" eddies in the Western Gulf of Mexico.

DESCRIPTION: TAMU technicians made 373 CTD casts and 271 XBT drops of opportunity during 22 cruises of R/V Gyre and 1 cruise of R/V *Powell* between Oct 1989 and Sep 1993 (Fig. 1). The data were collected during NSF-, Navy-, and DOE-sponsored cruises, as well as during cruises dedicated to State-sponsored graduate training and research, and to oil and gas industry sponsored piston coring. In addition, 23 CTD casts were made from an offshore gas production platform owned by Mobil Exploration & Production USA at 27°54.2'N, 93°34.4'W in lease block HIA-389 during a 3-week period in summer 1991. TAMU Technical Report 93-09-T is a synopsis of these first 4 years of MMS-TAMU SOOP work (Biggs, 1993).

TAMU technicians made 130 CTD casts and 329 XBT drops of opportunity during 11 cruises of R/V Gyre, 1 cruise of R/V Powell, and 1 cruise of B/O *Antares* between Oct 1993 and Jun 1995 (Fig. 2). The data collection from Gyre and Powell was again done during federally-sponsored cruises, as well as during cruises for State-sponsored graduate training and research, and for oil and gas industry sponsored piston coring. MMS-sponsored Ship Of Opportunity Program hydrographic data collection was completed in June 1995, with a 2-ship hydrographic survey of Eddy Zapp, the Loop Current, and the Yucatan Channel carried out by R/V Gyre from TAMU in cooperation with B/O Antares from the Direccion General de Oceanografia naval (DGON) of the Mexican Navy.

All these CTD and XBT casts of opportunity were made in addition to those done on 10 hydrographic cruises made Apr 1992 - Nov 1994 for the Texas-Louisiana Shelf Circulation and Transport Processes study (Dr. W.D. Nowlin, Jr., P.I.).

SIGNIFICANT CONCLUSIONS: The TAMU-SOOP hydrographic data document these is a strong positive correlation between the depth of the 15°C isotherm (x) and the dynamic height relative to a reference level of 800 db (y): $y = 0.26x + 54$ ($r^2 = 0.93$). There is also a strong positive correlation between the sea surface height (SSH) anomaly of the Loop Current and the eddies it shed 1989-1995 (x) and the geostrophic transport (y) : $y = 0.42x - 0.7$ ($r^2 = 0.95$).

STUDY RESULTS: In general, most of the TAMU-MMS SOOP CTD stations of opportunity are concentrated on the LATEX shelf in the NW Gulf of Mexico, in particular along transects off Galveston and off Corpus Christi, Texas, which were revisited as

part of the Texas Institutions Gulf Ecosystem Research initiative (Biggs, 1990). In contrast, most of the TAMU-MMS SOOP XBT stations are seaward of the LATEX shelf. Those over deep (>2 km) water were dropped during basin wide transits of opportunity to/from Galveston and the Straits of Florida and the Straits of Yucatan. These transits of opportunity crossed Quiet Eddy (Oct 90), Eddy Triton (Oct 91), and Eddy Zapp (Jun 95). When Quiet Eddy reached the western Gulf, it was revisited in Mar 1991 during a follow-up cruise that was fielded as part of the TAMU-Mexico cooperative program Analysis Multidiciplinario de Investigaciones en el Golfo Occidental (AMIGO). Two other cruises in the western Gulf revisited Eddy Triton in May-Jun 1992 (biggs et al., 1994). AMIGO/TIGER cruises also surveyed the companion cylonic eddies that appear to be created when these Loop Current rings experience the shoaling topography of the western Gulf and transfer mass/vorticity to the adjacent slope water (Biggs et al., 1991).

Hydrographic data collected by TAMU-SOOP field programs are of interest for data assimilation into general circulation models of the northern Gulf of Mexico and for ongoing studies of the Loop Current and the eddies that shed from it (Biggs, 1992; Biggs et al., 1996). A synthesis of TAMU-SOOP hydrographic data with CTD + XBT data collected by the GulfCet program (Dr. R.W. Davis, P.I.) and AXBT data collected by the LATEX Eddy program (Dr. T.J. Berger, P.I.) is underway to allow us to better understand the processes by which Loop Current eddies "spin down" in the western Gulf of Mexico. Since the launch of TOPEX/Poseidon in Fall 1992, this synthesis has been used to provide "sea truth" verification of TOPEX altimetry in the Gulf of Astrodynamics Research (Leben et al., 1993). Presentations were given by Biggs, at meetings of AGU and IUGG; abstracts of these presentations are published in *EOS Trans. AGU*, and several cooperatively authored manuscripts are in preparation for *J. Geophys. Res*.

STUDY PRODUCTS: The Oct 89 - Jun 95 hydrographic data were published as a series of 28 TAMU technical reports, each released 1-2 months after each cruise of opportunity. The XBT, CTD, and bottle data archived in these reports were also shared in digital format with NOAA's National Oceanographic Data Center (NODC) as LATEX supplement code 0215. Citation information for the 28 reports is provided as Appendix 1. A useful synopsis of the first 18 reports is:

Biggs, D.C. 1993. A -synopsis of hydrographic data from the TAMU Ship of Opportunity

Program: XBT, CTD, and bottle data collected from the Gulf of Mexico November 1989 - September 1993 by the Technical Support Services Group, TAMU. Technical Report 93-09-T, TAMU Dept. of Oceanography. 40 pp.

OTHER STUDY PRODUCTS:

Biggs, D.C. 1990. The Texas Institutions Gulf Ecosystem Research initiative: Multi-year, repeated hydrographic surveys in the NW Gulf of Mexico continental shelf and slope, pp. 175-181. *In* Proceedings, 10th Annual Information Transfer Meeting, U.S.

Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 90-0027.

Biggs, D.C. 1992. Nutrients, plankton, and productivity in a warm-core ring in the western Gulf of Mexico. J. Geophys. Res. 97(C2): 2143-2154.

Biggs, D.C., M.M. Crawford, D. Salas de Leon, O. Salas Flores, and S. Escoto Hidalgo. 1991. A United States-Mexico cooperative study of a cold-core ring in the western Gulf of Mexico, PP. 374-380. Proceedings, 11th Annual Information Transfer Meeting. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 94-0061.

Biggs, D.C., G.S. Fargion, P. Hamilton, and R.R. Leben. 1996 (in review). Cleavage of a Gulf of Mexico Loop Current eddy by a deep water cyclone. J. Geophys. Res., manuscript WSB-0381; submitted 3/23/95; revised and resubmitted 1/15/96.

Leben, R.R., G.H. Born, D.C. Biggs, D.R. Johnson, and N.D. Walker. 1993. Verification of TOPEX altimetry in the Gulf of Mexico. TOPEX/Poseidon Research News, 1: 3-6.