Deep Water Oceanography
Capability Enhancement for IMP

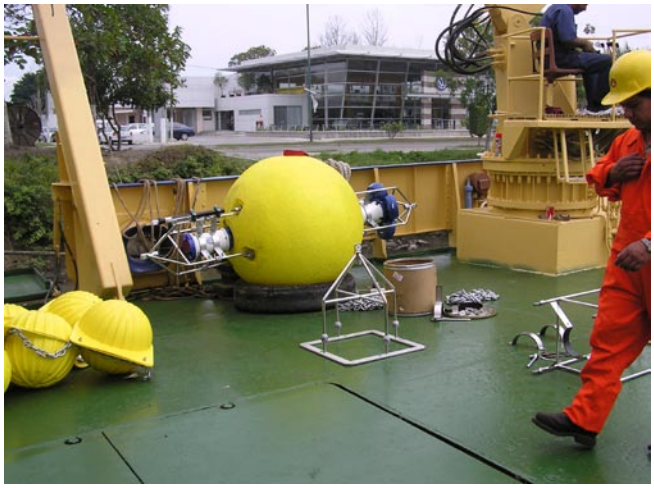
Project Characteristics:

- *Deepwater Moorings in Gulf of Mexico*
- *Hydrographic (CTD) Surveys*
- *Acoustic Doppler Velocimeters*
- *Deepwater Current Measurements*
- *Data Processing and Analysis*
- *Training Program*
- *Onsite Client*

Instituto Mexicano Del Petroleo (IMP) requires knowledge of current variability in the deep western Gulf of Mexico in support of future oil drilling operations. The IMP capability enhancement project focused on training an engineering team from IMP in mooring design, instrumentation, deployment and recovery operations as well as data processing and analysis. The program consisted of pre and post-deployment training sessions. As a part of a capability enhancement and training program, IMP, in cooperation with Woods Hole Group, deployed a deepwater mooring in January 2005 off Nautla, Mexico, at approximately 1500 m depth. The mooring was recovered 27 days later.

The basic instrumentation package consisted of an upward-looking 300 kHz RDI Workhorse ADCP; two downward-looking 75 kHz RDI Long Ranger ADCPs, measuring ocean currents from near the surface down to about 950 meters; and, two Aquadropp single point current meters, measuring currents approximately 90 m and 290 m above the bottom. The Workhorse and a 75 kHz ADCP were mounted on the upper float of the mooring (Figure) and were deployed at a depth of 75 meters, with the Workhorse looking upward and the Long Ranger looking down. The other 75 kHz ADCP was deployed at a depth of 500 meters in a downward looking position. The two Aquadopps were deployed at depths of 1223 and 1426 meters to collect current data in the layer below the reach of the lower 75 kHz ADCP. The mooring deployment and recovery operations were accompanied by CTD surveys of adjacent areas.

During the deployment period, the oceanographic conditions were characterized by the presence of an anticyclonic eddy in the area north of 22°N, slowly propagating in the general southward direction. At the deployment site, the mean flow had a three-layer structure associated with the major features of density stratification: an upper mixed layer, a main pycnocline, and a deep layer characterized by weak density stratification.



*On board R/V **Justo Sierra**: 300 kHz Workhorse and 75 kHz Long Ranger mounted on the upper float*

At all depths, the variance of current velocity and velocity shear was dominated by oscillations with a period close to the inertial period, which is about 34 hours at the latitude of the deployment. Mean and low frequency currents were generally weak, which allowed the inertial oscillations to be observed clearly. The velocity and shear records were characterized by a superposition of upward and downward-sloping bands representing clockwise-rotating upward and downward-propagating near-inertial waves with observed frequency of about 0.95 of f_0.

The vertical wavelength varied in the range from about 300 to 800 meters, and the wavelength did not depend on the density stratification of the layer or orientation of the wave number vector. Typically, a packet of 5-10 near-inertial waves was characterized by a fixed vertical wavelength, regardless of the part of the water column where it was observed. The frequency spectra of velocity oscillations were characterized by an appreciable blue shift of the near-inertial peak suggesting the waves were generated at some distance to the north in the area of interaction of the anticyclonic eddy with the slope topography.

The results from the measurement program will be used to plan future offshore oil exploration activities and larger-scale measurement programs.

WOODS HOLE GROUP