GEOLOGY, HYDROLOGY, AND BIOLOGY OF THE FLOWER GARDEN BANKS, NORTHWEST GULF OF MEXICO

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ABSTRACT

The East and West Flower Garden Banks, situated approximately 100 nautical miles south of Sabine Pass, represent the northern limit of flourishing coral reef growth in the Gulf of Mexico. The reefs are located on the crests of salt diapirs. They are surrounded by aprons of carbonate sediments which are created more or less *in situ* and interfinger downslope with the normal terrigenous sediments on this portion of the continental shelf. The sea-bottom at the base of the banks varies from 100 to 180 meters in depth. The crests of the reefs lie at depths of approximately 20 meters. The reef biota is a typical West Indian reef assemblage except for the absence of the Emergent Reef Community.

The biological zones at the Flower Garden Banks are bathymetrically controlled. The living reef consists of three zones: 1) *Diploria-Montastrea-Porites,* 2) *Madracis,* and 3) *Stephanocoenia.* These zones correspond to the Reef-Bank Communities of the West Indian reefs. The Algal-Sponge Zone which lies below the living reef zones is equivalent to the Bank Communities of the West Indian Reefs. Below the Algal-Sponge Zone is a Transition Zone between the clear-water biota above and the turbid-water biota of the Nepheloid Zone below. Table 1 shows the relationships between the biological zones and the sediment facies. The loose sediments around the reefs reflect the depth zonation of the biological communities. However, the sediment facies boundaries do not coincide with the biological boundaries. This is partly because of the downslope movement of sediment due to the force of gravity and partly due to the use of soft-bodied organisms in delineating the biological zonation (see Table 1). The bank sediments are carbonates derived from the skeletons of organisms living on the banks. The open-shelf sediments surrounding the banks are terrigenous sands and muds that have been transported to the Gulf by streams such as the Mississippi, Sabine, Trinity and Brazos Rivers. These sands and muds do not occur at depths shallower than 85 meters at the Flower Garden Banks.

From long term moored current meter records it is apparent that the mean near bottom flow (lowest approximately 10 meters) on the open shelf is directed obliquely offshore. Up in the water column the long term flow (periods $\geq$ 30 days) oscillates from eastward to westward. Near the banks, the flow is strongly deformed by the presence of the banks. The stream splits, accelerates along the isobaths, then reconverges on the downstream side of the bank. Cross isobathyal flow on the bank is negligibly small even under extremely fast flow (approximately 100 centimeters/second).

There are several periods at which the currents oscillate about the mean flow. The strongest of these oscillations is at the diurnal period with less energetic changes in the currents occurring at the semidiurnal period. The effects of storms may be seen in modulations of the flow having periods of 3 to 5 days.

The nepheloid layer during all of these flow phenomena remains trapped in the bottom boundary layer. There appears to be a background level of suspended sediment in continuous suspension in the nepheloid layer with episodic increases in concentration attending the flow modulations. Highest elevation above the bottom of resuspended sediment in the nepheloid layer coincides with the faunal break between clear water and turbid water organisms and the shallowest occurrence of silt and clay in the carbonate sand facies on the banks. The depth of this break is defined by the depth of the shelf surrounding the bank, not the absolute depth of the water.

Display will include maps showing the distribution of biological zones and sediment facies, bathymetry, a side-scan sonar mosaic of the West Flower Garden Bank, bottom photographs, current meter records and profiles of transmissivity, salinity, temperature, and velocity.

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Table 1. Biological Zonation and Sediment Facies.

BIOLOGICAL ZONE	DEPTH (meters)	SEDIMENT FACIES	DEPTH (meters)
Montastrea-Diploria-	*20-35*	Living Reef (massive limestone)	20-50
Porites			
Madracis	*28-46*	Coral Debris (coarse sand and gravel)	25-50
Stephanocoenia	*35-52*		
Algal-Sponge			46-88
Gypsina-Lithothamnium			*50-75*
		(coarse gravel and massive limestone)	
Transition	88-89	*Amphistegina* Sand (medium to coarse sand muddy at depths greater than 85 meters)	75-90
Nepheloid	> 89	Quartz-Planktonic Foraminifer (sandy mud)	> 90
		Mulluscan Hash (muddy sand)	> 90

TRACE FOSSIL ANALYSIS OF THE DEPOSITIONAL ENVIRONMENT OF A PORTION OF THE ANACACHO LIMESTONE, WHITE'S MINES QUARRY, UVALDE COUNTY, TEXAS

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ABSTRACT

Pholadid borings preserved as internal molds were collected from a narrow stratigraphic interval within the Cretaceous Anacacho Limestone in the White's Mines asphalt quarry near Dabney, in Uvalde County, Texas. Specimens were gathered from an abandoned bench in the quarry where they weathered from an enclosing shaley matrix.

The borings have a sac-like morphology, circular in cross section, with a wide base and narrow neck. The long axis is straight. Maximum diameter is 2 cm; maximum length is 4 cm. Shape is constant throughout the sample population. Many of the molds display a systematic concentric external pattern which extends from the base to midway up the boring. The borings may or may not show the development of an inner lining, which if present, is visible in the texture of the chamber wall. Most of the borings are vacant. However, a small number contain structures which may be nestling organisms or possible original shell material. All are filled with clastic debris dominated by abraided fossil fragments and lithic clasts.

These fossils are indicative of both a low-energy, relatively shallow-water marine environment and the development of a hard substrate. Deposition of this portion of the Anacacho Limestone, therefore, was not uniform and continuous, but was characterized by alternating periods of sedimentation and partial lithification, followed by rapid burial under coarse clastic debris. We suggest a general stable, shallow-water biostromal environment subject to periodic sudden influx of sediment, perhaps the result of storm tides.

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