SEISMIC EXPRESSION AND DIRECTLY OBSERVED CHARACTERISTICS OF SEEP-RELATED FEATURES, NORTHERN GULF OF MEXICO CONTINENTAL SLOPE

Harry H. Roberts[1] and Thomas W. Neurauter[2]

ABSTRACT

Acoustically amorphous seismic facies are present over the entire depth range of the continental slope. Recent research involving analysis of high resolution acoustic data coupled with "ground truth" observation and sampling via research submersibles (Pisces II, Johnson Sea-Link, and ALVIN) has provided new insight into the types and characteristics of modern sea floor features that have positive relief and are acoustically amorphous. All of these features investigated over the past 3 years have been associated with faults and hydrocarbon/brine seeps. They fall into three major categories: (1) mud volcanos and/or mud diapirs, (2) hydrate hills, and (3) carbonate mounds.

Mud volcanos and mud diapirs appear to form a continuum. Faults provide both a pressure release mechanism as well as an avenue of transport for fluid mud, liquids, and gases to the sea floor. Direct observations of mud diapirs and both active and inactive mud volcanos indicates that local carbonate cementation is taking place on the surfaces of these features. Analyses of cements reveal that they are commonly very C-13 depleted ($\delta^{13}C$ of –30 to –48% PDB) suggesting an origin related to microbial degradation of hydrocarbons. Crude oil and gas are common products from active mud volcanos (*e.g.* in Green Canyon Block 143).

In water depth below ~500 m mound-like features having amorphous seismic character may represent hydrate hills. These features are composed of a frozen mixture of fine grained sediment, water, hydrocarbon gases, and crude oil. Submersible observations and sampling indicate the presence of chemosynthetic communities and abundant authigenic carbonates from pellet-like nodules in the sediment to exposed hardgrounds. Geomorphically, no evidence of a central crater or ejected material was found on one such feature in Green Canyon Block 185. Hydrate hills tend to occur at the intersection of faults, have elliptical slopes, are at the apex of up-turned bedding, and connect with acoustically amorphous or chaotic sequences at depth. Discontinuous high amplitude surface and near surface reflectors commonly observed with these features appear to be locally cemented horizons.

Carbonate mounds frequently with 10–20 m relief occur on the highly faulted crest and upper flanks of salt diapirs. Their acoustically amorphous signature is in response to a hard substrata, rather chaotic structure, and the invariable presence of gas. Extreme C-13 depletion of constituent carbonates indicates an origin linked to microbial breakdown of hydrocarbons. These "false reefs" occur from the shelf edge to the basin floor and in a spectrum of sizes from sheetlike hardgrounds to massive mounds. The mounds are commonly steep-sided and crossed with crevasses reflecting faults and joints that function as seep sites. Chemosynthetic communities are frequently found in these crevasses.

[1] Coastal Studies Institute, Louisiana State University, Baton Rouge, Louisiana 70803
[2] ARCO Oil and Gas Company, 2300 West Plano Parkway, Plano, TX 75075