HGS Dinner—Poster 2

Gulf of Mexico evolution, from basement to seafloor

by Allen Lowrie and Susan Moffett

Petroleum exploration has entered a critical phase, with the search for hydrocarbons extending to deeper water and deeper strata. There is a real need to determine how the entire stratigraphic column responds to existent stresses, from basement to seafloor. To the present, there has been a genuine neglect of effects arising from basement and near-basement. Deep-sea surveys show the existence of mid-ocean ridges (MOR), extinct or active, intersected by fracture zones of various sizes, ranging from basin-spanning, first-order features at approximately 110 km spacing to much smaller features. Detailed bathymetry reveals that fracture zones are generally perpendicular to MOR and parallel to each other and that spreading ridge segments may be offset from each other. Free-air gravity data represents MOR, fracture zones, transitional and oceanic crust, and Louann Salt beneath sediment cover in the Gulf of Mexico.

Mapped fracture zone trends coincide with some salt trends north of the Sigsbee Escarpment. This may indicate a causal relationship. Deep-sea data suggest greater heat flux along fracture zones. Greater heat flux rising through overlying sediments should impact continuity of the Louann salt wedge and surrounding groundwater flow. Hot groundwater can transport hydrocarbons in solution, serving as part of the fluid migration system, and dissolve salt, re-precipitating it elsewhere.

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The Gulf of Mexico is seismically active in some regions, with at least 150 seismic events since 1963. These events occur at different depths: events less than 10 km deep occur within sediments; those between 10 - 20 km occur along sediment/basement interface, and those deeper than 20 km are within the crust. Earthquake data must be combined with other geophysical data in the emerging basin synthesis.

There is a need to discern how principal stresses within the continental margin operate. There is also the growth through time of the Gulf Coast geosyncline, which has been linked to extrusion of Louann Salt. The implications are that the salt transmits lateral stress. Review of geophysical data from the Nigerian and Gulf of Cadiz margins suggests the entire slope is sliding, similar to the Gulf of Mexico passive margin.The Louann Salt may diffuse the confining pressure, creating the Mississippi Fan foldbelt. Regional confining stress at base of slope, with possible basement interaction, makes the fan fold belt an area of dynamic geology. Finally, resolution of the evolution thereof will be a major key to understanding how passive margins operate.

Biographical sketches

Allen Lowrie has been an explorationist for the past 37 years, having worked for Lamont-Doherty Geological Observatory of Columbia University, Mobil Oil and the U.S. Navy. In those years, he has sailed all the world's oceans save the Arctic and been to all continents except Antarctica (and freezing is not now a life goal). He has written three books and some 60 technical publications, taught at Tulane University, University of Southern Mississippi and continuing education for SEG and AAPG. His abiding interest has been in continental margins and their evolution. The distribution of tectonics from province to province and how they interact is the question to be answered. Allen's present objective is to gain entrance into the massive database held by oil exploration companies and to work with company personnel.

Susan Moffett earned an MS in the field of marine science with a thesis topic including micropaleontology, biostratigraphy and sedimentology. She is employed by the U.S. Navy to interpret and synthesize geophysical/geological data. Susan's current interests include sedimentary processes along continental margins. □