AAPG EASTERN SECTION

October 7-8, 1982

Late Abstracts

BROWN, LARRY D., Cornell Univ., Ithaca, NY

COCORP Seismic Profiling, The Eastern Overthrust, and Continental Evolution

COCORP deep seismic reflection surveys in New England, Georgia, and Arkansas confirm that crustal scale overthrusting is an important aspect of Appalachian-Ouachita orogenic evolution. The southeastern Appalachian traverse, by tracing early Paleozoic shelf sedimentary rocks (or their metamorphic equivalents) eastward beneath the Blue Ridge and Piedmont, defined a master decollement above which crystalline rocks were transported 124 mi (200 km) or more. The Arkansas traverse likewise suggests that the southern part of the Ouachitas are allochthonous, with the deep water facies of the Benton uplift thrust over relicts of an early Paleozoic shelf. The southern Appalachian and Ouachita results are consistent with the tectonic burial of continental margins beneath crystalline thrust sheets during collisional orogeny. The New England surveys also testify to the importance of "basement"-involved thrusting, with indications that the the Green Mountain Precambrian massif is an allochthonous sliver and the crust beneath New Hampshire a complex of imbricate thrust slices of metasedimentary and igneous material.

While debate continues regarding interpretational details, these results provide clear support for the hypothesis that "thin-skinned" style overthrusting on a crustal scale is an important, if not the important, mode of continental accretion. It has been speculated that sediments and water emplaced in the lower crust by such megathrusts may explain certain types of magmas, high conductivity layers, and low velocity zones in the crust. A layered complex discovered in the lower crust beneath the eastern Adirondacks by COCORP profiling may represent just such a relict of underthrust sedimentary material, perhaps buried during the Grenville orogeny and thus representing the predecessor to Appalachian accretion.

HARTMAN, R., D. PASICZNYK, and C. CURTIS, International Exploration, Inc., Warminster, PA

Analysis of Simultaneously Acquired Airborne Gravity and Aeromagnetic Data in Eastern Overthrust Area

Continuously recorded airborne gravity surveying is a new airborne geophysical technique, conducted in a gridded survey mode in combination with simultaneously acquired aeromagnetic data. The interpretation of the two data sets was achieved by fitting a series of layered structural surfaces to the gravity data, guided by the approximate depth to critical subsurface sources obtained from detailed analysis of the magnetic data. The interpretation of the aeromagnetic survey data indicates the presence of a very deep horizon in excess of 25,000 ft (1,620 m) in some areas. Although the possibility that these depths arise from intrabasement sources is strong, a structural surface based on the gravity field can be constructed to conform with this horizon which appears reasonable. The more common depth to probable crystalline basement derived from the magnetic data is about 15,000 to 20,000 ft (4,570 to 6,100 m). The relief that occurs on this surface is again obtained from the analysis of gravity data.

The importance of being able to correlate both surfaces adds considerable credibility to the interpretation. It is believed that the major thrust surfaces may be identified by the recognition of density contrasts between the Cambrian-Ordovician rocks, particularly the limestones, and the overlying shales. In addition, through the correlation of the magnetic and gravity data, the depth and the relief on the thrust sheets as well as on the basement surface can be determined. Wedges of crystalline rock from the basement apparently incorporated into the thrust sheet in some locations are also suggested by the magnetic data, and this is supported by small increases in the density contrasts. These implications of the subsurface have great significance in the exploration for petroleum in the area.

AAPG RESEARCH CONFERENCE

Role of Clay Minerals in Hydrocarbon Exploration
October 10-13, 1982

Late Abstract

WANG, CHI-YUEN, Univ. California, Berkeley, CA

Mechanical Properties of Clays in Fault Zones Under High Pressure Conditions

Examination of exposed sections of active fault zones often reveals the presence of abundant clayey materials. Observations in deep tunnels, in deep mines, and deep boreholes have also revealed abundant clays on faults at depths to 1.24 mi (2 km). Experimental clay mineralogists have shown that the stability fields of montmorillonite, kaolinite, and chlorite may extend to conditions existing at mid-crustal depth. The question whether clays can exist down to appreciable depths has been addressed by several authors with convincing arguments in support of the hypothesis that clays can exist on faults down to depths of 6 mi (10 km) or more. Interpretation of the seismic velocities in the San Andreas fault zone, considering laboratory data, is also consistent with the hypothesis that large quantities of clayey gouge may be present along the fault zone to depths of 6 mi (10 km) or more.

If clayey gouges are indeed present in significant quantity along faults at mid-crustal depth, their mechanical properties would influence the behavior of faults. When the fault surfaces are separated by a layer of montmorillonite or vermiculite, the frictional resistance to sliding becomes very low. However, the presence of dry illite, chlorite, and kaolinite does not significantly lower the frictional resistance, and violent releases of energy may occur at high pressures. At high pressures dry clays are capable of sustaining considerable deviatoric stresses; the strength is characterized by having a peak value and a gradual decline to a residual value as strain is increased at a constant rate. Saturation of the clayey gouge, however, significantly lowered the shear resistance and stabilized sliding.

Laboratory studies of soil at low pressure have shown that the deformation and failure of soils involve time-dependent rearrangement of matter and the theories developed for rate-dependent processes are applicable to the study of soil deformation. Work on the time-dependent deformation of clayey gouge at high pressures, however, has just begun. New experimental results have shown that the bulk compressibility of clays at high pressure exhibits pronounced time-dependent characteristics.