Synsedimentary Deformation in Fossil Accretionary Prism, Greece

Structural and stratigraphic evidence demonstrates that Paleogene turbidites of the Politses Formation were progressively deformed during sedimentation. The Politses Formation is preserved in internally undeformed thrust sheets that are tectonically intercalated with sheets of severely deformed blocks of the formation. This imbricate stack is interpreted as a fossil accretionary prism.

The Politses Formation typically consists of hemipelagic red shales and limestones (basin-plain facies association) followed by thin-bedded terrigenous turbidites (fan fringe, interlobe and distal depositional lobe facies associations) which are overlain then by predominantly thick-bedded turbidites (depositional lobe facies association). This "normal" progradational sequence is interrupted by incised channel complexes which lie above basin-plain sediments and beneath fan-fringe deposits in some thrust sheets. Atypical facies organization suggests tectonic activity during sedimentation. Small-scale soft sediment deformation in the form of convolute lamination exists in about 20% of turbidite sandstone beds. Assuming that the deformation resulted from seismic activity, sedimentation rates and the distribution of structures indicate that seismic shocks affected the depositional area every 10 to 100 years on the average. The most important evidence for synsedimentary deformation lies in the distribution of marl marker beds among thrust sheets. The stratigraphic distribution of marls corresponds uniquely to individual thrust sheets. This and other sedimentological relations demonstrate that marl and turbidite accumulation was controlled by progressive tectonic removal of thrust sheets from active deposition. The absence of unconformities within thrust sheets suggests that the deep sea fans represented in the Politses Formation were deposited in a trench.

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Sandstone Diagenesis in Geopressured Tertiary Gulf Coast Basin

Texas Gulf Coast sandstones have been subjected to several stages of burial diagenesis: mechanical compaction, silica and carbonate cementation, and cement and grain dissolution. Each stage is well-developed before the sandstone aquifer is geopressured; only iron-rich carbonate cement continues to be precipitated in the geopressured zone.

Fluids must pass through an aquifer for cementation to occur. Ideally there is minimal fluid movement in the geopressured zone because overpressuring requires the fluids to be trapped. However, if faults are periodically opened and fluids escape, a drop in pressure of the aquifer would result. Lower pressure would allow carbon dioxide gas to evolve and the carbonate equilibrium would then favor precipitation of carbonate minerals.

Evidence of the above process is scale precipitated in wells producing geopressured fluids. As the fluid pressure is lowered by production of the well, iron-rich carbonate minerals are formed. These carbonate minerals are precipitated because of a pressure drop which may be analogous to pressure drops along opened fault zones.

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Properties of Water in Clay Mineral Systems

Among the properties of water in clay mineral systems receiving special attention are specific volume, specific heat capacity, coefficient of thermal expansion, and viscosity. Every property, J, of the interstitial water is described by the equation $J = J^\circ \exp [\beta/m_w/m_m)]$ in which J° is the value of the property for pure bulk water, β is a constant and m_w/m_m is the mass ratio of water to montmorillonite—the clay mineral used as a prototype.

The swelling of clay will also be discussed and it will be shown that $m_w/m_m = \lambda\rho_w S/2(l\text{-}r)$ where m_w/m_m is the mass ratio of water to montmorillonite (or any other layer silicate), λ is the interlayer distance, ρ_w is the density of the interlayer water, S is the specific surface area of the clay and (l-r) is the fraction of the water in interlayer regions. In this equation, λ is a function of the swelling pressure, π. If λ is the same for all clays at any given π, the equation indicates that a plot of m_w/m_m against S for different clays yields a straight line. Experimental data show that this is the case. Then the value of λ at each of several values of π can be calculated from the slope, $\lambda\rho_w/2(1\text{-}r)$, of the corresponding straight line and the results used to make plot of π versus λ which should be valid for all clays. Finally, this plot and the foregoing equation are used to show how excess pressure develops in a shale from which water cannot escape when the geostatic pressure increases or when S decreases owing to the conversion of montmorillonite to illite.

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Multi-Parameter Regional Mapping and Interpretations

A global mapping program of those geologic parameters that may influence acoustic propagation through the ocean floor has evolved a number of mappable parameters including bathymetry, physiographic provinces, surface sediments, sediment thickness, paleomagnetic anomalies and age of seafloor, inferred thickness of lithosphere, heat flow, potential temperature of deepest waters, areas of possible bottom current activity, acoustic velocity of deepest waters, acoustic velocity in uppermost sediments, calculated ratios of acoustic velocity along water-sediments interfaces, possible petrologic provinces within lithosphere, roughness of acoustic basement, regional structure, and earthquake locations.

Mapping efforts present maximum detail consistent with data and application of established geologic principles. In areas lacking sufficiently definitive data, a reasonable interpretive fabric is shown. By interrelating appropriate parameters, greater interpretive accuracy is routinely possible.

The principal correlations between parameters are those that fall within the province of plate tectonic theory. Relations between several of these parameters are obvious, e.g., bathymetry and physiographic provinces, and paleomagnetic anomalies and seafloor age. New generations of model reliabilities will occur as further interrelations are found.

The current suite of theories describing overall geologic phenomena, e.g., seafloor spreading and marine sedimentation, are adequate in first order, basinwide terms. Second and third order accuracies are not possible without interpretation on a regional scale.

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Seismic Stratigraphy and Structure of Falkland Plateau

Multichannel and single-channel seismic reflection profiles and sonobuoy reflection and refraction measurements indicate that the Falkland Plateau is not a simple extension of South America, but largely owes its morphology to sediments deposited in a continental slope-ocean basin floor environment.

The western part of the plateau is a segment of oceanic crust over which has been deposited 4 to 6 km of sediment in a basin bounded by the Falkland Islands platform on the west, a narrow ridge associated with the Falkland Escarpment on the north, M. Ewing Bank on the east, and the North Scotia Ridge on the south. M. Ewing Bank, a subsided continental block sampled by D/V *Glomar Challenger* Leg 36, forms the eastern part of the plateau.

The sediments in the basin have been deposited in an oblique progradational-type of configuration. Widespread sheets of sediment dip southward from the Falkland ridge and are terminated updip by erosional truncation. They lap out against the Falkland Islands platform and M. Ewing Bank. The lower boundary of the depositional sequence has been disrupted through movement of the North Scotia Ridge toward the plateau, resulting in subduction of the lower sequence of sediment beneath the ridge and deformation and uplift of the upper sequence to outbuild the northern flank of the ridge.

Overall reflection geometry of sediments filling the basin suggests that they were transported from the north. This implies that they are largely continental slope deposits of pre-drift (>130 m.y. ago) age. Strong bottom currents evidently have caused erosion of significant amounts of the post-drift sediments. The drilling results of D/V *Glomar Challenger* Leg 71 will be discussed in interpretation of the depositional environment of the Falkland Plateau.

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Geology of Syncrude Canada Limited Mine Site, Athabasca Oil Sand Area

The Athabasca oil sand deposit covers 4.4×10^6 ha., of which 0.2×10^6 ha. are amenable to surface mining. In-place reserves of crude bitumen are estimated to be 114.5×10^9 cu m (720×10^9 bbl), of which 11.8×10^9 cu m (74×10^9 bbl) are within the surface minable interval of less than 46 m. The Syncrude mine site covers 2,850 ha., has in-place reserves of 0.24×10^9 cu m (1.5×10^9 bbl), and commenced production in 1978 with a plant design capacity of 20,500 cu m (129,000 bbl) of synthetic crude per day. The geologic complexities of the oil-bearing McMurray Formation and the overburden zone have had a major impact on engineering considerations at the Syncrude mine.

The Cretaceous McMurray Formation was deposited along a transgressive shoreline between two regional highlands and is interpreted to be mainly estuarine. Paleotopographic lows in the underlying Devonian limestone are filled with salt marsh clays and fluvial water sands. The overlying oil-bearing part of the McMurray Formation is subdivided into a basal fluvial sand, a middle thick estuarine unit with interbedded tidal flat clays, and an upper low-marine unit. Dipping beds contributing to possible highwall instability are associated with estuarine and marine channels.

The overburden zone ranges up to 30 m thick and is composed of marine mudstones and indurated siltstones of the Cretaceous Clearwater Formation and overlying Pleistocene tills, lacustrine clays, and glaciofluvial granular materials, all of which impact on the mine plan.

Detailed documentation of the depositional facies is a prerequisite in geotechnical consideration and mine planning of an oil sand mining operation.

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Depth Migration and Interpretation of Cocorp Wind River, Wyoming, Seismic Reflection Data

To better understand the effects of Laramide deformation, deep seismic reflection data in the Wind River (WR) Range area of Wyoming have been migrated using a 45° ω-Finite-difference depth migration. The algorithm allows velocity to vary laterally and with depth, contains the thin lens (or shifting) term, and correctly migrates energy in laterally varying media within the limits of a 20 algorithm and 2D dataset. Each migrated section shown is the best from a series of migrations.

Major structural features displayed in the migrated data are the Pacific Creek (PC) anticline and the WR thrust. The PC anticline is underlain by a thrust fault similar in geometry to the WR thrust. The base of the Green River basin sediments has a seismically observed vertical offset of 0.6 km. The intra-basement PC thrust reflections are as conspicuous as the WR thrust reflections, yet the movement along the PC thrust was 0.02 of that of the WR fault. The reflectivity of the PC fault is attributed to the change in seismic impedance of the fault-zone constituents. The thinning of sediments over the anticline in Late Cretaceous time (possibly Lewis, certainly earliest Lance time) indicates that the anticline is part of the Laramide deformation. The anticline continued to grow by faulting and buckling the lower 2 km