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LATERAL CLAY-MINERAL VARIATIONS IN MODERN DELTAIC SEDIMENTS OF GODAVARI RIVER, INDIA

The less than 2-micron fractions of modern deltaic sediments of the Godavari River were analyzed for their clay-mineral assemblage by X-ray-diffraction technique. The results obtained are as follows: with progressive increase in the salinity of the water downstream, there is a corresponding increase in the concentration of Na^+ montmorillonite, illite, and chlorite, and a decrease in kaolinite. Na^+ montmorillonite is the predominant clay mineral in the paludal deposits of the mangrove swamps, illite in the lagoonal facies, and chlorite in the deep marine facies (prodelta?) of the Godavari delta. Ca^{++} Na^+ montmorillonite is restricted specifically to the fresh-water Godavari channel. Within the saline environment of the delta, illite concentration is lowest in the swamps.

It is obvious that the observed lateral variations in the clay minerals are a response to the changes in the physicochemical conditions of the depositional environments. The increase in Na^+ montmorillonite toward more saline environments is due apparently to the cation exchange of Na^+ for Ca^{++} in the Ca^{++} Na^+ montmorillonite, whereas the increase in illite and chlorite is probably an outcome of regeneration—by K^+ and Mg^{++} adsorption—from their respective degraded forms. The abrupt fall in the illite content within the mangrove swamps is attributed to a return of the regenerated illites to their original degraded state, which in turn, is a consequence of the preferential leaching of K^+ by the dense mangrove vegetation.

The geochemistry of potassium, sodium, calcium, and magnesium pertaining to the clay fractions of the deltaic sediments generally tends to support the above contention. Attempts to define the polymorphic forms of the illite and chlorite have proved futile because it is nearly impossible to fractionate these minerals from the other associated minerals.

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SYSTEMATICS AND DISTRIBUTION OF FUSULINID GENUS *Afghanella*

The fusulinid genus *Afghanella*, with *Afghanella schencki* as the genotype, first was proposed and described by M. L. Thompson in 1946. The specimens came from the Bamian Limestone 7 km west of the summit of Shibar Pass, northwest of Kabul, Afghanistan. At that time he assigned to this genus *Neoschwagerina sumatrinaeformis* Gubler from what is now Cambodia and *Sumatrina pusuliensis* Ozawa and Tobler from Greece, and stated that *Afghanella* occurred widely in the Permian Tethyan regions of Europe and Asia. *Afghanella* has now been reported or described (11 species at last count) from many localities in the Tethys region (*e.g.*, Tunisia, Yugoslavia, Turkey, Soviet Tadzhikistan, China, and Japan) where it is associated with fusulinids of the *Verbeekina-Neoschwagerina* zone.

Cutbill and Forbes (1967) have suggested that the prolocular diameter and its effect on comparisons by volution can lead to difficulties in the description of fusulinids. They suggest that the comparison of measurements at equal radii instead of by volution may help eliminate this problem. The present study concerns a discussion and comparison of species of *Afghanella* from the Tethys region and the use of ideas of Cutbill and Forbes in attempting to differentiate populations of *Afghanella*.

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SEDIMENTARY STRUCTURES IN DEVONIAN FANGLOMERATES, WESTERN NORWAY

Coarse Devonian terrestrial sediments were deposited in six distinct basins preserved along the western coast of Norway 100–200 km north of Bergen. The brown- to red-colored alluvial conglomerate, breccia, and sandstone, loosely termed "Old Red Sandstone," were derived from nearby surrounding source areas. The basins are similar tectonically and sedimentologically to the Triassic Newark basins, in that they were formed after a major geosynclinal orogeny (Caledonian), consist of thick redbed sequences with plant and fish remains, are bounded by normal faults with apparently large displacements, contain mafic intrusives and extrusives, and have been subjected to post-depositional folding, faulting, and uplift. However, the Norwegian analogues are more limited in area and in lithologic variety.

The Solund and Buelandet-Vaerlandet Norwegian Devonian basins contain well-exposed sedimentary structures, textures, and fabrics. About 5,000 m of coarse conglomerate, with scattered, interbedded lens-shaped bodies of sandstone, crops out in the Solund basin. The conglomerate represents a broad coalesced alluvial fan complex deposited into an east-west-trending half-graben (40 × 20 km). The southerly source area, composed primarily of Caledonian igneous and metamorphic rocks, was a rapidly eroding highland dissected by youthful streams transporting coarse debris northward to the fans. Uniform orientation of sedimentary structures and fabric throughout the basin indicates a relatively steep northward-sloping depositional gradient.

The Solund conglomerate beds are generally massive, structureless bodies, with a prominent, anisotropic imbricated fabric. Flat stratification is the most common feature of sandstone lenses within conglomerate beds; primary current lineation and cobble-boulder trains are typically associated. Cross-strata are either large-scale singular plunging troughs, festoon troughs, or planar or tabular small-scale types. Ripple-drift bedding is prominent locally, as are asymmetrical current ripple markings and sand waves. Erosive features include channel scours and preserved undercut banks of stream channels. Evidence of rockslide deposition is found locally. Fining-upward cycles of sandstone-conglomerate are characteristic of many of the sandstone lenses. The stratigraphic evidence suggests deposition in braided stream channels, primarily under conditions of the upper-flow regime, on a humid-temperate coalescing alluvial fan complex.

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OIL FIELDS IN MIO-PLIOCENE ZONE OF EASTERN CARPATHIANS, PLOIEŞTI DISTRICT, ROMANIA

This paper is a synthesis of all data obtained on the geology and conditions under which hydrocarbon accumulations were formed in the Mio-Pliocene zone of the Ploieşti District, an important oil region in Romania and one of the most prolific ones in the world.

The zone studied is at the periphery of the Eastern Carpathians, at their western-plunging end, where their structure of overthrust sheets is masked by the upper Neogene cover.

Most of the fields discovered are included in the late Miocene-Pliocene cover deposits (Sarmatian, Meotian, and Dacian age), generally in structural traps, in the formation of which salt diapirism played an important part. Several less numerous accumulations are in the older sediments which underlie the cover deposits (Helvetian, Burdigalian, and Oligocene); these accumulations generally are in stratigraphic traps, just below the unconformity which separates the Sarmatian-Dacian from the Helvetian-Oligocene.

The presence of important hydrocarbon accumulations in the region studied may be explained by the following facts:

1. The zones of hydrocarbon accumulation are along the western uplifted edge of the Neogene depression at the maximum curvature of the Eastern Carpathians along the path of lateral hydrocarbon migration.
2. The Pliocene is developed completely in the form of conformable pelitic and psammitic sequences without any sedimentation breaks; this permitted the generation, accumulation, and preservation of oil pools.
3. Favorable structural conditions existed, particularly because of the diapirism of the Oligo-Miocene (Aquitanian) salt which was active during the deposition of the hydrocarbon-bearing Pliocene formations.

Among the oil fields so far discovered, the most important one is the Moreni-Gura Ocniţei field, situated on the main echelon of Teiş, Gura Ocniţei-Moreni, Filipeşti, and Tintea-Răicoi.

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PENNSYLVANIAN EVAPORITE CYCLES AND PETROLEUM PRODUCTION, SOUTHERN ROCKY MOUNTAINS

Cyclic evaporite deposits of Desmoinesian Pennsylvanian age are associated with carbonate-mound petroleum reservoirs in the Paradox and Eagle basins of southeastern Utah and western Colorado. In both basins there are basin-type evaporites associated with starved-basin trough sediments that cover a complete range of evaporitic deposits including hypersaline potash beds, halite, anhydrite, very fine-grained dolomite, and black sapropelic muds. A broad facies belt of petroleum-bearing biogenic carbonates and fine clastics occurs in cyclic association on the mildly tectonic basin shelves. Coarse arkosic facies and narrow belts of biogenic carbonates occupy the tectonically active basin edges adjacent to the Uncompahgre and Front Range highlands of the "Ancestral Rockies." Five major juxtaposed evaporite-carbonate mound cycles are mappable in the Paradox basin. Each major cycle contains several subcycles showing different degrees of completeness; individual salt, anhydrite, and black shale beds demonstrate a well-defined microcyclic sedimentation pattern, perhaps related to annual or seasonal climatic changes. The major cycles and most subcycles can be correlated throughout the basin by use of mechanical logs. Microstratigraphic studies of evaporite cores indicate that individual microcycles can be traced for relatively large distances where sufficient cores are available.

The evaporite environment is believed to be directly responsible for the presence of petroleum deposits in the Paradox basin because of its role in the genesis of organic-rich basinwide potential petroleum source beds, improvement of reservoir quality by dolomitization in some places, and the indirect influence of the sapropelic shale-bed geometry in determining size and positioning of carbonate-mound reservoir belts. Conversely, some detrimental effect of the evaporite phase is found in the sealing of some original porosity by later anhydrite infilling.

Most of the petroleum deposits occur in shelf carbonate reservoirs along the southwest flank of the basin. However, probably even greater potential reserves are locked in sapropelic fractured shale beds in the central basin salt anticline area, not now recoverable under the limitations of present exploitation technology.

Evaporite deposits equivalent in age to those of the Paradox basin are present in the Eagle basin of northwestern Colorado. Although thinner than the Paradox evaporites, and more closely interrelated with clastic sediments, these beds occur also in a well-developed cyclic evaporite-black shale depositional sequence. Significant petroleum deposits in facies association with the evaporite section have not yet been found in the Eagle basin, although in most of the basin area drilling density is sparse.

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SHALLOW-MARINE CURRENTS ON EARLY(?) TRIASSIC WYOMING SHELF

Analysis of 690 asymmetric ripple-mark and 40 cross-stratification paleocurrent directions from 37 localities in the Red Peak Formation of Wyoming indicates three major current directions: northeast, southwest, and northwest. These are interpreted to represent respectively, wave drift, rip, and longshore currents moving on, off, and along a northwest-southeast-oriented coast that bordered the shallow, open-marine, Wyoming shelf embayment during the Early(?) Triassic.

Commonly used interpretive techniques based on calculated vector means of paleocurrent directions are inadequate for the polymodal distributions in the Red Peak. Instead, the major directions at each locality are determined and the resulting pattern interpreted visually. The use of vector means and moving averages would not define and could possibly mask the complex current patterns to be expected in the shallow, open-marine environment.

Ripple marks have been used infrequently as paleocurrent direction indicators. The long-standing misconception equating external shape with mode of formation has inhibited their use. Evidence from the Red Peak supports other studies which have suggested