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#### AGI ACTIVITIES

(No abstract submitted)

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#### PRODUCTION OF REEF-MARGIN BRECCIAS BY SUBMARINE CEMENTATION AND SLUMPING OF CARBONATE SANDS, MIETTE REEF COMPLEX

Carbonate breccias in beds up to 1–2 m thick interbedded with coarse, reef-derived, carbonate sands and fine, basinal, terrigenous and carbonate muds are present seaward of the southeastern margin of the Devonian Miette Reef Complex of the Canadian Rocky Mountains.

The majority of the breccia fragments are cemented carbonate sand set in a matrix of noncemented sand. The allochems of both the fragments and the matrix are very similar in composition. The associated beds of carbonate sand that are intercalated with the breccias show similar textures. Within the latter, both *boudinage*-cemented layers and nodules with tension cracks, as well as slumped sequences of cemented sand in a noncemented matrix are seen. The breccia beds are therefore considered to have formed by differential submarine cementation of fore-reef carbonate sands coupled with downslope creep and slumping.

Breccias of this type do not record a profound break within the reef complex but correspond to times of maximum supply of sand to the fore-reef slope. Slumping is the direct result of instability of the sand accumulation on the slope during periods of more rapid sedimentation.

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#### DIPMETER ERRORS AND RELIABILITY

Dipmeter data can be used successfully to recognize structural anomalies and may yield valuable stratigraphic information provided one can distinguish valid dips and comprehend their geologic significance. A basic understanding of the techniques used to process the data and of the limitations of the recording tool can assist in achieving this goal.

Correlation, the process by which raw dipmeter information is transformed into dips, is the fundamental link between borehole information and geologic interpretation of dips, yet many geologists are not fully aware of how it can influence dip results. Because of correlation problems, generalized rather than true formation dips are generated; only if beds are strictly parallel will both be equal. The type of correlation program also determines the extent to which detailed dip changes are masked or revealed. If borehole irregularities are present or the strata are poorly bedded, slumped, or have local heterogeneities, revision of the correlation program may result in data improvement in some cases.

Dip errors and inconsistencies are present in almost every diplog. Mechanically induced errors arising from obvious malfunctions or limitations of the dipmeter tool can be detected by proper examination of the field-recorded dipmeter log. Other errors and inconsistencies are less easily detected and generally must be tolerated in the interpretation stage. Comparison of dips from duplicate logging runs is an important technique

for estimating the magnitude of these more subtle errors and inconsistencies.

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#### STRATIGRAPHIC AND PALEOECOLOGIC SIGNIFICANCE OF OSTRACODS FROM SHUBUTA CLAY (TERTIARY) OF MISSISSIPPI

The Shubuta Clay at the type locality in southeastern Mississippi consists of about 75 ft of gray, marine calcilutite. It yields a diverse and well-preserved invertebrate fauna of ostracods, foraminifers, and nannofossils. Study of more than 8,000 specimens of ostracods, differentiated into 36 species, provided a basis for morphologic, evolutionary, and paleoecologic interpretation of this rich mid-Tertiary fauna.

Comparisons of the Shubuta ostracods with those of the subjacent Pachuta Marl and the superjacent Red Bluff Clay indicate that the Shubuta fauna is clearly intermediate in character; however, a marked faunal change is found about 45 ft above the base of the Shubuta at the type locality. The lower assemblage is characterized by *Bairdia woodwardensis* Howe and Law, *Cytheropteron montgomeryensis* Howe and Chambers, *Digmocythere russelli* (Howe and Lea), and *Hermanites? dohmi* (Howe and Chambers) whereas the less diverse upper fauna is dominated by *Haplocytheridea montgomeryensis* (Howe and Chambers) and lacks many forms present in the lower part. The vertical change from high diversity to low diversity may reflect a shift to deeper water deposition during the Shubuta interval. This interpretation is corroborated by a comparison of the Shubuta ostracods with the depth distribution of related living forms.

The paleontologic evidence suggests correlation of the lower part of the Shubuta with Jacksonian (Upper Eocene) strata of the Gulf Coast. In contrast, the ostracods of the upper part show a closer affinity to Vicksburgian forms.

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#### KNIFLEY SANDSTONE: EARLY MISSISSIPPIAN INFRA-LITTORAL SANDSTONE BODY

Stratigraphic and petrologic relationships indicate that the Knifley Sandstone was the product of littoral to infralittoral processes, which deposited sands at the shoaling inner margins of a shallow, Early Mississippian sea.

The Knifley Sandstone is an elongate body, 30 mi long, 5 mi wide and up to 200 ft thick, within the Ft. Payne (= Borden) Formation (Lower Mississippian) of south-central Kentucky. This sandstone body trends northwest-southeast, parallel with the regional depositional strike. It is offlapped to the southwest by 2 elongate limestone bodies of similar dimension and orientation.

The thick widespread Ft. Payne (= Borden) Formation consists of bioturbated, siliceous dolosiltites. The Knifley Sandstone is a coarsening-upward sequence of fine- to medium-grained, glauconitic, dolomitic, sub-graywackes, which grade downward into the underlying Ft. Payne (= Borden) dolosiltites. Extensive bioturbation

tion has destroyed most primary bedding features except the southwest-dipping master bedding. Dielectric anisotropy data indicate long-grain axis orientations toward the southwest, perpendicular to the length of the sandstone body and regional depositional strike. The 2 parallel limestone bodies consist almost entirely of coarse, well-sorted bryozoan-crinoidal biosparites. These limestones contain a minor percentage of terrigenous quartz; silicification of skeletal fossil debris is common. Directional properties in the 2 limestone bodies indicate a southwesterly transport direction.

The coarsening-upward sequence of highly bioturbated sandstone with an increase in carbonate down dip indicates a littoral to infralittoral barrier separating a gently shallowing sea on the southwest from its shoreline on the northeast.

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#### LATE PLEISTOCENE BIOSTRATIGRAPHY AND PALEOCLIMATE OF GULF OF MEXICO DEEP-SEA CORES

Studies carried out on 25 of 55 piston cores collected during *Kane* surveys in the Gulf of Mexico show that detailed paleoclimatic curves can be determined for the late Pleistocene based on change in frequency of planktonic Foraminifera. Three carbonate-rich cores from the southwestern Gulf of Mexico have been examined in detail and show that most of the 28 species or forms distinguished in these cores show quantitative trends in response to paleoclimatic change. During warm intervals the *Globorotalia menardii* complex, *Pulleniatina obliquiloculata*, and *Globorotaloides hexagona* (interglacial) are characteristic whereas *Globorotalia inflata* and *Globigerina falconensis* indicate cool intervals.

A total of 3 major warmings and 2 major coolings are recorded; these probably correlate with zones Z to V of Ericson and Wollin. In addition faunal changes of less magnitude reflect secondary temperature oscillations superimposed on the more marked (glacial-interglacial) climatic oscillations. The climatic oscillations are remarkably uniform in some cores if fairly constant sedimentation rates are assumed.

Volcanic ash zones in 2 cores approximately correspond to the lowermost and uppermost boundaries of the last interglacial period. In one core a large increase in *Orbulina universa* coinciding with these ash zones may be due to temporary environmental changes associated with extensive ash deposition.

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#### DEPOSITIONAL ENVIRONMENT OF WIDESPREAD PENNSYLVANIAN BLACK SHALE (EXCELLO)

The Excello Shale covers an area of almost 200,000 sq mi in the Mid-Continent and the Illinois basin, and is the most widespread lithologic unit of the Summum cyclothem. It overlies both marine carbonates and coals, and is overlain by marine carbonates and deltaic clastics. The typically carbonaceous Excello grades laterally into more oxidized greenish-gray facies as it onlaps and crosses structural highs.

It is difficult to explain the great lateral extent of the thinly-laminated, fine-grained, organic-rich Excello Shale by a nearshore or lagoonal origin. The strati-

graphic relations and lithologic characteristics of the Excello Shale are indicative of deeper water sedimentation in a stratified anoxic water system.

The accumulation of organic-rich bottom sediments resulted from the growth of a widespread density gradient (thermocline) which inhibited circulation of bottom waters of the epicontinental Excello sea to such an extent that anoxic water conditions arose as a result of the subsequent processes of deoxygenation, denitrification, and sulphate reduction. The distribution of the sulfide-bearing bottom waters, and hence the distribution of the organic-rich bottom sediments, was controlled by submarine topographic highs and basinal depressions. Sedimentation was restricted to the slow influx of clay minerals (probably clad with organic films) and detrital plant and animal remains. Return to the normal marine environment and clastic deposition was brought about as the Excello sea became shallow, thus breaking up the thermocline and destroying the anoxic bottom waters.

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#### HOLOCENE AND PLEISTOCENE SUBAERIAL CRUSTS AND PISOLITES, NORTHERN BARBADOS, WEST INDIES

Laminated calcareous crusts are present on most surface outcrops of Pleistocene limestone on northern Barbados and are similar to the caliche so common in areas with semiarid climate and a source of  $\text{CaCO}_3$ . Crust development is most intense at the surface of relatively young, poorly lithified, commonly little diagenetically altered carbonates. The complete zone of alteration (irregular, hard calcareous bands alternating with soft, chalky carbonate) may extend to depths of 6 ft or more. Large amounts of salt spray, either wind blown or direct splash, also contribute  $\text{CaCO}_3$  to the system, resulting in the formation of thick crusts.

When developed on poorly indurated carbonates, crusts are usually interbedded with pisolites. These pisolites are either laminated microcrystalline grains, formed in the process of limestone alteration or, where salt spray is heavy, coated skeletal grains.

The Pleistocene section on northern Barbados includes a succession of transgressive reef complexes, unlike the generally regressive sequence on the rest of the island. Each episode of reef building is considered to represent a separate high stand of sea level during the late Pleistocene. Occurrence of fossil calcareous crusts and pisolites (similar to those forming on the surface today) between overlapping reef complexes in the transgressive sequence suggests a period of subaerial exposure and diagenesis between the formation of each successive reef complex.

The presence of comparable calcareous crusts and pisolites, both Holocene and fossil, in other Pleistocene and some Paleozoic limestone successions indicates they are useful criteria for subaerial exposure.

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#### NEW ASPECTS OF QUANTITATIVE INTERPRETATION OF VELOCITY DATA AND THEIR IMPACT ON GEOLOGIC EVALUATION OF EXPLORATION PROSPECTS

Studies on elastic wave velocities in rocks have proved increasingly useful in the geologic investigation of sedimentary basins. Velocities of sediments are