

The transgressive cycle marks the drowning of the thrombolitic bioherm by a rise in sea level. Lithofacies recognized within the transgressive sequence C are: (1) millimeter-laminated micrite and biomicrite (subtidal shelf); and (2) tabular-bedded biosparite (open platform). The lateral expansion of the platform biosparite sands over the thrombolitic bioherm, intertidal, and supratidal environments coincides with the mass trilobite extinction between the deposition of the Mistaya and Survey Peak Formations.

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#### New Regional Magnetic and Gravity Maps of Central and Western Gulf of Mexico

As part of the regional synthesis phase of the proposed Ocean Margin Drilling Project, magnetic and gravity anomaly maps of the central and western Gulf of Mexico have been prepared from existing data, many of which have not been previously processed or interpreted.

Magnetic anomalies, derived by removal of the modified 1975.5 IGRF and average diurnal variation, are of relatively small amplitude, generally  $\pm 50$  to 100 gammas, with wavelengths on the order of 50 to 200 km. Free air gravity anomalies have typical amplitudes of  $\pm 30$  milligals and wavelengths of 50 to 200 km.

Distinctive linear magnetic and gravity anomalies parallel the northwest (Texas) Gulf Coast and the northwest margin of Campeche Bank. Such anomalies are poorly developed along the margins of the Bay of Campeche.

Over the central Gulf, low-amplitude linear magnetic anomalies are present. These anomalies are consistent both in trend and apparent offset with predictions based on hypothetical formation of the Gulf by sea-floor spreading synchronous with early opening of the central North Atlantic. Modeling of these anomalies and calculation of magnetic depth-to-source are in progress and should provide better insight into the origin of the Gulf of Mexico.

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#### Behavior of Some Common Clays in Response to Various Oil Field Fluids

The marginal or questionably productive nature of some hydrocarbon-bearing zones can be due to clays distributed within rock pores in a manner adversely affecting fluid flow. This research involves laboratory measurement of several clay rheological properties that are not commonly used in evaluating hydrocarbon-bearing reservoirs. Liquid, plastic, and shrinkage limits and plasticity indexes of a kaolinite, bentonite, and an illite are being determined using fresh water, salt water, methanol, xylene, and a non-ionic wetting compound as the moisture components.

Conclusions about the relative merits of each liquid as an oil-recovery enhancer may be drawn directly from the results of their effects on the plastic behavior, or indirectly when these results are applied in conjunction with other data concerning the rate of flow of reservoir fluids in the intergranular environment. When the liquid limit of attached clay particles is exceeded by the introduction of a stimulation fluid, they presumably become transient and change into a blocking phase. An attached clay can be induced to deform into new configurations that alter tortuosity if its plastic limit is exceeded. Differing ranges for the plasticity index would be expected to indicate preferential hydrofracture or stimulation fluids for certain reservoirs depending on type, position, and attachment status of the

associated clays.

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#### Normalization of Well Log Data for Regional Stratigraphic Analysis

The normalization of well logs is a recognized technique for the removal of instrument and sensitivity errors.

This paper describes a project which used logs from 240 wells that penetrated Upper Cretaceous rocks in the Powder River basin of Wyoming. Normalization of the gamma ray, density, and conductivity curves was accomplished by adjusting each curve to a trend surface for the project area. Examples before and after normalization will be shown and alternate methods are discussed.

Processing and problems, data flow, and tabular results of discriminant analysis of the normalized log digits are discussed. The discriminant analysis relates to the evaluation of geologic models established for the Sussex and Shannon formations.

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#### Hydrogen and Carbon Isotope Analyses of Natural Gases from Candela, Italy—Case History of Mixing Gases of Different Origins

The gases of Candela, south Italy, have been investigated earlier and have been considered as an example of natural gas migration. In a new study, we have performed hydrocarbon and carbon isotope analyses on gases as well as GC-analyses up to the pentanes.

The gases range from  $-62$  to  $-42\text{‰}$  in the  $^{13}\text{C}/^{12}\text{C}$  ratios and from  $-200$  to  $-170\text{‰}$  in their D/H ratios of the methane. The  $\delta^{13}\text{C}$  and  $\delta\text{D}$  values are linearly correlated when cross plotted in a  $\delta^{13}\text{C}/\delta\text{D}$  diagram. This relationship is strong evidence for mixing of two gases: (1) bacterial gas and (2) thermogenic gas. The compositional changes in the gases also follow mixing relationships.

These data are evidence that variations in the isotopic composition of gases are not necessarily the result of gas migration. Simple mixing of two sources in various proportions are likely to account for much of the observed variation in natural gases.

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#### Humid Alluvial Fans

Braided streams dominate environments characterized by high sediment load and flashy discharge. Although coarse-grained braided alluvium is most abundant today in association with semiarid to arid alluvial fans, several authors have speculated about the effects that a lack of terrestrial vegetation may have had on sedimentation prior to the late Paleozoic. It has been suggested that the increased flashiness of discharge and sediment yield associated with the lack of vegetation probably biased the pre-Carboniferous record toward braided alluvial deposits formed in humid areas.

A model for alluvial-fan sedimentation in a humid environment is based on the investigation of six fans formed in response to flooding associated with hurricane passage along the Sierra de