transition flow beds, and 2 kinds of dune beds. Bed material used in the study was a moderately well sorted sand (median = 0.286 mm) from the Rio Grande near Bernardo, New Mexico. Opaque heavy minerals consisting mainly of ilmenite and magnetite (median = 0.144 mm) made up 0.38% of the bed material by volume.

Concentrations of opaque heavy minerals were formed as 3 basic types: (1) small thin concentrations associated with dunes that lacked topset beds and on the stoss sides of large dunes with topset beds; (2) concentrations associated with the topset deposits of large dunes and with dunes formed in the transition flow; and (3) widespread concentrations associated with the flat-bed condition.

The most important factors influencing the type and degree of sorting of the opaque heavy minerals from light minerals were bed configuration and grain density. The thickest deposits of heavy minerals were associated with the topset deposits of large dunes, but the most widespread deposits were associated with the flat-bed type of bed form. Density is important to segregation because the differences in shear stress necessary to move the light minerals and to move opaque heavy minerals are large. Equivalent fall velocities of grains of two different densities were determined to have little importance in local segregating mechanisms.

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Causes of Temporal Changes in Carbonate Compensation Level

Numerous authors have treated the $CaCO_3$ compensation level in deep-sea sediments as an immutable boundary fixed by temperature and pressure. Some have gone so far as to use it as a paleodepth indicator. This concept is totally invalid. Actually the depth at which calcite solution becomes important is controlled by a delicate balance between carbon supply to the ocean and carbon removal by organisms. The fact that organisms precipitate $CaCO_3$ from seawater far faster than it is being supplied by rivers demands that solution take place. The proportion of the sea floor bathed in calcite undersaturated water is such that the precipitate in excess of supply is returned to solution. In such a system changes in supply rate of carbon, productivity of carbonate producing organisms, and mixing regime of the oceans will upset the delicate balance between supply and demand and lead to fluctuations in the level of compensation. That such changes can occur on a short time scale is demonstrated by the fact that the compensation level was lower during glacial than during interglacial times. It is not at all surprising that the JOIDES cores show evidence of large fluctuations in this level through Tertiary time.

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Recognition of Fluvial and Deltaic Sandstones of Pennsylvanian and Permian Ages in North-Central Texas

Sedimentary and stratigraphic evidence indicates that most Virgil and Wolfcamp elongate sandstones on the Eastern shelf of north-central Texas are segments of dip-fed fluvial and deltaic depositional systems. These sandstone bodies are composed of superposed delta front, channel-mouth bars, and distributary channels, on top of which are superimposed fluvial and peripheral sheet and small barlike bodies.

Fluvial facies consist of channel-fill sandstones and conglomerates, and overbank mudstones and siltstones; levee deposits are difficult to recognize. Elongate sandstones enclosed in overbank mudstone become finer upward, and characterize fine-grained meander-belt deposits; braided and coarse-grained meander-belt sandstones are extensive tabular to highly belted bodies with little mudstone.

Constructional deltaic sandstones become coarser upward. Delta-front facies display parallel and ripple bedforms, and commonly show distorted basal bedding resulting from subsidence into prodeltaic muds. Channel-mouth bars are normally distorted sandstones with trough crossbedding and small scour channels. Symmetrically filled distributary channels are shallow and up to 50 yd wide. Delta-front sandstones grade laterally into thin, destructive sheet sandstones and strandplain facies within adjacent interdeltaic areas.

Delta progradation, fluvial aggradation, compaction, avulsion, destruction, and marine transgression, followed by later reoccupation of deltaic and fluvial sites, result in distinctive lateral and vertical facies relations.

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Origin and Controls on Distribution of Arid Supratidal (Sabkha) Dolomite, Abu Dhabi, Trucial Coast

Holocene dolomites in supratidal carbonate beds south of Abu Dhabi are polygenetic. The overall distribution of most *authigenic* dolomite is controlled primarily by a pre-Holocene Pleistocene sand topography.

Two types of dolomites are present: (1) a series of disordered calcium-rich dolomites ($Ca^{52}Mg^{48}$–$Ca^{57}Mg^{43}$), and (2) a disordered stoichiometric dolomite ($Ca^{50}Mg^{50}$). Dolomitic carbonate muds contain various combinations of calcium-rich dolomite species and/or stoichiometric dolomite.

Calcium-rich dolomites have two origins. A major part is formed by reaction of aragonite and magnesium calcite with seawater-derived brines ("marine dolomite"), and a minor but locally significant part is formed by reaction of aragonite and calcite with continental groundwaters. The stoichiometric dolomite is detrital and of wind-blown origin. Authigenic dolomites form the major fraction, but locally 25% is detrital dolomite.

Distribution of authigenic "marine dolomite" is controlled by interrelated factors of (1) sedimentary facies, (2) surface relief, and (3) frequency of seawater flooding. These factors are in turn controlled by the pre-Holocene sand topography. Dolomitization is most extensive (to 100% dolomite) in buried, former intertidal sediments composed of an algal-laminated aragonitic mud facies and a burrowed aragonitic mud facies. Rocks in the latter facies are more completely dolomitized, probably because of their greater permeability. An underlying subtidal skeletal aragonitic mud facies is only partly dolomitized (5–15% dolomite).

The dolomitized buried facies attain their greatest areal distribution underlying elongate supratidal areas of low relief. These areas, because of their relief and orientation, are frequently flooded with sea-water resulting in input of brines with ${}^{m}Ca^{2+}/{}^{m}Mg^{2+}$ ratios > 30 for dolomitization. These supratidal areas of low relief are ancestral to tidal channels cut into the underlying Pleistocene sandstone beds.

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OIL AND GAS ACCUMULATIONS IN TIN FOUYE TABANKORT AREA (ALGERIA)

During the past decade several large oil and gas fields have been discovered in the Tin Fouye Tabankort area, which is in the eastern Algerian Sahara Desert approximately 1,000 km southeast of Algiers. The oil and gas accumulations are related to a large Paleozoic north-south trending arch on the southern edge of the Ghadames basin. The hydrocarbons are found in 2 major stratigraphic zones: (1) an uppermost Ordovician sandstone which contains 2 major accumulations, (a) a gas accumulation in the highest part of the arch on the south (*ca.* 40 billion cu m reserves), and (b) a major oil accumulation extending northward from the gas to the plunging nose of the arch (*ca.* 150 million cu m reserves); (2) Upper Silurian to Lower Devonian zones in which 4 oil fields have been discovered on northward-plunging noses; the 2 northernmost do not have structural closure on the south (*ca.* 145 million cu m reserves).

Three petroleum concessions have been granted in the Tin Fouye Tabankort area. SOPEFAL is the operator of the ASCOOP concession. The oil fields in the northern part of the arch have oil-water contacts tilted north to northwest with slopes ranging from 5 to 15 m/km. The Ordovician reservoir is enhanced both in size and petrophysical characteristics as a result of the development of a fluvioglacial facies related to the last Ordovician ice period.

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UNCONFORMITY TRAPS

Unconformities occur in three different parts of the depositional environment—on the shelf, the basin-margin coastal plain, and within the basin. Those on the shelf, typified by the Pennsylvanian-Permian of the Mid-Continent, are regional disconformities occurring above and below coal cyclothems. Sand-filled channels are commonly present above these surfaces, and they can form long, narrow, oil and gas traps.

Regional low-angle unconformities characterize the coastal plain as exemplified by the Cretaceous of southern Arkansas and east Texas. They are angular unconformities only from the regional viewpoint, for the structural difference between stratigraphic units is generally less than ½°. Porous belts are commonly truncated and overlapped by impermeable layers, producing large-scale stratigraphic traps concealed in a confusing array of overlapping and offlapping sequences.

Erosion occurred at places deep in the depositional basin on relatively local anticlines. Such folds may be part of a mid-basin arch or may simply be local tectonic features. Salt or shale domes and igneous intrusions produce similar effects. Porous formations are sharply truncated by unconformities; locally the difference in dip between units above and below may be as much as 90°. Traps formed under these conditions are narrow and commonly short, but the oil or gas column may be high.

Of the various kinds of traps associated with unconformities, those which form in the area of gentle and repeated tilting and warping on the basin margin are the largest and most copious. Search for them involves problems in stratigraphy and geometry, but ultimately may prove to be vastly rewarding.

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PERMIAN AND EOCENE CLASTIC STRATIGRAPHIC TRAPS IN TEXAS AND LOUISIANA

Stratigraphic traps account for oil production from clastic reservoirs in 4 studied fields of Texas and Louisiana. Three of the traps occur in Eocene beds of the Upper Gulf Coast area; the fourth is in Cisco rocks and formed on the eastern shelf of the Permian basin. Subsurface data were used to delineate typical barrier bars in the 2 Texas fields. In Louisiana the sandstone stratigraphic traps have a delta-distributary channel pattern.

The electric log character of these sandstone reservoirs may be diagnostic of their sedimentary environments.

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HALIBUT FIELD, GIPPSLAND BASIN, SOUTHEASTERN AUSTRALIA

Australia's first offshore production, in the Gippsland basin of southeastern Australia, was discovered in 1965. Further exploratory drilling in the area has led to the discovery of additional oil and gas fields.

The Halibut oil field, currently being developed, is considered as a field case history of this Australian offshore operation. The field was discovered, by drilling only 1 exploratory well, in August 1967. It is 40 mi offshore in 238 ft of water and encompasses an area of 11 sq mi. At this early stage, the confidence factor on the seismic interpretation was sufficient to construct a 24-conductor drilling platform.

Oil, associated with a common oil-water contact, is found at the top of the Latrobe complex of Paleocene rocks between depths of 7,400 and 7,856 ft subsea. Stratigraphically the reservoir is composed of braided stream sandstones with some point bar and stream mouth bar sandstones that have been subdivided and mapped as 8 units separated by impermeable breaks. These strata, dipping monoclinally westward, are truncated by a post-Eocene angular unconformity. Closure in excess of 500 ft is provided at the unconformable surface by the combination of erosion and post-Oligocene tilting.

The field is being developed by drilling deviated wells, some in excess of 45° and 6,000 ft from the centrally located platform. With an available maximum of only 24 conductors, optimum drainage points must be selected with care. The number of wells to be drilled to any specific sandstone unit is based on its respective percentage of total reserves. The optimum drainage position is then determined from structure and isopach maps where individual sandstone units are in their highest nontruncated structural position.

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RECENT SILICA GEL FROM SALINE LAKE IN GALAPAGOS ISLANDS

A 4-m drill core of undisturbed sedimentary rock from the crater lake on Isla Genovesa (Tower) has well-defined banding, revealing a complex depositional

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