of the basin. Larger platform reefs may be present throughout a belt north of, and parallel with, the pinnacles. The productive trend, presently 15 mi wide and 150 mi long, was found as a result of renewed drilling activity in this exploration frontier. The high incidence of locating reefs is due mainly to detailed seismic evaluation. Significantly larger reserves could be contained in the platform reefs, but where found to date in the northwestern part of the current play, they are composed of nonporous dolomite.

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BIOSTRATIGRAPHY AND HISTORY OF CIRCULATION OF NORTH ATLANTIC

Distinct latitudinal control of the distribution of marine microfaunas in the North Atlantic Ocean began in the early part of the Tertiary (Paleogene) and is related to the opening of the North Atlantic to the Arctic region about 60 m.y. ago when the present deep-water circulation pattern was probably initiated. At that time a boreal zoogeographic province was established in the Atlantic Ocean for the first time. Caribbean and Mediterranean benthonic foraminiferal faunas exhibit a marked degree of similarity during the early Tertiary. The gradual displacement of west-east current migration routes into higher latitudes and the compression of Spain against North Africa brought an end to this amphiatlantic distribution pattern about 15 m.y. ago. Initiation of glaciation about 3 m.y. ago had a marked effect on circulation in the North Atlantic and temperature may have been the primary factor responsible for the many extinctions in planktonic Foraminifera.

Sediment cores and bottom photographs provide evidence of measurable bottom circulation within the Western Boundary undercurrent in the western North Atlantic. This contour current has played a major role in controlling fine-grained sediment deposition since the early Tertiary. Data from recent deep drilling suggest that during middle Cretaceous to early to middle Tertiary times extensive unconformities occurred, and during the early Tertiary a sudden onslaught of deep circulation coupled with wholesale erosion and redeposition of deep-sea sediments may have occurred. Currents gradually diminished in strength during the late Tertiary and are now flowing at moderate velocities apparently sufficient to transport and deposit sediment with only local erosion.

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PHYSICAL CHEMISTRY OF CARBONATES IN OCEANS

The common carbonate minerals found in oceanic sediments are aragonite and high and low magnesium varieties of calcite. A large proportion of deep seawater is undersaturated with respect to all three. This conclusion is based on laboratory studies of the effects of temperature and pressure on carbonate equilibria in seawater combined with shipboard measurements of water properties as well as upon actual measurements of dissolution rates of calcium carbonate samples held at various depths. Undersaturation is caused by biologic production of CO_2 at shallower depths and by the effect of increased pressure at greater depths on the solubility of $CaCO_3$. The so-called "compensation depth" below which $CaCO_3$ disappears from deep sea sediments does not represent simply a downward change from supersaturated to undersaturated water. This is proved by the presence of undersaturated water above the compensation depth and by the fact that the compensation depth may be thousands of meters below the depth where $CaCO_3$ begins to disappear from the sediments; *i.e.*, there is a zone of disappearance and not a single sharply defined depth. The rate of dissolution of $CaCO_3$ in undersaturated seawater is slowed by dissolved Mg and by dissolved organic matter and this helps account for the lack of dissolution where it is expected to occur.

Surface seawater, in contrast to deep water, is generally supersaturated with respect to both calcite and aragonite. However, inorganic precipitation rarely occurs due to the inhibiting effects of Mg^{++} and organic matter as dissolved species and as surface coatings on mineral grains.

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SOURCES OF SEDIMENT IN WESTERN BASINS OF ATLANTIC OCEAN

The Mid-Atlantic Ridge divides the Atlantic Ocean into two isolated north-south troughs. The western basin is subjected to intensified north-south moving currents because of the Earth's rotation. In addition to the surface currents such as the Gulf Stream and the Falkland Current, deep western boundary currents are presently identifiable as the North Atlantic Deep Water and the Antarctic Bottom Water. These currents affect the source and distribution of sediments in the western Atlantic basin.

In the western North Atlantic basin, bottom transport from high latitude sources is clearly seen by the contour of such mineral indicators as quartz, amphibole, and diagnostic "mixed-layer" clay minerals. The transporting agent is the North Atlantic Deep Water. In the western South Atlantic basin, bottom transport via the Antarctic Bottom Water from high southern latitudes supplies a major part of the sediments in the Argentine basin. The sediments came from glacial sources in Antarctica and from South Pacific volcanogenic sources. These volcanogenic sediments are carried eastward by the Antarctic Circumpolar Current. This is indicated in part by the mineralogy, but more so by the distribution pattern of the S^{87}/S^{86} ratio in the detrital parts of the sediments. A diagnostic criterion for Antarctic glacial source relative to fluviatile sources from southern Argentina is seen in the surface texture of quartz grains.

On the basis of material-balance calculations, much of the detrital sediment in the western Atlantic basin can be ascribed to high-latitude, glacially originating sources close to the continental margin; bottom transport from the shelf and slope also will contribute significant sediment.

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EXPERIMENTAL STUDY OF HEAVY MINERAL SEGREGATION UNDER ALLUVIAL FLOW CONDITIONS

In order to understand local alluvial flow sorting processes of grains of different densities, studies were made of 4 bed configurations in a large recirculating flume. These bed configurations included flat beds, 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