gas accumulations are present along the shelf edge although deformation may have allowed hydrocarbons to escape.

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Deep-Sea Drilling in Northwest Pacific and Philippine Sea: Lithology and Physical Properties

Seventeen sites were drilled on Leg VI of the Deep Sea Drilling Project in 5 contrasting areas of the Pacific: (1) Pacific basin floor, (2) Shatsky Rise, (3) Horizon Ridge, (4) Caroline Ridge, and (5) Philippine Sea.

Sediments of the Pacific basin floor are characteristically Tertiary brown clays overlying Cretaceous nannoplankton oozes containing chert and lithified ash. Tertiary chert-bearing nannoplankton oozes were found on Horizon Ridge. On the Shatsky Rise, Neogene nannoplankton oozes unconformably overlie Eocene and Upper Cretaceous nannoplankton oozes; Lower Cretaceous and Jurassic(?) carbonate oozes there have abundant chert. These Jurassic(?) to Lower Cretaceous sediments are the oldest reported from the Pacific. The sequence on the Caroline Ridge is Pleistocene to Oligocene nannoplankton ooze and volcanic ash lying on a very smooth "basement" of olivine dolerite. In the Philippine Sea, Miocene to Oligocene brown clay, thick volcanic ash, and red metamorphosed limestone lie on an irregular "basement" of olivine basalt.

Shipboard measurements of 6 physical properties were made on the sediments recovered: natural gamma radiation, sound velocity, wet-bulk density, porosity, thermal conductivity, and penetrability. These correlate chiefly with lithology and show no systematic variation with age or depth of burial. Gamma radiation is typically highest in zeolitic clays, intermediate in ash and brown clay, and low in microfossil ooze. Clayey sediments and microfossil ooze have low sound velocities (about 1.5 km/sec), sand-silt size ashes and microfossil ooze intermediate values (about 1.6–2.2 km/sec), and limestone and basalt the highest values (3.19–6.02 km/sec).

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Petrology of Permian Weissliegendes Sandstones in North Sea Basin

The contact between the continental redbeds of the Early Permian Rotliegendes and the marine sediments of the Late Permian Zechstein is a widespread and significant stratigraphic interface in the western European North Sea basin. It is at this boundary that the economically important Weissliegendes reservoir sandstone beds are present. Petrologic examination of the Weissliegendes sandstone and adjacent units, in the outcrop belts of eastern England and western Germany and in the subsurface in the southern North Sea and in the Netherlands, gives indications of their origins and suggests possible distribution patterns for the Weissliegendes reservoir sandstone bodies in the North Sea basin. The Weissliegendes sandstones, whose compositional aspects are controlled by local conditions, range from orthoquartzites, to subarkoses, to subgraywackes, to graywackes. The sandstones are multicycle deposits, largely derived from the local marine reworking of Rotliegendes sandstone, mudstone, and conglomerate. Interpretations of the textural and bedding characteristics of the Weissliegendes sandstone bodies indicate that they are of a subaqueous origin (*e.g.*, submarine sand ridges and banks), rather than of the eolian dune origin that has been long postulated for them. The distribution of the sandstone bodies is irregular with some having elongate shapes several kilometers wide, up to 40 m thick, and several tens of kilometers long. These sandstone bodies are most prevalent on the flanks of pre-Permian structural highs, in places overlapping the Rotliegendes and extending onto the Variscan basement.

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Reef Configurations: Some Causes and Effects

It has been assumed that the deep borings on Pacific atolls have confirmed Darwin's theory of coral-reef development which holds that continued subsidence results in the successive appearance of fringing reefs, barrier reefs, and atolls. It is true that the considerable thicknesses of shallow-water carbonates found in these core holes necessitates subsidence; however, it does not necessarily follow that this subsidence has resulted in the genetic succession of reef types advocated by Darwin. The author enlarges on an alternate theory (first presented by MacNeil) and demonstrates that many, if not most, of the shape attributes of modern reefs are fundamentally karst induced rather than growth induced.

There is little doubt that the carbonate platforms beneath most modern reefs have suffered some degree of subaerial exposure. This general inference is warranted by the apparent thinness of recent shallow-water carbonate deposits in conjunction with the low stand of sea level during Wisconsin glaciation. Thus it seems logical to conclude that most modern reefs have developed on a karst substrate. The presence of drowned sink holes a few hundred feet deep on several modern carbonate platforms supports this conclusion and, more importantly, suggests a potential for the development of considerable solution relief.

Experiments with limestone blocks indicate the feasibility of solution development of the diagnostic cross-section morphology of both barrier reefs and atolls. Tropical karst land forms are suggestive of the same conclusion. All that is required apparently is a large surface area of gently dipping beds bordered on 1 or more sides by a relatively steep slope. The dissolving action of meteoric water differentially lowers the central area relative to that adjacent to the steep slopes and results in a partly or completely rimmed solution basin. Subsequent rise in sea level permits coral colonization of both the solution rim and the residual karst prominences within the basin. The resulting barrier reef or atoll, with its satellite lagoon reefs, is thus formed without recourse to a prior history of reef development.

The attributes of the reefs themselves support this interpretation, and all seem related to the development of a karst solution basin. Thus drowned "atolls" reflect drowned karst topography; reef passes originate as drainage breaches in the solution rim; faros are a karst product of breaching; peripheral limestone islands are exposures of the fossil drainage divide; and