where contemporaneous planktonic-foraminiferal pelagites accu-
cumulated. Middle Eocene to middle Miocene carbonate rocks
deposited in the deep-sea realm represent a distinctive lithogen-
etic unit herein united as the Montpelier Group.

The preponderance of globigerinid and radiolarian tests typi-
ifies lower Montpelier (late Eocene to early Miocene) microfos-
sil assemblages. Dominant benthic forms include Melonis pom-
piloides, Fontbonnia wuellstorfi, and species of Stolaostomella
and Pleurostomella. Available faunal criteria including assem-
blage parameters, depth preferences for extant species, and
convergent-ecologic morphologies suggest that abyssal (below
2,000 m) paleodepths prevailed at the depositional site on a
sediment apron at the base of the Duanvale-Wagwater escarp-
ment. Middle Eocene to early Miocene subsidence computed
from inferred paleodepth and estimated sedimentary thickness
totals 2,800 m. Biostratigraphic and paleoecologic evidence
does not support the concept of a regional unconformity within
the Montpelier, as has been proposed.

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NEOGENE STRATIGRAPHY OF PARATETHYS OF CEN-
TRAL EUROPE AND ITS CORRELATION WITH
OTHER AREAS

During the last 10 years, a group of Neogene specialists has
restudied the Neogene sections in the Alpine and Carpathian
foredeep (molasse zone) and the inner Alpine and Carpathian
basins. These studies have given rise to a new Neogene stratig-
graphic concept for this area—the so-called "Paratethys."

The lower boundaries of these Miocene and Pliocene stages
(Egerian, Eggenburgian, Ottnangian, Carpathian, Badenian,
Sarmatian, Pannonian, Pontian, Dacian, and Romanian, in
ascending order) are defined by planktonic and larger forami-
nifers, calcareous nannoplankton, ostracods, mollusks, micro-
vertebrates, and macrovertebrates. From radiometric age deter-
nimations of biostratigraphically dated glauconite and rhyolite
or andesitic tuff zones, correlations are possible with the Neo-
genie planktonic zonation of Blow on one side, and with verte-
brate Neogene scales on the other. Correlations can be made
between the boreal, Atlantic, and Mediterranean bioprovinces
of Europe and, therefore, with most of the stratotypes of the
international Neogene time scale. On the basis of Paratethyx
faunas, the bioprovinces of western Europe can be correlated
with the eastern Neogene deposits as far as the Crimean and
Caspian Sea areas. Planktonic and larger foraminifers, as well
as macrovertebrates and macrovertebrate correlation levels,
can be related to the Neogene of the United States. There are major
conflicts between the early and middle Miocene radiometric
dates obtained in the Paratethys and those from deep-sea cores.

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MAJOR PERMIAN TECTONIC FEATURES AND POST-
PERMIAN DISPLACEMENTS IN WESTERN UTAH,
NEVADA, AND SOUTHEASTERN CALIFORNIA, AS
REFLECTED BY DISTRIBUTION OF PERMIAN RIEPE
SPRING CORALLINE FACIES

Several facies of the Riepe Spring Limestone and its equiva-
lets in Utah, Nevada, and California have been recognized.
The most distinctive is limestone with massive, rugose corals.
This facies is interpreted as representing low-energy, shallow-
shelf deposition, on the basis of sedimentary characteristics and
abundance of algae. Generally eastward, the coralline facies is
replaced by dolomite and sandstone representing nearshore,
restricted environments of deposition. Westward, higher energy
and/or deeper water deposits accumulated. The coralline facies
forms a band 15-50 mi wide that extends from southern Idaho
to southeastern California. In northeastern Nevada and western
Utah, this facies forms an enormous westward-directed loop,
where it accumulated around an approximately westward-
trending axis of restricted environments. In southern Nevada
and southeastern California, the coralline facies clearly is offset
tens of miles in a right-lateral sense on the Las Vegas shear
zone and on the Furnace Creek-Death Valley fault zones.
Southeast of the Garlock fault, either facies trends shift direc-
tions abruptly, or there has been tens of miles of movement in a
left-lateral sense.

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UPPER PRECAMBRIAN AND LOWER PALEOZOIC
MIOGEOCLINE IN GREAT BASIN, WESTERN
UNITED STATES

Shallow-marine, intertidal, and supratidal detrital and car-
bonate strata of late Precambrian (less than 850 m.y.) and early
Paleozoic (more than 345 m.y.) age thicken from a few thou-
sand feet in cratonic areas east of the Great Basin to 40,000 ft
in the central Great Basin 200-300 mi west. Coeval rocks in the
western Great Basin are deep-water strata characterized by
chert and argillite associated with mafic pillow lavas. Strata
deposited at moderate depths are present between the shallow-
and deep-water facies, but have a limited distribution, suggest-
ing a relatively abrupt transition from shelf to deep-ocean ba-
sin. The thick accumulation of shallow-water deposits in the
Great Basin is similar to deposits along present-day stable continua
tional margins. Such accumulations have been termed mio
geoelines, rather than miogeosynclines, because they are open
to the sea on one side and are not synclinal in form.

The continental margin along which the late Precambrian
and early Paleozoic miogeoeline was constructed apparently
developed as the result of a late Precambrian (less than 850
m.y.) continental separation. Extensive faulting and flowage
related to this separation extended well into the continent and
may have produced major crustal thinning as far east as the
"Wasatch line," across which the rate of westward thickening
of upper Precambrian and Paleozoic strata increases markedly.
A persistent positive belt, perhaps analogous to the buried ridge
beneath the outer edge of the present-day Atlantic continental
shelf, may account for regional thinning and local erosional
truncation of lower Paleozoic strata along the western margin of
the Cordilleran miogeoeline.

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MODELS FROM EUROPEAN SEAS TO AID DETECTION
OF, AND SEARCH FOR, ANCIENT SAND BODIES

Many large porous sand bodies formed in open reaches of
ancient continental shelves and slopes should be recognizable
in the stratigraphic record; they have considerable economic
and academic significance. The present paper is concerned with
modern analogues in the shallow seas around western Europe.
The new deposits and their depositional environment allow the
depositional environment of the ancient ones to be interpreted
more realistically. In addition to the extensive but thin sand
sheets, there are many modern sand bodies that are isolated
from one another. They can be tens of miles in length, a few
miles wide, and more than 200 ft thick. They may occur singly
or in extensive groups and are parallel with or transverse to the
currents that formed them. Some of the largest ones were made
by the Mediterranean undercurrent on the continental slope of
the Gulf of Cadiz. Others, of similar size on the continental
shelf, are attributed to a tidal-current origin. Modern tidal flow
around the British Isles also is responsible for such sand bodies,
as well as a variety of other forms. Only semiuniidirectional
currents seem to be depositing sand in the western approaches
to the Baltic.

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AUTHIGENIC DOLOMITES FROM RED SEA

Deep-Sea Drilling Project Sites 225 and 227 were located in the main trough of the Red Sea, 10 and 3 m, respectively, east of the axial trough in the vicinity of the Atlantis II Deep. Coring was continuous. The sedimentary section included 3 units. Unit 1 (0-175 m) is carbonate and nannofossil ooze and chalk, with minor variable detrital admixture. It is of early Pliocene to Holocene age. Unit 2 (175-195 m) is claystone, rich in dolomite and pyrite, and is earliest Pliocene. Unit 3 (195-7 m) is layered anhydrite and halite, with interbeds of black shale. Dolomite is present in the shale and between anhydrite nodules. Unit 3 is of late Miocene age.

Scanning electron micrographs show the dolomites in Units 2 and 3 to have euhedral planar crystal faces and to show penetration twinning, indicating them to be authigenic. The overall percentage of dolomite increases from less than 10% at the top of Unit 2 to, locally, more than 80% within the evaporite.

Geochemical signatures differ between the dolomites of Units 2 and 3. The dolomites in Unit 2 contain excess calcium. The dolomites of Unit 3, generally of finer crystal size, achieve stoichiometric composition and show better ordering. Both types of dolomite are interpreted as early diagenetic, with the calcium-magnesium ratios being indicative of paleosalinity conditions, analogous to the dolomites of the Zechstein and the Triassic Keuper Formation.

Stable carbon and oxygen isotope data show the environments of deposition of dolomite of both units to have been restricted, but to differing degrees. The situation is directly analogous to the dolomites of the Mediterranean basin.


DEPOSITIONAL ENVIRONMENT OF OIL SHALE IN THE GREEN RIVER FORMATION, WYOMING

Oil shale in the Green River Formation of Wyoming was deposited in shallow water. The sandstones and siltstones spatially associated with oil shale are characterized by mudcracks, ripple marks with flattened crests, ripple marks with mudcracks in the troughs, many burrows and root casts, thinly bedded units with current laminations, and fluviatile channel deposits. The sandstones and siltstones lack graded bedding and other sedimentary structures diagnostic of turbidite sequences.

The assemblage of carbonate rocks associated with oil shale includes dolomicroite with mudcracks, crystal casts, and plant debris; flat-pebble conglomerates; coquinas containing pulmonate gastropods; oolits and pisoliths; algal bioherms; and mudcracked ostracodal limestones.

Disrupted bedding and a lack of continuous lamination are distinctive of the oil shale in the Green River basin. At some locations oil shale contains abundant ostracodes and insect larvae. The oil shale is closely associated with trona beds in the Wilkins Peak Member of the Green River Formation.

The sedimentological evidence is overwhelmingly in favor of a shallow-water origin for the oil shale in the Green River Formation of Wyoming. This genetic interpretation is consistent with the playa-lake (continental sabkha) model recently proposed by Eugster and Surdam.

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GAUSS-BRUNNIES DISCONFORMITY IN SOUTHEASTERN INDIAN OCEAN—PALEOMAGNETIC AND BIOSTRATIGRAPHIC ANALYSIS

Previous work in antarctic regions south of Australia and New Zealand described an erosional disconformity, centered in the southern Tasman basin, that formed when bottom currents removed sediments as old as late Miocene (Gilbert). Detailed analyses of cores from Eltanin cruise 39 indicate, however, that the extent of the disconformity is considerably greater than previously reported, especially on the west, along the Southeast Indian Ridge. Sediments just below the erosional surface have a remarkably constant late Gauss age (2.6 m.y.b.p.), but no specific areal trends could be determined from observed age variations. Locally, some Brunhes-age sediments have accumulated during the last 0.3 m.y., and range in thickness from thin veneers to 2 m or more.

Late Gauss and late Brunhes sedimentary hiatuses, as observed in the present area, are easily overlooked in routine core studies. The magnetic polarity is the same, and biostratigraphic definition of the late Brunhes in these latitudes is difficult. An excellent illustration of this problem is given by core E39-40. Th-D measurements, visual inspection, evaluation of radiolarian and foraminifer indices, and polarity changes demonstrate that sediments in the top 60-70 cm are of Brunhes age (less than 0.3 m.y.b.p.), that sediments contain certain reworked Gauss elements, and that the hiatus is marked by a layer of distinctly stained (ferromanganese coatings?) foraminifers. A Gauss-Gilbert sedimentary sequence follows in the remainder of the core.


FORTIES FIELD, NORTH SEA

The Forties field was discovered in 1970 in the northern part of the British sector of the North Sea, about 110 mi east-north-east of Aberdeen, in a water depth of 350-450 ft. The reservoir is a Paleocene sandstone at a depth of about 7,000 ft, at the base of a thick Cenozoic section consisting primarily of mudstone. The Paleocene is a sandstone-mudstone sequence and is underlain by Danian and Maastrichtian chalk. The trap is a broad, low-relief, anticlinal feature with a closed area of 35 sq mi (22,000 acres). Maximum gross oil column is 510 ft, the structure being full to spill point.

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SEDIMENTARY STRUCTURES AND DISCRIMINANT ANALYSIS OF TEXTURAL CHARACTERISTICS OF RECENT AND ANCIENT POINT BARS

Point-bar deposits of the Raton-Vermejo (Cretaceous) Sandstone are analogous to recent point-bar deposits of the Brazos River of Texas. Sedimentary structures in the two bars are similar; both contain abundant trough (f festoon) crossbedding and climbing ripples. Avalanche forested bedding is prominent at the maximum curvature of the meander in the Brazos River; reverse climbing ripples formed at the toe of the foresets. The upper and lower surfaces of the bars, measured perpendicular to flow direction at the maximum curvature of the meander, converge shoreward in both the Brazos and the Raton-Vermejo bars.

Grain-size analyses of the Brazos River and Raton-Vermejo point bars are similar. In comparison with known suites of eolian, fluvial, and beach sands, all of 33 samples of Brazos River sands are classified as fluvial sands by multiple-group discriminant analysis. Ten of the initial 50 variables calculated for each sample were removed to decrease provenance effects. Classifications were performed from the remaining 40 by using the 16 most discriminating variables.

Individual sedimentary structures in both the recent and ancient bars have similar grain-size distributions. Discriminant analysis indicates that grain-size variables alone are sufficient to separate the samples into 5 different sedimentary-structure groups (trough crossbedding, avalanche foresets, climbing ripples, reverse-climbing ripples, and horizontal laminations).

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