

Drilling has begun only in the Papuan, Gippsland, Bass, Otway, Carnarvon, and Canning basins but the few wells that have been drilled confirm the prospects and have resulted in commercial discoveries of oil and gas in Cretaceous and Jurassic rocks at Barrow Island, oil and gas in Eocene and Cretaceous rocks in Gippsland basin, and gas in Miocene rocks in Papuan basin.

Many large anticlinal, reef, and delta-form structures are known but have not been tested. In addition, large areas have not been surveyed geophysically. Wells drilled offshore have not penetrated rocks older than Triassic. Therefore, the sedimentary areas of the Australian continental shelf must be regarded as good prospects for oil and gas.

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PATTERNS OF PERMO-TRIASSIC SEDIMENTATION, SOUTHEASTERN AUSTRALIA

Fluvial, deltaic, and marine-shelf sediments were deposited in a 100×200 mi, north-south-oriented trough centered around Sydney where as much as 18,000 ft of strata accumulated during the Permo-Triassic. The trough is between and was filled by debris from two major blocks of older, deformed Paleozoic rocks. The northern block consists mainly of radiolarian chert, volcanic graywacke, and mudstone, intermediate-composition volcanics, and Permian granite. The southern and western block consists mainly of quartzose sediments, silicic volcanic rocks, quartzite, granite, and Permian basaltic rocks. Short transport distances and relatively slight reworking of these diverse rock types within the basin of deposition yielded a petrographically complex sequence but one in which contributions from southern, western, and northern sources can be distinguished readily.

Lower Permian sediments apparently were derived mainly from the southern and western blocks and, except for small deltas in the nearshore area, were principally marine-shelf deposits having an abundant fauna of thick-shelled pelecypods, brachiopods, and bryozoans. Most of the marine sandstone and siltstone deposits contain a very large proportion of lithic fragments but some, apparently representing subaqueous bars, are mainly quartzose. During the Middle Permian the sequence was covered by a rapidly prograding sedimentary sequence derived from the northern block, which until Middle Triassic time provided most of the sediments to the trough. The principal sediment complexes derived from this northern system were two fluvial wedges. One wedge each was deposited on either side of a basement high, and the two wedges coalesced southward into a deltaic plain facing a shallow sea. Close borehole control within the fluvial system establishes the presence of channel-bar sandstone beds 50–200 ft thick. These grade laterally into levee and lacustrine siltstone and back-swamp coal beds. The alluvial deposits grade seaward into delta-plain deposits consisting of distributary-mouth bar sandstone beds 30–50 ft thick which interfinger laterally with inter-distributary "bay fills." "Bay fill" sequences generally grade from fine- to coarse-grained upward and commonly are overlain by intensely burrowed sandstone or "root-clay" and coal beds. Delta-front sandstone flanks the delta-plain deposits and merges with mottled gray siltstone of the open shelf.

Several episodes of delta outbuilding separated by periods of marine transgression can be delineated. The last, most widespread progradation was followed in early Middle Triassic time by an equally extensive marine transgression. Fluvio-deltaic deposits which formed during this latest episode lack coal, and the sedimentary sequence is dominated by an orthoquartzitic barrier bar-tidal delta system, locally 1,000 ft thick, which grades laterally into marine red claystone and gray tidal-flat siltstone and fine-grained sandstone. The mineral composition of the latter sediments shows an increasing quantity of basaltic detritus from the south and a concurrent reduction of sediment influx from the north.

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COMPACTION EFFECTS IN OÖLITIC GRAINSTONE

A survey of the packing density in oölitic grainstone from surface and subsurface samples shows compaction ranging from zero in unburied Pleistocene Bahamian oölite to nearly 90% for parts of the Late Jurassic Smackover Formation at a depth of about 10,000 ft in the Haynesville field, northern Louisiana. Mississippian oölitic grainstone which crops out has been compacted as much as 59% in the Greenbrier Formation of West Virginia, contrasted with only 10% in the Ste. Genevieve (Levia Member) of Indiana. Commonly, Smackover thin sections show amounts of compaction between 50 and 70%.

Grain fracturing, cementation of broken grains, stylolitization, partial dolomitization, and authigenic quartz formation can be related to the degree of compaction in favorable circumstances. Noteworthy is the observation that authigenic quartz apparently formed after as much as 60% compaction had taken place in Smackover oölite. In addition, final calcite cementation apparently occurred in a Smackover sample after grain compaction of 61% and fracturing, an example of very late cementation.

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IDENTIFICATION AND INTERPRETATION OF UPPER CRETACEOUS FLUVIAL AND DELTAIC SANDSTONES

Well-developed fluvial and deltaic characteristics are present in the Upper Cretaceous Ferron Sandstone Member of the Mancos Shale in east-central Utah. Detailed stratigraphic relations and sedimentary structures not only provide criteria for paleoenvironment identification, but also form the basis for semiquantitative estimation of paleogeographic parameters.

The fluvial facies consists of 100–700 ft of alternating sandstone, shale, and coal in units of inconstant lateral continuity and thickness. The fine- to medium-grained sandstone beds are in distinct channels or more laterally continuous sheets as thick as 60 ft. The sandstone beds have sharp bases, fining-upward sequences, dominantly trough cross-lamination, and large-scale, point-bar-migration cross-beds. A generally northerly transport direction is shown by decreasing unit thicknesses, decreasing grain size, and by current-oriented sedimentary structures.

The deltaic facies is mainly an inclined series, 20–40 ft thick, of delta-front sheet-sandstone beds that thin and become finer grained down the 5–10° depositional foreslope. Beds in the sequence are thin,