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STRUCTURAL EVOLUTION OF MESOZOIC AND CENOZOIC BASINS IN WESTERN NORTH AMERICA

The North American segment of the Circum-Pacific east of the Aleutian Trench is distinguished from adjoining segments by the absence of an oceanic trench and the lack of recorded seismicity with focal depths exceeding 70 km. The continental margin seaward of the North American cordillera incorporates a series of irregularly distributed sedimentary basins of late Mesozoic and Cenozoic age. The structural development of these basins was determined by progressive, episodic subsidence accompanied by interbasin uplift.

The tectonic history, structural style, and distribution of the basins demonstrate the presence of a composite system of mobile vertical stress fields which has endured over the past 140 m.y. A superimposed horizontal stress field of uncertain duration is expressed tectonically by strike-slip faults and related structures. These data are incompatible with hypotheses of overriding lithospheric plates and their corollaries as currently proposed.

Basin development was initiated in late Mesozoic time, with the differentiation of the continental shelf into discrete basins of localized subsidence. Progressive deepening, migration, and reorientation of the basin axes, and local reversals of vertical movement combined to produce the present composite basins. Commonly structural relief of 20-30 km is developed on the steeper flanks and most basins contain sedimentary thicknesses in excess of 10 km. Internal structures, including basin-margin compressional features, reflect the dominant vertical stress system. Second-order drag folds are well developed in association with strike-slip fault systems.

The primary vertical tectonic forces which created these basins are still active, as evidenced by earthquake, geodetic, and geomorphic data.

A total of 21 billion bbl of oil and 37 trillion cu ft of gas has been discovered in seven of the 36 basins described. A practical understanding of the structural style and framework of these prime target areas is critical to the realization of the energy potential of the relatively untested basins of this province.

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OUTLINE OF PHANEROZOIC HISTORY OF AUSTRALIA AND SURROUNDING OCEANIC REGION

The Tasman orogenic zone has been accreted onto the eastern side of a Precambrian shield. A series of transitional to postorogenic basins has been superimposed.

The Tasman orogenic zone, which was mobile from the Cambrian to Early Cretaceous, underwent progressive but stepwise cratonization with culminations or orogenesis in the Early Ordovician, Middle Devonian, Early Permian, and Early Cretaceous. Relicts of this orogenic zone crop out in New Zealand and New Caledonia, and are inferred in the foundered continental blocks of the Queensland Plateau, Lord Howe Rise, Norfolk Ridge, and the Campbell Plateau. The Tasman orogenic zone, which differs considerably from the classic model, can be explained as an active plate boundary between a Paleopacific-oceanic plate and a continental plate. Mountain building has been of a modest scale and no great crustal thicknesses have been developed.

The sediment filling the various basins is mainly clastic and, in the early and middle Paleozoic at least, had a dominant southerly source. Antarctica must have been a significant contributor, and probably remained so even in the Permian and early Mesozoic when parts of the Eastern Highlands were elevated. In the early Paleozoic, carbonate rocks are more abundant in the north of the continent.

Fragmentation of this part of Gondwanaland commenced in the west in the Late Jurassic to Early Cretaceous with the formation of the Wharton basin. In the east, the Tasman Sea started to form in the Late Cretaceous. Although an incipient rift formed across southern Australia in the middle Mesozoic, new seafloor formation and northward motion of Australia away from Antarctica did not commence until the Paleocene. Eastward accretion of oceanic crust took place in the Eocene and Oligocene (the Coral Sea and the South Fiji basin). Some phases of plate convergence occurred in this time interval resulting in overthrusts of oceanic crust. Relocation of the Pacific plate boundary inside the Melanesian arcs resulted in some of the sea floor, formed during extension, being consumed from the Miocene onward. Folding and uplift in the island of New Guinea also took place in the later Tertiary and Quaternary.

The continental shelf and thick sediment accumulations in marginal basins have formed as a response to rifting.

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EFFECT OF SUBSURFACE WASTE-DISPOSAL PRACTICE ON GROUNDWATER RESOURCES IN HAWAIIAN ISLANDS

Geologic and hydrologic framework (K. J. Takasaki).—Groundwater in Hawaii is present as basal water, as dike-impounded water, and as perched water. Basal water, the fresher part of it forming a lens-shaped body floating on saline groundwater, is in dike-free volcanic rocks and in sedimentary rocks. Dike-impounded water is confined to volcanic rocks in eruptive zones. Perched water is present in all rocks and at all altitudes.

Most recharge to groundwater is in the wet interior mountains. Therefore, the main areas of recharge are upgradient from developed areas where most wastes are disposed of in the subsurface. This natural deterrent, by position of the recharge area, so far has kept much of the groundwater in its pristine quality state. Deterioration of the groundwater will increase as land developments encroach toward the recharge areas—the degree will depend greatly on the waste-disposal practices.

Most natural discharge of groundwater is along the shore, downgradient from disposal wells. The contamination of the beaches rather than of the water supply is the main concern regarding subsurface disposal of wastes in the low areas under present conditions.

Hydraulic, geochemical, and monitoring aspects of liquid-waste injection under Ghyben-Herzberg equilib-