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Model Presentation for Displacements Between Western North America, Eastern Eurasia, and Adjacent Oceanic Plates for the Past 180 Million Years

A model is presented for the displacements between western North America, eastern Eurasia, and adjacent oceanic plates (Pacific, Farallon, and Kula) for the past 180 million years. The model is based on the assumption that the hot spots in the Atlantic region have remained fixed relative to the hot spots in the Pacific basin (although not necessarily relative to the spin axis) and uses a new determination for relative motion between the Kula, Pacific, and Farallon plates. Reconstructions of the major elements of the Pacific basin are derived.

The results indicate that between 180 and 53 m.y.B.P. the Kula plate moved in a general south to north motion through the Pacific basin, implying rapid subduction beneath Eurasia and right lateral oblique subduction with respect to North America. In contrast, the Farallon plate swept from west to east across the basin and allowed for rapid subduction beneath North America, with a left lateral oblique component and predominantly left lateral strike slip in Eurasia. The motion of the Farallon plate relative to North America after 53 m.y.B.P. changed to right lateral oblique subduction. The oceanic-continental linear velocities are given as diagrams showing at selected points around the Pacific margin the azimuth and speed of the relative motion as a function of time.

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Geology of Offshore New Ireland Basin in Northern Papua, New Guinea

The 62-mi (100 km) wide New Ireland basin extends northwestward from southwest of Bougainville to north of the Admiralty Islands. We have studied some 5,000 mi (8,000 km) of geophysical data from the basin north of Bougainville to west of Manus Island. The data were gathered by CCOP/SOPAC, the Australian Bureau of Mineral Resources, Gulf Oil Co., and a French Consortium.

The part of the New Ireland basin studied here is a fore-arc basin which contains Neogene sediments, and lies between two ridges formed as part of an old north-facing arc-trench system in the Oligocene and Miocene. The southern ridge is the old volcanic axis and consists of volcanic rocks forming New Ireland, New Hannover, and the Admiralty Islands. The northern ridge appears to be an accretionary prism which forms the southern flank of the West Melanesian Trench uplifted during its active phase in Oligocene-Miocene times.

The central New Ireland basin is generally a simple, little-deformed synclinal basin, with as much as 3 mi (5 km) of well stratified sediment along its axis. The basin fill contains several seismic discontinuities and unconformities and probably consists of Miocene-Pliocene-Quaternary volcaniclastic and carbonate sediments. The older sequences are lateral equivalents of sediments outcropping on New Ireland and other islands, but younger flat-lying carbonate oozes and turbidites are ponded in the basin. North of New Ireland a number of volcanic islands consisting largely of pyroclastic rocks and lavas have cut through the basin.

Northeast of Manus Island, folding and faulting in the basin increase markedly, with faults forming large scarps on the sea floor. Volcanism may have had a more active role in sedimentation, reducing seismic penetration in the sediments in areas of extensive flows. North of Manus Island, young deformation and volcanism have replaced the flat-lying strata common to the central basins area, obliterating further traces of the deeper basin, if it exists.

The thickness of the sedimentary sequence, and the possible presence of some carbonate buildups at depth in the central basin, indicates that the basin may have some petroleum potential. Major unknowns are source rock potential, and the thermal gradient history in the basin. Carbonate buildups are the most likely reservoir rocks for any petroleum generated in the basin.

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Paleomagnetic Evidence for Large Microplate Rotations in the Southwest Pacific

The Bismark Archipelago of northern Papua New Guinea shows evidence of an Eocene to Holocene island-arc system. Originally north-facing, the arc reversed in the late Miocene, and was partly disrupted by marginal basin sea-floor spreading in the Bismark basin from late Pliocene to Recent.

Paleomagnetic data has been collected and analyzed from over 200 sites throughout the archipelago. Principal component analysis has shown moderate angular motion of New Britain, associated with back-arc spreading. Large angular rotation of island-arc microplates has been detected from earlier epochs. These microplates appear not to be disrupted by internal block rotations, but appear amenable to conventional plate tectonic analysis techniques.

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Burial and Thermal Geohistory Analysis at Passive Continental Margins

Burial geohistory analysis involves progressive stripping of sediment bodies defined by well chronostratigraphic horizons. Underlying section, to basement, is corrected for compaction effects and paleo-water-depth, and plotted as a "paleowell" section in a time-depth framework. The procedure is amenable to computer processing.

Given a tectonic model for basin subsidence, a theoretical paleobent flow function can be applied to the calculation of integrated thermal and maturation history of the well section as a function time and depth. The procedure may be extended to cross sections providing migration direction relative to trap formation. Our examples, from the southern and southwestern margins of Australia, illustrate these applications, and provide constraints to passive margin formation processes.

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Petroleum Exploration Strategies in Developing Countries

The petroleum industry strategy of most developing countries is not clearly defined. Strategies can differ significantly, because of differences in potential, willingness to accept risk, distance to markets, etc. from country to country. Further differences result from the degree to which governments are knowledgeable as to the significance of their own data. It can be said that the

quality of a government's technical information is the key factor in its formulation of an effective strategy.

The status of petroleum exploration in each country must be assessed, and the most important elements or tools to be used by governments to achieve the objectives of their strategies must be understood. These are such instruments as Petroleum Regulations, Reconnaissance Licenses, and Exploration and Production Licenses. Next, it is necessary to consider how the principal objectives can be achieved and how strategies can be improved as scenarios change. With this background, a sequence of actions can be proposed and the petroleum industry assistance offered by the United Nations Department can be evaluated.

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Development of Ranger Mine

The first indications of what is now Ranger Mine were found by a joint venture of two major Australian mining companies, Peko Wallsend Ltd. and Electrolytic Zinc Co. of Australasia Ltd. in mid-1969. By 1971, sufficient ore reserves had been proven for those companies to undertake an initial process design study and market surveys for uranium concentrates. Negotiations commenced early in 1972 for the granting of a Special Mining Lease and sales contracts were made with two Japanese electric power utilities.

Development of the project was then delayed until early 1979 by a series of events: (1) the change of government in December 1972 and the evolution of a policy on federal ownership of the uranium reserves of the Northern Territory of Australia; (2) failure of the government to secure a majority in the Senate for the expropriation of those uranium reserves; (3) negotiation of a compromise with the government which led to a joint venture between the companies and the Australian Atomic Energy Commission; (4) the institution of a major environmental inquiry covering the generic issues of uranium mining and the uranium fuel cycle and the specific environmental issues of the Ranger Project; (5) the decision of the federal government in August 1977, following the report of the Environmental Inquiry, to allow mining and export of uranium to proceed; (6) the passage of the Aboriginal Land Rights (N.T.) Act and subsequent agreements between aboriginal interests and the federal government on the terms under which development of Ranger would proceed; and (7) commencement of further negotiations between companies and the federal government on the terms of the joint venture.

Development of the mine and mill started in January 1979 but, in August of that year, the federal government announced its intention to divest itself of its interest in the Ranger venture. Those interests, together with the interests of Peko and EZ,were subsequently acquired by a new company, Energy Resources of Australia Ltd. A series of agreements were concluded by that company which gave assured markets for the major part of production over the first 15 years of the mine's life, provided the necessary financial backing for the development of the project, and introduced 25% foreign equity by parties who were also purchasers of uranium concentrates. The company was then floated on the Australian stock exchanges with a 15% Australian public equity: the remaining equity being held equally by Peko and EZ.

Production at the designed annual rate of 3,000 tonnes U_3O_8 started in October 1981, almost exactly 12 years after the initial discovery. Since that time the mine and mill have been performing at rates in excess of the design criteria and has successfully completed its first two shipments to customers. Development of the mine has led to the establishment of a major new town in the Northern Territory and has set new standards in the protection of the environment.

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Hydrocarbon Prospectivity of Australian Basins in Light of Recent Petroleum Exploration Results

There has been a continuing upsurge of exploration activity in Australia since 1976, leading to a record expenditure in 1981. Although large economic discoveries have been rare, significant discoveries have been made at widely separated localities, particularly in the unproductive Eromanga and Canning basins. At the same time, geochemical analyses and organic microscopy determinations of material from wells drilled have helped to identify Australia's potential source rocks and their maturity for petroleum generation. The additional drilling and seismic surveying have also enabled a better definition and understanding of reservoir distribution, development of traps, and thermal and tectonic history of a number of Australia's sedimentary basins.

It has been assessed that there is an 80% chance of finding more than 950 million bbl of oil, but only a 20% chance of finding more than 3,800 million bbl of oil. However, the reliability of these numbers is questionable, because it has been necessary to use a large amount of subjective judgment in the assessment.

According to the assessment, the best chances for future oil discoveries are offshore in certain Western Australian basins and onshore in the Eromanga and Canning basins. Undiscovered gas resources are believed to have a somewhat different distribution.

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Oil Economy of Brunei and Its Prospects for the 1980s

Brunei began exporting oil in small quantities in 1929 and because of rapid development of the petroleum industry during the years following World War II, the country's production passed the 100,000 bbl per day mark. Offshore exploration began during the 1950s and by 1970, about 60% of the daily production of 129,000 bbl was from offshore wells. Today, offshore fields account for about 85% of 230,000 bbl daily production. Additionally, Brunei has exported LNG from its Lumut liquefaction plant at a rate of 5 million tons per year, since 1973. The crude price explosion of the 1970s escalated the value of Brunei oil to a record price of US$40.00 per barrel in 1980. The economic criteria for petroleum exploration and production have changed accordingly. Heavy investment in exploration, particularly for small deposits and in sophisticated recovery techniques and in upstream activities are the consequences. Plans for downstream activities have been revised also.

The effects on the national economy are visible. Brunei, which becomes independent in 1983, earns almost all of its revenues from the oil and gas industry. There have been ambitious development plans, with emphasis on diversification of the economy, but few of the programs have materialized. Prospects for further economic development rest with petroleum reserves, which are expected to last for about another 20 years.