There is an along-strike difference in the degree of deformation observed landward of the trench slope break. Subduction of the east-west-trending South China basin relict spreading center at the Manila Trench near 16°N appears to roughly define the boundary between two contrasting tectonic regimes of the margin. South of this boundary, deposition of terrigenous sediments in the fore-arc region has occurred in a relatively quiet tectonic setting. In contrast, north of the boundary, the sediments of the fore-arc region have been disturbed by ubiquitous faulting. Some of the faulting is probably associated with the offshore extensions of splays of the Philippine fault system. Furthermore, anticlinal folds, consistent in character and trend, are found both onshore and offshore along Lingayen Gulf near 16 and 17°N and probably formed in response to a common stress field.

MCS records reveal a basement ridge, trending northward from the western side of Lingayen Gulf, which we interpret as the likely offshore expression of the Zambales ophiolite exposed on land to the south.

We are attempting to reconstruct the tectonic evolution of this fore-arc region by extrapolating the limited stratigraphic information from onshore wells and outcrops onto the observed offshore seismic stratigraphy.

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Structural Styles of Mesozoic-Cenozoic Petroliferous Basins of China

The continental lithosphere of China is situated at the junction of the Marginal Pacific tectonic domain and the Tethys-Himalayan tectonic domain. The former is characterized by a series of extensional tectonics, including taphrogenesis and the latter by a series of compressional tectonics with orogenesis, all taking place during the Mesozoic and Cenozoic eras.

The Marginal Pacific crust of east China was attenuated by rifting and a north-northeast-trending of Mesozoic-Cenozoic basins developed, e.g., the Songliao basin, the North China basin, etc. Rifting followed mainly preexisting zones of basement weakness for the most part. Then, basin and range structures formed and large, fault-bounded basins subsided. Extensional structural styles have prevailed in Mesozoic-Cenozoic basins of east China: listric normal faults and tilted blocks in the basement; detached normal faults, rollover anticlines, and drape fold in the sedimentary cover. These structural styles are favorable for hydrocarbon accumulation, and indeed the famous Daqing and Huabei oil fields are located in the above-mentioned basins.

The crust of west China was thickened by collision and a series of Mesozoic-Cenozoic intermontane basins or foredeeps were formed, e.g., the Qaidam basin, Jinquan basin etc. Compressional tectonic styles are predominant in the Mesozoic-Cenozoic basins of west China; compressive fault blocks and ramps in the basement; detached reverse faults and parallel folds in the cover.

The Mesozoic-Cenozoic basins of China have undergone numerous tectonic events, with earlier structural styles always overprinted by later ones, e.g., compressional structural styles are sometimes converted into extensional ones. On the other hand, most basins of China have twofold mechanical behavior, e.g., extensional shear and subsequent compressional shear. The combination of taphrogenesis, orogenesis, shearing, and gravitation, which seems to have controlled the development of Mesozoic-Cenozoic basins, formed favorable traps for hydrocarbon accumulation in China.

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Copper Deposits—Frieda River Prospect, Papua New Guinea

The Frieda River Prospect is located within the New Guinea mobile belt, between the Frieda and Lagaip fault systems. Mineralization is associated with an andesitic volcanic complex, interstratified in the mid-Miocene Wogamush formation.

The volcanic edifice of the Frieda Igneous Complex was built up by two cycles of pyroclastic and flow deposition, and has been intruded by five phases of co-magmatic and post-volcanic porphyritic diorite, andesite, and trachyandesite intrusions.

Extensive hydrothermal alteration has given rise to a widespread assemblage, consisting of quartz, alunite, kaolinite, pyrite, and locally, native sulfur. Superimposed on this, and localized around centers of porphyry copper mineralization, is an assemblage which progresses from a central potassic core through a transitional zone into sericite-quartz-chlorite; sericite-quartz-andalusite; and eventually propylitic zones.

The known deposits are related to the same series of igneous events and represent a spectrum of physical and chemical conditions in a large hydrothermal system, ranging from deep level porphyry copper mineralization, to near surface, pyrite, luzonite/enargite, chalcocite, and barite mineralization. A halo of quartz-sericite-chalcopyrite-tetrahedrite-sphalerite-galena veins, peripheral to the porphyry copper deposits, appears to be an intermediate style in the system.

The porphyry copper reserves consist of a probable 760 million tonnes of mineralization, made up of 500 million tonnes at Horse and Ivaal, with an average grade of 0.5% Cu and 0.3% Au, and 260 million tonnes at Koki, averaging 0.41% Cu and 0.28 g/t Au.

Initial feasibility studies indicate that the high capital and operating costs of a project in this remote region, combined with current depressed copper prices, make the project uneconomic at this stage.

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Ok Tedi—A Gold-Copper Open Pit Development in Papua New Guinea

Construction is well under way on Ok Tedi Mining Ltd.'s gold-copper open pit development in Papua New Guinea. Start up is scheduled for mid-1984 at 15,000 tonnes of gold ore per day, expanding to 45,000 tonnes of copper ore per day by 1989.

Dramatic price increases for gold, at the time the feasibility study was submitted to the government in November 1979, heightened national expectations and led to further studies to satisfy government requirements, prior to formal agreement to proceed, reached in February 1981.

Difficulties encountered in implementing the project, so far, are due to various factors including lengthy financing negotiations, lease of tribal lands, community demands, normal bureaucratic delays, separated national and provincial administrations, and the State's position as regulator and shareholder.

The real challenge, however, is physical—remote location, rugged terrain, heavy rainfall, and jungle wilderness. In return, an enlightened agreement between state and company promises adequate returns to both developer and the people of Papua New Guinea.