moved from elsewhere to their present positions along a major strike-slip zone. Play concepts can be developed in the Philippines for continental fragments in each of the three major present-day tectono-stratigraphic systems that are dominated by strike-slip, but include subduction and extension tectonics, with both carbonate and clastic sediments.

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Continental Margin of Eastern Canada—Geologic Framework and Petroleum Potential

The Atlantic-type continental margin of eastern Canada is underlain by a series of Mesozoic-Cenozoic sedimentary basins separated by basement highs or areas of thinner sediments. Regional and/or salt tectonics have structured the Mesozoic sequence, which is masked by a less-deformed wedge of prograding uppermost Cretaceous and Cenozoic sediments. The basins have been targets of active hydrocarbon exploration for over 2 decades. Data from 138 exploratory wells and over 680,000 km (420,000 mi) of multichannel seismic coverage have indicated four major geologic/geochemical regions: Scotian Shelf, southern Grand Banks, northeastern Grand Banks, and Labrador-Southeast Baffin Shelf.

On the Scotian Shelf, 13 significant gas/condensate discoveries have been made out of 62 wildcats drilled since 1967. Five of the discoveries, including the Venture field, are in an overpressured zone that has been explored only since 1979. No commercial hydrocarbon accumulations have been found in the southern Grand Banks where 28 wildcats were drilled between 1966 and 1975. The northeastern Grand Banks region has been actively explored since 1971. The 22 wildcat wells drilled through late 1983 have yielded six significant light oil discoveries, including the giant Hibernia oil field. Labrador-Southeast Baffin Shelf exploration has yielded six gas/condensate discoveries in 26 exploratory wells drilled since 1971.

The Geological Survey of Canada has developed hydrocarbon-generation models to explain the regional variation in oil and gas occurrence and to assess future potential in terms of the nature and thermal maturity of the source rocks, type of organic material, and time of trap formation. These factors are related to the geologic history of the margin, which is characterized regionally by diachronism in major basin inception and in the resultant stratigraphic record. We predict an exciting future for this vast petroleum province.

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Circum-Arctic Petroleum Potential

The Arctic is one of the most climatically hostile and demanding areas in the world. However, to the petroleum explorationist it is one of the most exciting and promising hunting grounds that remains to be explored.

The low-lying areas and the shallow broad shelves of the circum-Arctic are underlain by many large sedimentary basin complexes. From the Late Devonian through the Tertiary, many types of sedimentary basins were formed and filled. Episodes of continental rifting have created large interior basins, passive continental margins, and new ocean basins. Major shear or transform faults have displaced continental segments hundreds of kilometers and formed sedimentary basins in the process. Convergent plate motion has resulted in thrust faulting, magmatism, subduction, and the accretion of exotic terranes to the continents. The processes of crustal contraction have formed sedimentary basins, and in some cases, inverted them.

Paleolatitudes have ranged from near the equator to the present polar portion and climates have fluctuated from tropical to arid to boreal.

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Basin Development and Hydrocarbon Occurrence Offshore Mid-Norway

The continental shelf offshore Mid-Norway was opened for exploration drilling in 1980. The area extends southward to the North Sea sedimentary basins and northward to the Barents Sea continental shelf. The central part is a proven petroleum province. By use of mainly seismic and well data, the tectonic evolution, sedimentary facies, reservoir potential, and hydrocarbon generation and distribution have been studied.

After peneplanation of the Caldeonides, a large epicontinental basin connected the region between Greenland and Norway during the late Paleozoic and Mesozoic. Pre-Triassic rocks have not yet been recorded in the wells and nothing is known about their exact composition. The main targets for the exploration drilling have been the Triassic-Jurassic succession. The Triassic consists mainly of continental red shales with sandstone and salt intervals of poor to no source or reservoir potential. During the Triassic, regional extension initiated the formation of half grabens.

A change in climate to more humid conditions toward the end of the Triassic led to coastal plain deposition that persisted into the Early Jurassic. These carbonaceous sediments are important source beds for gas and condensate. The reservoir potential is low because of expected lack of continuity of the channel sands and extensive kaolinite cementation.

A major transgression took place during the Early Jurassic, leading to deposition of a sequence of shallow marine sands, tidal-flat sands, and offshore muds of medium to low reservoir quality. A Middle Jurassic regression resulted in deposition of shallow marine sandstones presently representing the main reservoir in the area. Diagenesis has not been detrimental to the reservoir properties, and a similar porosity-depth trend as seen in the North Sea is present.

Normal and growth faulting during the Triassic to Early Jurassic culminated with the main Kimmerian (pre-Callovian) tectonic phase that resulted in extensive horst and graben development, with subsequent erosion of structural highs. The Upper Jurassic consists of marine shales, of which the upper part is an oil-prone shale of excellent source rock characteristics.

The base of the Cretaceous is developed as a regional unconformity (late Kimmerian) onlapped by Cretaceous marine shales, marls, and minor limestone with no reservoir potential. Differential subsidence created the main platforms and basins. The resulting Cretaceous thickness ranges between 0 and 3 km (9,800 ft), with the main depocenter at the outer part of the shelf.

The Tertiary represents a period of epeirogenic subsidence leading to rapid deposition of marine clastic sediments. The northward progress of the North Atlantic rift is seen in the sedimentary record as a series of tuffaceous layers within the upper Paleocene-lower Eocene. Along the margin, a volcanic high was formed. As the continental slope and shelf subsided, damming of glacial deposits landward of the outer high created the Voring Plateau. Reactivation of older fault zones took place, and there is evidence for strike-slip movements and folding, especially in the northern area.

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Basins and New Frontiers: an Overview

Although the global transition to alternate energy sources has begun, for the coming decades the world's chief reliance will be on oil and natural gas supplies. Therefore, petroleum exploration must be concentrated toward discovering the oil and gas that lie untapped in both the known petroleum producing areas of the world and in the frontier regions. These frontier areas—the deserts, ice-covered lands, deep waters, and remote continental interiors—are estimated to hold vast hydrocarbon accumulations. It is in these sectors where future oil and gas discoveries could make the difference between a proper energy transition or a global catastrophe.

Explorationists must reevaluate the mature and developing petroleum regions of the world. The vast ocean areas and the remote continental interiors must also be carefully and thoroughly appraised to ascertain their petroleum potential. In conjunction with these investigations, new and better uses of geology, geophysics, and petroleum engineering and technology must be employed so as to enhance not only exploration, but development and production.