strike-slip components with horizontal displacements of dozens, or even hundreds of kilometers. Pre-Mesozoic faults, in part reactivated during the Mesozoic, had an important role in controlling the distribution of Jurassic-Cretaceous organic-rich shales and porous clastics. Wrench faults that developed during the Late Cretaceous–Tertiary mark the limit of the major petroleum provinces of west Siberia: the oil-rich Mid-Ob province, the less-prolific southern basin, the northern province (the world's leading gas region), the as yet little-drilled Khatanga trough, plus several other less-explored areas. Furthermore, most of the low-closure hydrocarbon-bearing structures seem to be of the drag type, being directly related to wrenching.

The relationship between strike-slip faults and the comparatively much smaller petroleum accumulations within the Paleozoic of the basin's southern part is more difficult to understand.

Future exploratory drilling to Mesozoic targets, including the deep-seated Jurassic in northern regions, and the Cretaceous in little-explored, low-accessibility parts of central-southern regions, should result in considerable new reserves of oil being found, probably exceeding the amount already found. A comprehensive wrench-tectonical approach may help find these undiscovered resources.

SCHRAMM, MARTIN, JR., Seagull International Exploration, Inc., Houston, TX, and G. LIVRAGA, Petromarine Italia S.p.A., Rome, Italy

Vega Field and Potential of Ragusa Basin, Offshore Sicily

Vega, the largest single oil field in the Mediterranean Sea, is located between the southeastern coast of Sicily and the Island of Malta. The field lies entirely in Italian waters. Its discovery in October 1980 was based on interpretation of a very poor-quality seismic survey which, nevertheless, roughly outlined a relatively small structure. A limestone and dolomite fractured reservoir of the Inici, or Siracusa Formation, of Late Jurassic age, may contain in excess of 1 billion bbl of heavy crude (15.5 API) within a productive area of approximately 10,000 acres (4,000 ha.). Reservoir properties are excellent, with permeabilities in darcys. The field extends northwest-southeast for 8.5 mi (14 km) and averages 1.7 mi (3 km) in width, according to the 3D seismic survey (2,000 km) shot soon after the discovery well was drilled. The gross oil column reaches approximately 820 ft (250 m). The southeasternmost part of the Vega structure is not yet completely defined, and an additional 3D seismic survey is in progress. Should the new seismic results confirm expectations, the Vega structure could extend over 10 mi (17 km).

The deepest formation reached by wells in the Ragusa basin is the Taormina Formation (dolomite of Middle to Late Triassic age) to which the Ragusa, Gela, Ponte Dirillo, and Piano Lupo oil fields are linked. The overlying Streppenosa Formation (Late Triassic to Early Jurassic age) is represented by bituminous shale with limestone development at the bottom (basal Streppenosa or Noto Member), which produces in the Mila and Irminio fields.

The overlying Inici reservoir consists of dolomite and underlain by limestone in the southwestern part of the basin, and entirely of limestone in the northwestern portion of the basin. The Inici Formation represents the platform facies of the open-sea Villagonia and Giardini sediments. The Cammarata-Pozzillo (discovered in 1959), Perla (1979), Vega (1980), and Prezioso (1983) heavy crude oil fields are related to this formation.

The Vega structure lies across the edge of the Inici carbonate platform. The northeastern flank appears to be controlled mainly by the facies variation between the Inici and Villagonia Formations. The southwestern flank seems, rather, to be controlled by dip.

The potential for discovery of other fields similar to Vega in the Ragusa basin is excellent.

ST. JOHN, BILL, Primary Fuels, Inc., Houston, TX

Antarctica—Geology and Hydrocarbon Potential

Antarctica covers approximately 14 million km^2 (5.4 million mi^2) and hosts an estimated 90% of the world's ice. About 98% of the continent is covered by glacial ice with an average thickness of 2,000 m (6,500 ft). Temperatures range from slightly below freezing along the coast in January to -88°C (-126°F) in the interior in August.

Seven nations lay claim to parts of Antarctica. However, some claims overlap and none are accepted or recognized by most nations, including the United States and the USSR. The 1959 Antarctic Treaty, which expires in June 1991, did not annul, but froze, the existing claims for the duration of the treaty. International meetings to determine jurisdictional and exploitative rights have been and are continuing to be held.

The first impression of the hydrocarbon potential of Antarctica is generally negative. The environment is hostile and only 2% of the continent is seen through the ice. Careful study of the surprisingly ample volume of published data available on the geology and geophysics of Antarctica, coupled with the application of the principles and mechanics of plate tectonics relative to the oceans and adjacent land masses, gives a different and very positive attitude toward the hydrocarbon potential of this vast unexplored frontier area.

On the basis of limited data, 21 sedimentary basins are identified for Antarctica and immediately adjacent areas. These include six onshore subglacial basins and 15 offshore basins. Excluding 11 basins considered to have little or no potential, the other 10 basins contain an estimated 16.9 million km^3 (4.05 million mi^3) of sediment having a potential hydrocarbon yield of 203 billion bbl oil equivalent.

The problems associated with hydrocarbon exploration in Antarctica are formidable. Technology is adequate for seismic surveys and exploratory drilling of the Antarctic continental shelf, as concluded from current operations in the Arctic and from operating requirements of drilling rigs under construction. However, a working relationship among involved nations must first be evolved and production, storage, and transportation problems solved.

SUND, TORE, Statoil, Stavanger, Norway

Tectonic Development and Hydrocarbon Potential Offshore Troms, Northern Norway

The study area, offshore Troms, is located from 16 to 25°E long. and 70 to 72°N lat. The geologic border between continental and oceanic crust is defined by a dramatic increase in water depth in the western part of the area. The area with water depth less than 500 m (1,640 ft) covers approximately 6,000 km^2 (2,300 mi^2). In this area, several highs and basins are defined. The Troms and Hammerfest basins are situated between the Loppa high on the north and the Troms-Finnmark basement high on the south. The southwestern continuation of the Troms basin is a strongly faulted depression, the Harstad basin. Thinned continental crust under the Troms basin is covered with more than a 15 km (9.3 mi) thick sedimentary sequence of Paleozoic and younger rocks. Early Permian evaporites have formed a few large diapiric structures. The main rifting phase in the Troms basin occurred during Late Jurassic–Early Cretaceous. Several thousand meters of Cretaceous claystones were subsequently deposited. During early Tertiary, a second rifting phase resulted in sea floor spreading west of the studied area. During the cooling stage, the southwestern Barents Sea acquired a westward dip. Tertiary sediments onlap the Upper Cretaceous unconformity from the west. Quaternary sediments lie directly on Cretaceous sediments in the eastern part of the area.

The north-south–oriented Ringvassøy-Loppa fault complex separates the Troms from the Hammerfest basin. In the Hammerfest basin, the Permian is developed as a shallow shelf carbonate facies. Tertiary and Mesozoic sedimentation was dominated by clastics. The Harstad basin is dominantly filled with Jurassic and younger sediments, and Paleozoic sediments are thought to underlie. Minor amounts of diapirism are present. Several compressional structures, formed by mid-Cretaceous strike-slip forces, are associated with the Troms-Finnmark fault complex. The Loppa high is a triangular-shaped structure covered by relatively thin Jurassic to Quaternary sediments. The southeastern part is an inverted Triassic basin. Shallow shelf carbonates define a good seismic marker in the upper Paleozoic.

Seismic control of the area offshore Troms, at present, is generally a 2 by 4 and 2 by 2 km grid. More detailed surveys cover the licensed areas, totaling 2,200 km^2 (850 mi^2). The first exploratory well was spudded in spring 1980, and 15 wells, dominantly wildcats, have now been drilled. Five gas discoveries have been made in the western Hammerfest basin, two of them with recoverable reserves in the range of 50-100 × 10^9 Sm^3 (1.76-3.52 tcf) gas.

All discoveries have been made in Early to Middle Jurassic sandstones. Rocks of Triassic and Permian age will be increasingly important toward