simultaneous reduction of iron oxides and oxidation of organic material.

Some of the late subsurface carbonate cements with extremely depleted $\delta^{18}O$ values precipitated either from hot brine or from isotopically light water; both possibilities require the vertical movement of fluid along faults. Galena and sphalerite occur in small amounts in some cores; a single fluid inclusion homogenization temperature from sphalerite was 20°C (68°F) higher than the present formation temperature at that depth. Brines moving up faults after albitizing feldspars in more deeply buried formations could be the source of lead and zinc for these minerals. Strontium isotopic ratios for calcite cement in these rocks are similar to ratios for brines from the Stuart City reef trend that are believed to originate deep in the Gulf of Mexico basin.

WU CHENQUAN, Yumen Oil Field, China

Jiuquan Basin—a Highly Explored (Mature) Area and Its Exploration Future

Jiuquan basin is one of the piedmont basins of the Qilian Mountain range in northwestern China. The basin has an area of about 2,700 km^2 (1,042 mi^2) and trends WNW-ESE. Cenozoic to Mesozoic deposits, with a total thickness of 4,500 m (14,764 ft) overlie lower Paleozoic rocks. Some Carboniferous, Permian, and Triassic outcrops are exposed near the margin of the basin.

Jurassic and Cretaceous formations, characterized mainly by marsh-lake sedimentary facies, are the source beds within this area. The thickness changes of these formations are related to the effect of crustal movement during deposition. On the uplifted parts of this area, Jurassic and Cretaceous deposits are very thin or absent; otherwise, they generally developed to a thickness of about 2,500 m (8,200 ft).

The Tertiary formations have a thickness of about 2,000 m (6,560 ft) and consist chiefly of river or lake to alluvial sediments deposited under arid climatic conditions. In the lower part of these formations, the river-delta sand bodies are the regional reservoir beds.

Between the Mesozoic and Cenozoic systems, a large depositional interruption exists. Upper Cretaceous to Paleocene deposits are all absent.

There are three structural belts in this area. From south to north, they are the southern anticline belt, the center depression belt, and the northern monocline belt.

The first field (Laojunmiao oil field) was discovered in 1939. Since the founding of the People's Republic about 33 years ago, six oil fields (comprising 14 oil pools) have been sequentially discovered within this basin.

The discovery history of the oil fields can be divided into three stages. During the first stage (1939-59), shallow reservoirs in the Tertiary were explored, based primarily on oil seepage and surface structure drilling. Fields discovered during this period were the Laojunmiao, Yarxia, Beiyanghe, and Shiyougou. From 1960 to 1974, the second exploration phase drilled to the deeper formations. As a result, a buried basement hill was discovered under the shallow Yarxia reservoir, and a new Cretaceous reservoir was found in the direction of the source area. After 1975, exploration entered a new stage with the search for pre-Tertiary nontectonic-type reservoirs. With improved seismic apparatus and data processing, the study of sedimentary facies using seismic stratigraphy is being applied to exploration efforts. The improved seismic and data processing, in combination with advances in drilling techniques, have led to the discovery of new nontectonic-type oil fields in places that had been previously drilled. The number of nontectonic reservoirs and their reserves are growing.

YALOM, MARC I., Univ. Maryland, College Park, MD

Simulated Effect of Time of Satellite Overpass in Mapping Lineaments

Current lineament mapping from satellite imagery is possibly limited by the time of satellite overpass and the resultant sun azimuth and elevation angles. The use of plastic topographic raised-relief maps provides a method of lineament mapping using a wide selection of lighting positions. A comparison of lineaments mapped from the two media has been made, including general orientation, orientation relative to sun azimuth, and orientations in which length is maximized. It has been determined that the lineaments are sufficiently similar to permit the use of relief-map photos as a viable alternative to satellite imagery. These photos can then be used to study the effect of satellite overpass time in lineament mapping.

Simulated overpass times were represented in raised relief map photos. Overall, maximum lineament detection occurs at a relative sun azimuth range of 10 to 30°, and at sun elevation angles of 30 to 40°. In individual images, the maximization by relative azimuth is modified by the presence of a major lineament trend.

An effort to predict optimum overpass time indicates that no one specific overpass will provide adequate detection of an entire collection of lineaments in a region. However, if an operator is interested in lineaments trending at a specific orientation, an overpass time can be recommended that will provide the desired sun elevation and azimuth angles. Relief maps of the Appalachian Plateau of West Virginia were used in these analyses.

YANG WANLI, Daqing, China

Formation Model of a Giant Nonmarine Oil Field

Daqing oil field is one of the giant nonmarine oil fields. Taking Daqing oil field in the Songliao nonmarine sedimentary basin as an example, and on the basis of the study of organic geochemical and geologic conditions for the formation of the giant nonmarine oil field, the characteristics of formation of a giant oil field are discussed.

The formation of Daqing oil field, according to the analysis of depositional, structural, and geochemical conditions, can be characterized by the small area ratio of source rocks to reservoir rocks and the short distance of secondary migration of oil and gas. From three aspects of the reservoir characteristics of Daqing oil field—the geochemical conditions for generation, expulsion, migration, the accumulation of oil and gas; and the relationship between these conditions and structural growth—the process of formation of Daqing oil field is discussed by the writer.

It is considered that the kerogen in Daqing oil field is of "combined" sapropelic type. The source rocks in Daqing oil field have high efficiencies both in hydrocarbon generation and in hydrocarbon expulsion, thus forming good source rocks, indicating that even a relatively small hydrocarbon generation area can effect a giant oil field.

Because the sandy reservoir (parallel with the striplike oil source sags on both sides) is surrounded with source rocks, lateral secondary migration of oil and gas over a short distance is the main migration pattern of hydrocarbon during the formation of this giant nonmarine oil field. As a result, a typical model for a giant oil field in a large eutrophic-like basin is presented as follows.

1. A good reservoir composed of a huge delta complex, part of which directly extends as a carrier bed into source rocks; a large structural trap with a very thick sand body; and a large cap rock