propping agents. Dolomite precipitated from slurries partly healed the fractures.

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Lower and Middle Paleozoic Potential of Paradox Basin

Successful oil exploration in the Paradox basin began in 1907 with the discovery of Pennsylvanian oil at Mexican Hat field in San Juan County, Utah. Accelerated exploration began with the discovery of oil in the Pennsylvanian Paradox Formation at Aneth field in 1956 and lasted into the 1960s. Cumulative production at greater Aneth field exceeds 271 million bbl of oil. A second major oil producing zone, the Mississippian Leadville, was established at Lisbon field in 1960. By 1978, its 25 wells had produced 40 million bbl of oil and 310 Bcf of gas. Recently, exploration in the area has been minimal with the exception of the current exploration for carbon dioxide for secondary recovery projects.

The Paradox Formation, the major producing unit in the basin, can be subdivided into both genetic units and facies subzones using sample and mechanical log information. Recognition and mapping of the major facies—hypersaline, penesaline, and marine shelf—for each genetic unit can delineate fairways most favorable for the development of algal mounds in which the best production occurs.

Perhaps the most significant remaining potential is in the Mississippian Leadville formation. Exploration for structural traps within this carbonate unit is difficult owing to the thick overlying Pennsylvanian salt section present over much of the basin. A pilot gravity modeling study in the Lisbon field area has shown that the salt effect can be removed and the underlying structure mapped. Regional gravity modeling of the remaining salt basin may define similar Lisbon-type structures.

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Recent Advances in Helium Analysis as Exploration Tool for Energy "Deposits"

Recent research by the U.S. Geological Survey demonstrates that helium-gas analysis of waters and soils holds great promise as a cost-effective exploration technique for uranium, oil and gas, and geothermal energy sources. The technologic advances include assembling a helium analyzer, almost entirely from commercially available equipment, and packaging the equipment into a mobile laboratory capable of performing as many as 100 analyses a day at a field location. Helium is an attractive indicator element for many exploration programs because of its unique properties: it is highly diffusive, chemically inert, radioactively stable, and not produced or affected by biologic activity. Many associations of helium with uranium have been observed, in which helium is produced by natural radioactive disintegration; with oil and gas, where helium is trapped by structural and stratigraphic features; and with hot-water geothermal systems, in which the cooling and reduced pressure of rising water causes dissolved helium to be released. The following are examples of distinctive helium anomalies found associated with energy "deposits": for uranium, the Ambrosia Lake district, New Mexico; for oil and gas, the Cement oil field, Oklahoma, and the Cliffside gas field, Texas; and for geothermal, the East Mesa known geothermal resource area in the Imperial Valley, California. With respect to an ambient air background of 5.24 ppm helium, the highest observed concentrations of excess helium in soil and soil gas were typically 0.5 ppm for uranium, 10 ppm for oil and gas, and 100 ppm for geothermal; water samples usually had several hundred parts per million helium for all types of energy deposits. Helium analysis can be used as a rapid and inexpensive reconnaissance tool and as complementary support for other geophysical and geochemical prospecting techniques.

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Seabed Characteristics and Sand Dispersal on Bedrock-Dominated Inner Shelf of Southern Labrador

The Labrador Shelf is dissected by the Marginal Trough into a narrow inner rocky shelf, which is the submerged extension of the Precambrian Shield landmass, and an outer shelf zone consisting of broad, flat banks mantled by thick deposits of glacial drift. The inner shelf north of Groswater Bay is 35 km wide, with a highly irregular bedrock-dominated bottom topography. Unconsolidated materials consist of sand, and coarse gravel "pavement" deposits. Sand deposits are less than 1 m thick and limited in areal extent to the flat-bottomed, low-lying areas between bedrock highs. Coarse gravel deposits occur as veneer pavements on the flanks of highs. The sands are underlain either by cohesive muds (early Holocene?) which were deposited in former basinal depressions, or by coarse gravels in local areas marginal to bedrock outcrops. The coarse gravels are probably relict lag deposits formed by the reworking of glacial drift, but the sands are thought to be derived from contemporary nearshore and beach sediments situated about 10 km west of the study area.

The thin and patchy sand distribution suggests that transport mechanisms are more than sufficient to disperse the volume of sand that is being supplied to the inner shelf. Preliminary analysis of near-bottom velocity measurements indicates that the seabed is subjected to a strong southeasterly current (Labrador current) which induces a net southeasterly sand flux across the shelf. The predominantly resistant substrate of the shelf would likely be swept clean of sand, if it were not for the irregular bottom configuration which provides local and temporary sinks for sand deposition.

The most important sediment-transport process on the inner shelf is the southeasterly directed Labrador current. Wave-generated currents are of lesser importance (except in shallow nearshore areas) as a sand-dispersal mechanism, and iceberg-scouring is more effective in redistributing sediment in areas seaward of the inner shelf edge.

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