soluble in ground fluids, practically non-adsorbable, highly mobile, and a direct product of radioactive decay.

The technique can be applied by collecting soil, soil gas, water or bottom sediment samples in reconnaissance, and semi-detailed and detailed arrays under a wide range of environmental conditions. Helium analyses are made by gas-source mass spectrometry. The resultant data are interpreted and presented with the aid of computers. In interpreting the helium data, it is necessary to consider the effect of some parameters which must be determined for each sample.

Helium anomalies have been found in near-surface soil and soil gas over known sandstone-type deposits in New Mexico, Texas, and Wyoming; hydrothermal(?) ore in Washington; unconformity-type mineralization in the Athabasca basin; and pegmatitic ore zones in Ontario. Anomalies have also been detected in lake bottom water and sediment overlying these types of deposits and in the groundwater recovered from wells and boreholes located close to them. The results from resurveys over several of these deposits indicate that even though the magnitude of the helium anomalies may vary from season to season, the anomalies themselves persist and hence define the location of the mineralization. This technique therefore seems to offer great promise as an economical indicator of deeply buried uranium deposits in a wide range of geologic environments.

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Oil and Metals in Ordovician and Devonian Kerogenous Marine Strata of Central Nevada

Kerogen-rich mudstone, siltstone, dolomite, and chert units as much as 50 m thick in the Vinini (Ordovician) and Woodruff (Devonian) formations contain potential resources of syncrude oil, V, Zn, Mo, Se, Ag, and Cr. Most kerogenous rocks originally consisted of organic-rich siliceous muds, slimes, and oozes. Organic matter is mostly amorphous, flaky, and stringy sapropel composed of planktonic organisms. The strata are within strongly deformed eugeosynclinal Paleozoic marine rocks of the Roberts Mountains allochthon.

Many fresh black rocks are low-grade oil shales which, upon pyrolysis, yield <40 l of oil per metric ton of rock; some thin layers yield as much as 125 l per metric ton. In these rocks, solid bitumen and liquid oil commonly fill voids and microfractures. Such early-phase hydrocarbons probably were released during diagenesis and formed without any major thermal degradation of the kerogen. Geochemical data suggest that the organic matter is thermochemically immature to mature and has not been subjected to temperatures above 60°C since deposition. Hydrocarbon contents (<100 to 5,400 ppm) and organic carbon contents (<1 to 25 weight %) vary widely.

V, Mo, Se, Ag, and Cr in fresh black rocks occur chiefly in organic matter; Zn occurs as sphalerite and Ni in iron sulfides. Concentrations are as much as 5,000 ppm V, 18,000 ppm Zn, 1,000 ppm Mo, 100 ppm Se, 20 ppm Ag, 150 ppm Ni, and 600 ppm Cr in unoxidized rocks. Enrichment of V and Se and depletion of Zn, Mo, Ni, and organic matter occur in oxidized rocks.

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Oil and Gas Potential of Wyoming-Utah-Idaho Overthrust Belt—Relation to Canadian Foothills Province Analog

The Cordilleran orogenic belt is generally considered to be a single tectonic element extending from northern Alaska to Central America. Two segments of the North American part of this element are oil and gas producers—the Canadian foothills thrust belt and the Wyoming-Utah-Idaho Overthrust belt.

Turner Valley was the first field discovered in the Canadian foothills. In the 55 years since that discovery, 32 fields have been found containing 9.3 Tcf of initially recoverable gas, 143 million bbl of natural gas liquids and 132 million bbl of oil. The first significant field discovery in the U.S. Overthrust belt was made in 1975 at Pineview. By the end of 1979 eleven new fields had been found, containing an estimated 500 million bbl of recoverable oil and 5.5 Tcf of recoverable gas, plus natural gas liquids.

The Canadian province is considered to be an appropriate geologic analog to the U.S. Overthrust belt, based on a number of characteristics common to both provinces. These include general structural configuration, trap types, reservoirs, stratigraphy, timing of migration of hydrocarbons, depth of burial, and age of tectonic movement. However, significant differences include age of major source rocks and paleothermal histories.

The future potential of the immaturely explored Wyoming-Utah-Idaho Overthrust belt is assessed by using a volumetric method, wherein hydrocarbon yields in barrels of oil and cubic feet of gas per cubic mi of sediments are established for the more densely explored Canadian foothills. These yields are applied to the less densely explored U.S. Overthrust belt. The usefulness of this method lies in the correct interpretation and analysis of similar, as well as dissimilar, geologic characteristics of the analog province. In addition, the assessment of the U.S. Overthrust belt is further refined by using the southerly productive part of this province as an "internal" analog which is applied to the remaining area of the province.

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Algal-Metazoan Bioherms of Lower Ordovician Age—St. George Group, Western Newfoundland

Bioherms are common in the St. George Group, a sequence of shallow-water carbonate rocks deposited on the western continental shelf of Iapetus Ocean. The cores of these bioherms are composed of thrombolites (unlaminated, branching, columnar stromatolites), "calcareous algae," and corals. On the basis of framework-building components, three types are distinguished: (1) thrombolite mounds, (2) *Lichenaria*-thrombolite mounds, (3) thrombolite-*Lichenaria*-*Renalcis* reefs. Associated with these structures is a diverse fauna of bur-