

the mine by lateral movement through the lower aquifer.

Water demand for the prototype industry is less than the natural recharge and can be supplied by ground water. If oil-shale development is to proceed beyond the prototype stage, water will have to be imported to meet the industrial demand, and mine-dewatering operations will eventually have to handle water with dissolved-solids concentration comparable to sea water.

#### COMPARISON OF COMMUNITIES

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Marine benthic communities can be compared spatially and temporally using 1) the Shannon-Wiener diversity index, 2) equitability, 3) mode of life, 4) trophic structure and 5) character of the substrate. Trophic structure can be subdivided into 1) rank of categories based on number of species in each and 2) species distribution within each category.

Determination of these parameters and their comparison with geologic age and substrate grain size for 7 lingulid communities (4 Paleozoic, 2 Mesozoic and 1 Holocene) suggest several generalizations for further testing. (1) Shannon-Wiener diversity of lingulid communities is sensitive to substrate grain size. (2) Equitability is below 0.50 indicating disturbed assemblages, unstable environments or both. (3) Sand substrates are dominated by epifaunal species as are all Paleozoic lingulid communities, indicating the grain size was unimportant to their mode of life; the Cretaceous clay community is dominated by infaunal species, the result of post-Paleozoic adaptive radiation of infaunal siphonate bivalves. (4) Low level suspension feeding species dominate 5 of the 7 communities and increase through time at the expense of the other 3 trophic groups. (5) Differences in percentages of collectors and swallows in communities with sand and clay substrates may reflect organic content and/or mobility (i.e. firmness) of the substrate. (6) The silt substrate supports a more even distribution of species in the 4 trophic groups which may be because a) the substrate is silt or b) this is the oldest community studied. (7) In general the two most abundant taxa (based on percent individuals) belong to different trophic groups with the dominant taxa in each group in most communities from 2 to 5 times more abundant than the second ranking taxa.

#### GEOTHERMAL EXPLORATION IN THE UNITED STATES - 1974

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Geothermal energy may prove to be an important future U.S. power source. The extent and potential of geothermal resources, however, remain virtually unknown since exploration is at a relatively low level and the technology of exploration is in its infancy.

The largest percentage of wildcat geothermal exploration in the United States in 1974 is in the Basin and Range Province, with smaller but no less important exploration efforts in the Rio Grande Trough in Colorado and New Mexico, the Modoc Plateau in California, the Cascades in Washington and Oregon, and in and around the Boulder and Idaho Batholiths in Montana, Idaho, and Oregon.

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The major problems confronting geothermal exploration in the United States are the validity of the various geochemical and geophysical techniques used, the bureaucratic confusion over leasing public lands, and resolution of the legal definition of geothermal energy.

#### ROCK GLACIERS AND BLOCK FIELDS

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Both tongue-shaped and lobate rock glaciers are recognized in most alpine regions today. For the tongue-shaped, two situations emerge: those with buried glacier ice (debris-covered glaciers) called ice-cored rock glaciers, and those with interstitial ice known as ice-cemented rock glaciers. Those with ice cores are revealed by shallow depressions between rock glacier and headwall cliff (where a former glacier melted), marginal and central meandering furrows, and collapse pits. Ice-cemented rock glaciers ordinarily do not possess these features. As applied to 18 rock glaciers in Colorado Front Range, 12 east of the Continental Divide are ice cored, 6 west of the Divide are ice cemented.

Many lobate rock glaciers also are in Colorado Front Range; of those studied, the majority are on south sides of valleys, and, except for talus, are the most voluminous form of mass wasting. All those above treeline are active with usual characteristics of other rock glaciers, all originated from talus, contain interstitial ice, move outward from valley wall at 1 to 6 cm/yr, and contribute far more debris than heretofore realized.

Block fields and block slopes (on  $>5^\circ$  slopes) are polar as well as alpine. They occur below cliffs and along ridgetops without visible source rock; some are stable and some active. Production of angular blocks by frost-wedging is not proved. Force exerted by adsorbed molecular water on mineral surfaces is sufficient to widen cracks formed previously by pressure release. Movement once was by gelifluction, if finer matrix between blocks, now washed out, formerly existed.

#### A COMPARISON OF LINEAMENTS AND FRACTURE TRACES TO JOINTING IN THE APPALACHIAN PLATEAU OF ALABAMA -- DORA-SYLVAN SPRINGS AREA

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In recent years, several workers have shown that the dominant modes for trends of lineaments and fracture traces mapped from aerial photographs taken at low to medium altitudes generally correspond to the dominant modes for the strike of joints in relatively flat-lying sedimentary rocks. Little detailed work, however, has been done to correlate joint modes with lineament and fracture-trace modes mapped from high-altitude ( $>18,000$  m) and orbital imagery.

Two 7½-minute quadrangles (Dora and Sylvan Springs) in the Warrior basin of the Appalachian Plateau were selected for a detailed joint and lineament/fracture-trace analysis. The major rock unit exposed in this area is the Pottsville Formation of Pennsylvanian age, which consists chiefly of alternating beds of sandstone and shale. Topographic and tonal lineaments and fracture traces were mapped from ERTS-1 band 5 and high-altitude color-infrared data and were transferred to the quadrangle.