

unless they were saturated, even if the ground were to be shaken vigorously. If much water were added to these deposits, however, either as a result of a rapid snowmelt or an unusually wet spring, the stability of these deposits would be lessened drastically, and it is possible that they might move even without any ground shaking.

In general, the potential for considerable damage exists in the area; the probability of such damage is small.

Pyritic alteration in the northern Keg Mountains, Utah

In the Delta 2-degree quadrangle, Utah, an unprospected zone of pyritic alteration containing anomalous trace concentrations of ore-stage base and precious metals was discovered by H. T. Morris in the northern Keg Mountains (Morris, 1978). Considerable interest in this area has been shown by exploration and mining companies. Claims were staked shortly after the announcement of its discovery, and currently the area is being studied in detail with the goal of selecting sites for diamond drill holes.

Tephrochronology

Tephrochronologic study by G. A. Izett of two volcanic ash beds interlayered in sediments of the Main Canyon Formation (Pleistocene and Pliocene) of Bright (1967) in Thatcher Basin in southeast Idaho indicates that the formation is much older than previously thought. The formation previously was assigned a late Pleistocene age (33,700–27,000 yr B.P.) based on seven carbon-14 ages. Of two of the ash beds in Bright's Main Canyon Formation, one correlates with the "Pearlette Type B" (2.0 m.y.) ash and the second with "Pearlette Type O" (0.6 m.y.) ash of the Great Plains. The correlation of the ashes in Bright's Main Canyon Formation with the "Pearlette Type B and O" ashes is based on similarities of (1) index of refraction of glass shards, (2) chemical composition of glass shards (major and trace elements), (3) chemical composition of phenocrysts of clinopyroxene, hornblende, magnetite, and ilmenite as determined using an electron microprobe, (4) phenocryst assemblage, and (5) paleomagnetic direction of the ashes. Zircon microphenocrysts of the ash in Bright's Main Canyon Formation that correlates with the "Pearlette Type O" yielded an age of 0.56 ± 0.18 million years (C. W. Naeser, USGS, written commun., 1978). The revision of the age assignment of the Bright's Main Canyon Formation indicated by the above data has important bearing on the geo-

morphic and tectonic history of Thatcher Basin relative to the history of Lake Bonneville.

An experimental technique for delineating areas best suited for mining of coal

An experimental method was developed for delineating those areas best suited for the surface mining of coal. A computer combined several resource and existing land-use maps into a single map that shows areas of low, intermediate, high, and very high suitability for mining. These map units were determined by adding separate evaluation scores that had been assigned to the current use of land, plus five natural resources—ground water, surface water, soil, wildlife habitat, and scenic quality. Evaluation scores for these factors were arrived at by rating their suitability for one of the following purposes: agricultural use, importance or uniqueness to local ecological systems, or esthetic quality. It is assumed that in regions of widespread minable coal, areas having the most valuable natural resources should be mined last or not at all.

The Gap quadrangle, Wyoming, was chosen as an example of the method. This area is representative of a larger region in northeast Wyoming underlain by coal amenable to surface mining techniques. The quadrangle was divided into a grid having several thousand map cells. The factors found in the cells were individually evaluated and their scores totaled. The range in sums was subdivided into the four map units of the final map. These were printed as symbols by the computer to result in a map showing suitability for mining.

IGNEOUS STUDIES

Volcanic recurrence intervals and volcanic hazards in the eastern Snake River Plain in Idaho

Combining field mapping, radiocarbon and K-Ar age determinations, and statistical analyses, M. A. Kuntz, G. B. Dalrymple, and J. O. Kork have attempted to determine recurrence intervals of volcanism in selected areas of the eastern Snake River Plain for the purpose of evaluating volcanic hazards. In the Arco-Big Southern Butte area, volcanic recurrence intervals are on the order of one eruption per 3,000 years. Radioactive waste storage facilities of the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering Laboratory (INEL) are subject to potential volcanic hazards from volcanism in the Arco-Big Southern Butte area. The RWMC lies at the mouth of a funnel-shaped volcanic eruption basin; thus,

lava flows from distant vents have the possibility of being channeled into the storage area. Studies are currently underway to determine the K-Ar ages of approximately a dozen lava flows encountered in cored drill holes at the RWMC to determine the recurrence interval of flooding of the waste storage site by lava flows.

In a similar study, K-Ar dating of five basalt lava flows in cored drill holes at a proposed reactor site at INEL showed that the site had been covered by the flows over a period of about 350,000 years. The K-Ar age data indicate that the site has been covered by lava flows at irregular intervals from perhaps a few thousand to as much as 150,000 years, with an average recurrence interval between flows of approximately 50,000 years.

Field mapping of the Craters of the Moon lava field, Idaho

Field mapping of the Holocene Craters of the Moon lava field in south-central Idaho by M. A. Kuntz and D. C. Champion (USGS) and R. H. Lefebvre (Grand Valley State College) shows that a large part of the lava field was formed approximately $10,000 \pm 2,000$ years ago, by tube-fed pahoehoe and as flows erupted from large spatter cones at the north end of the Great Rift. Several flows traveled as much as 45 km from their source vents. The older flows are covered by extensive younger flows, erupted about 2,000 to 2,400 years ago, also from large cinder cones at the north end of the Great Rift. Samples of organic soil were collected from beneath about 20 lava flows for radiocarbon age determinations; the data should provide the information necessary to provide an evolutionary model for the lava field. In addition, the age data will provide a framework for evaluation of the secular variation of the Earth's magnetic field during the last 12,000 years. The chemical and age data currently available suggest that lavas ranging from olivine tholeiite (~45 percent SiO_2) to ferrolatite (~63 percent SiO_2) were erupted nearly simultaneously from adjacent fissures in the Great Rift volcanic rift zone during several periods in the evolution of the lava field.

Structurally complex roots of a caldera near Questa, New Mexico

Reconnaissance mapping by P. W. Lipman of a little studied upper Tertiary volcanic field in the Sangre de Cristo Mountains near Questa, N. Mex., has led to recognition of a volcano-plutonic assemblage of remarkable structural complexity. This assemblage may reflect formation of an ash-flow

caldera in an extensional tectonic environment, related to early growth of the Rio Grande rift. A single cooling unit of rhyolitic ash-flow tuff 1 km or more thick overlies a chaotically brecciated assemblage of intermediate-composition lavas and intermixed tuffs. This assemblage is cut by compositionally and texturally diverse high-level granitic intrusions (with published dates of 22-23 m.y.) analytically indistinguishable from a single date on the ash-flow tuff. Structural interpretation of this volcano-plutonic association, which may represent a caldera-fill assemblage, is complicated by repetition and rotation to near vertical dips along north-trending normal faults. These faults have displacements that are generally down on the west, a geometry similar to that of the Sangre de Cristo frontal fault system along the east boundary of the Rio Grande rift. Exposures along these fault slices and steep west slope of the mountain range appear to provide a vertical cross section of several kilometers through the interior of the caldera. This probable caldera is of economic interest because a large zone of major acid-sulfate alteration and molybdenum mineralization, which includes the open-pit Questa Mine, occurs along its south margin in the Red River area.

Initial strontium values of rocks from the Pioneer Mountains

Initial strontium (i-Sr) values of Cretaceous intrusive rocks of the Pioneer batholith, and of rocks within the Proterozoic X gneissic basement complex nearby, were determined by J. G. Arth in conjunction with the areal mapping and petrologic studies of E-an Zen. Arth found that the i-Sr values of the batholithic rocks fall into two groups, those at or near 0.7113 and those at or near 0.7138. Zen finds that these two groupings are compatible with an interpretation of the field relations, which shows these two groups to form two distinct intrusive series, even though on a Harker variation diagram the two groups are not distinguishable. Because the two groups yielded identical K-Ar ages by concordant hornblende and biotite determinations, they presumably coexisted as two distinct but contemporaneous magma bodies, and differentiation within each body could have given rise to various plutons within each series. The i-Sr values are much higher than those of the Boulder batholith (Tilling, 1973); the values are also sufficiently high as to suggest highly differentiated parent material such as sedimentary rocks, even though the rocks exhibit petrologic features suggestive of the I-series of igneous rocks according to the nomenclature of White and Chap-