DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1483-A
PAMPHLET

MINERAL RESOURCE POTENTIAL OF THE POWDERHORN WILDERNESS STUDY AREA AND CANNIBAL PLATEAU ROADLESS AREA, GUNNISON AND HINSDALE COUNTIES, COLORADO

By

W. N. Sharp and R. A. Martin, U.S. Geological Survey
and
M. E. Lane, U.S. Bureau of Mines

Studies Related To Wilderness

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and related acts, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Powderhorn Wilderness Study Area and the contiguous Cannibal Plateau Roadless Area (02218), Gunnison National Forest, Gunnison and Hinsdale Counties, Colo. The Powderhorn was established as a wilderness study area by Public Law 94-579, October 21, 1976, and the Cannibal Plateau Roadless Area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the Forest Service, January, 1979.

MINERAL RESOURCE POTENTIAL SUMMARY STATEMENT

The combined Powderhorn Wilderness Study Area and the contiguous Cannibal Plateau Roadless Area have a low potential for mineral and energy resources except in the southwesternmost part of the Cannibal Plateau Roadless Area, where the caldera walls of the Lake City and Uncompahgre volcanoes are located. This part of the study area has a moderate potential for the discovery of gold-silver vein deposits and other metals such as molybdenum in subvolcanic porphyries commonly associated at depth with silicic volcanism.

INTRODUCTION

The Powderhorn Wilderness Study Area (51,000 acres or 20,640 hectares) and the contiguous Cannibal Plateau Roadless Area (29,500 acres or 11,959 hectares) are in Gunnison and Hinsdale Counties, Colo., approximately 50 mi (80 km) southwest of Gunnison and a few miles east of Lake City (fig. 1). Part of the area has been known as the Powderhorn Primitive Area. The mineral resource potential of the study area has been appraised by the U.S. Geological Survey and the U.S. Bureau of Mines; this appraisal consisted of a geologic study and investigation of mines and prospects by the Geological Survey and the Bureau of Mines (this report), a geophysical study by the Geological Survey (Martin and Sharp, 1983), and a geochemical study by the Geological Survey (Sharp and Lane, 1983).

The study area lies on the northern flank of the San Juan volcanic field between the Lake Fork of the Gunnison River and Cebolla Creek. Nearby Lake City is a well-known mining and resort town. The topography ranges from plateau tops at altitudes of approximately 12,500 ft (3,800 m) to valley floors at altitudes of approximately 8,500 ft (2,600 m). The study area is surrounded by well-maintained county roads, but access to the interior is mostly by trail. Only one logging road and one campground road on the north side extend into the study area.

The west and east sides of the study area are marked by precipitous slopes and vertical cliffs that flank the canyons of Cebolla Creek and the Lake Fork of the Gunnison River.

GEOLOGY

The study area lies on the northern flank of the San Juan volcanic field (fig. 2), an extensive region underlain by a thick accumulation of Tertiary volcanic rocks. Older, intermediate-composition strato-volcanoes, 35-30 m.y. old, are overlain by a widespread ash-flow-tuff field that accumulated 30-22 m.y. ago. The sources for the ash-flow-tuff sheets are marked by clusters of volcanic subsidence structures (calderas) outside the areas (Steven and Lipman, 1976); the western San Juan caldera complex lies to the southwest and the central San Juan caldera complex to the south and southeast (fig. 2). Flood-basalt lava

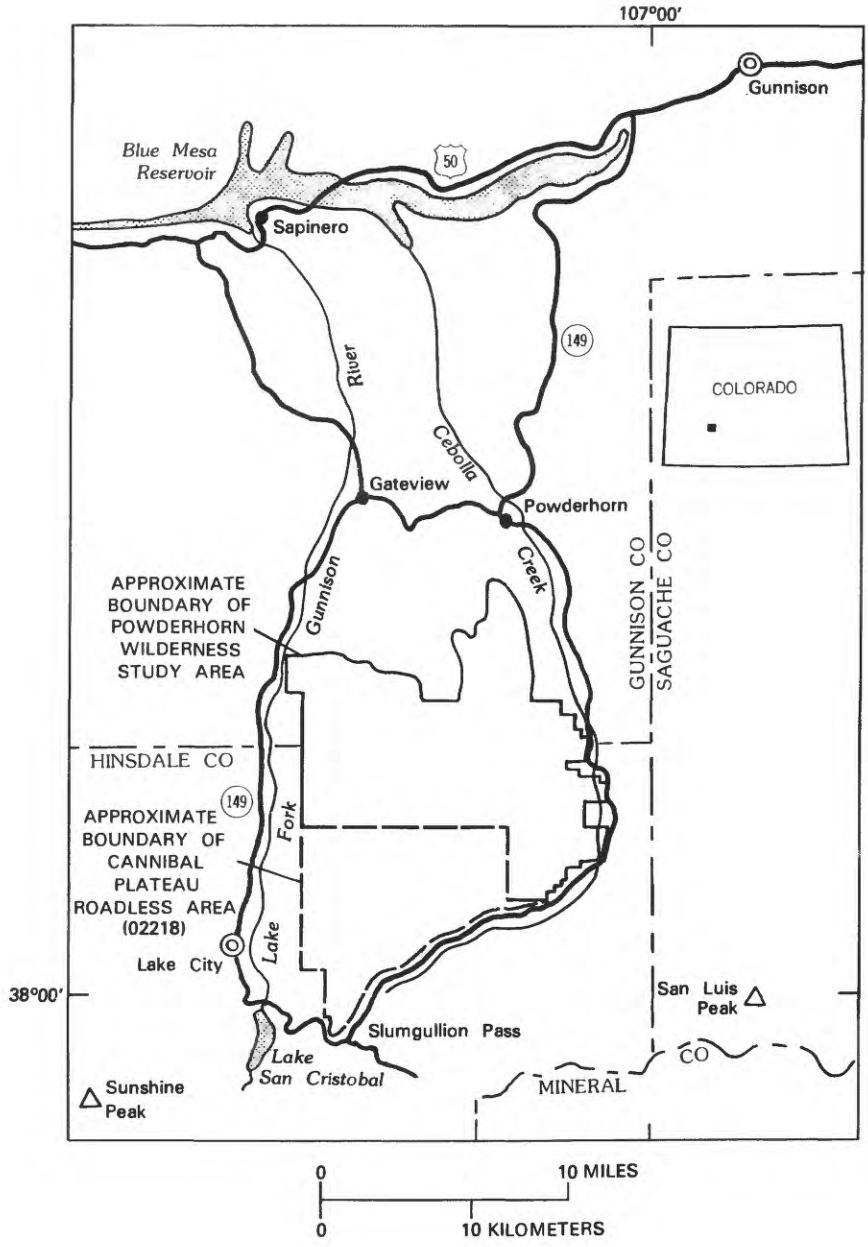

Figure 1.--Index map showing the location of the Powderhorn Wilderness Study Area and Cannibal Plateau Roadless Area (02218), Colorado.

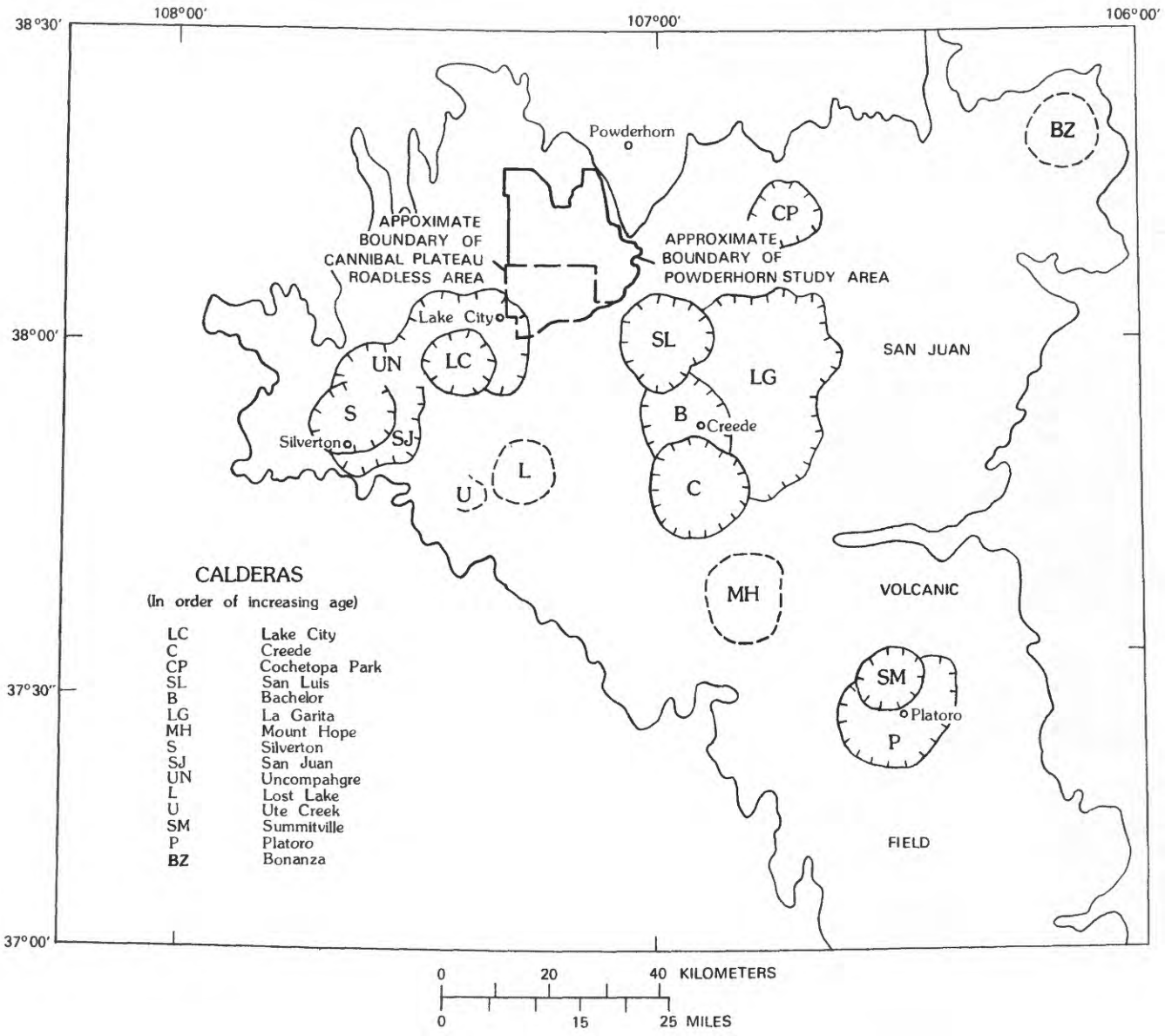

Figure 2.--Powderhorn Wilderness Study Area and Cannibal Plateau Roadless Area in relation to the San Juan volcanic field and calderas. Modified from Steven and Lipman (1976). Hatchured lines show calderas; dashed lines show buried or inferred calderas.

flows deposited after the period of ash-flow eruptions and caldera subsidences cap the high ridges in and near the study area. To the north, near Powderhorn, Colo., erosion has cut through the volcanic cover to expose Precambrian crystalline rocks, which are believed to underlie at depth most of the study area. In the study area, the erosion surface between the Precambrian basement and the volcanic cover appears to dip a few degrees to the southwest, so that in combination with rising topography southward, the Tertiary volcanic pile increases from approximately 1,500 ft (450 m) thick in the northeast to 5,000 ft (1,500 m) thick in the southwest.

The older stratovolcanoes in the vicinity of the study area consist of dark andesitic flows, flow breccias, and volcanic conglomerates that crop out along cliffs on the west side of the plateaus of the study area and form the hills of the northwest terrane of the study area and beyond. The overlying younger ash-flow tuffs, derived from caldera sources to the southwest and southeast, form widespread sheets of moderately to densely welded rocks that are exposed along extensive cliffs flanking valley walls on the south and east sides of the study area and along the deep, linear valleys that drain northward. Dark flood-basalt lava flows that cap the high plateau and associated ridges are part of the Miocene and Pliocene Hinsdale Formation (Lipman and others, 1970).

Several small granitic plugs, marking former volcanic vents, cut the older, intermediate-composition lava flows and breccias around the periphery of the study area. A number of rhyodacitic dikes cut the volcanic edifices around these intrusive plugs. Rocks adjacent to the intrusive centers and related dikes commonly were altered irregularly by hydrothermal activity during or after intrusion.

Several late faults cut the volcanic rocks, and along some of these faults the rocks are locally altered and show minor enrichment in several metals. None of the local mineralized areas along faults or near intrusive bodies in the study area, however, appear to have a potential for significant mineral resources.

The southwest corner of the study area is essentially part of the (older) Uncompahgre and (younger) Lake City volcanic calderas. Geologically, this is the most complex segment of the study area because it is part of large subsidence structures and is the site of rock alteration and vein-forming processes. Consequently, it is the economically significant part.

Mining activity

No mining is presently being done within the boundaries of the study area; only minor prospecting has been done and only around a granitic plug at the north edge, and in the altered terrane at the southwest corner, of the study area. However, mines are near the study area in this altered terrane. The Golden Wonder Mine and others near Lake City were operated sporadically until 1900, and since then have been promoted and maintained until the present time.

GEOPHYSICAL SURVEYS

An aeromagnetic survey covering most of the study area was flown in 1978 by L. K. B. Resources, Inc., at 13,000 ft (4 km) altitude and with 3/4 mi (1.2 km) line spacing. Data for a small segment of the study area were from a survey flown in 1970-72 by the U.S. Geological Survey (1972). The data are contoured at 20-gamma intervals (Martin and Sharp, 1983). Relatively magnetic basalt lava flows cap the high plateaus in the southern part of the study area, causing intense, steep-gradient magnetic anomalies (Martin and Sharp, 1983). The underlying volcanic rocks are somewhat less magnetic and have a much more subdued magnetic expression. Effects of the buried Precambrian rocks can be discerned only where the volcanic cover is thin near the north margin of the study area.

North of the plateaus, a gentle saddle on a magnetic ridge correlates with the Trout Creek plug. The lack of a stronger magnetic expression can be attributed to the compositonal similarity between the plug and the enclosing rocks.

The steep magnetic gradient that borders the low in the southwest part of the study area follows the mapped Uncompahgre caldera wall and probably represents a lithologic change across the wall. Magnetic highs west of the wall show no relationship to surface rocks and probably have deep-seated sources. Magnetic patterns from the deep-seated sources are obscured by the magnetic high caused by basaltic flood lavas.

No features in the aeromagnetic contour map (Martin and Sharp, 1983) and in gravity data (Plouff and Pakiser, 1972) may confidently be interpreted to have direct significance to mineral deposits. The aeromagnetic surveys extend across the hydrothermally altered terrane near the southwest edge of the study area, where magnetic patterns related to mineralization might be expected. However, high-amplitude anomalies, associated with the basaltic flood lavas on Mesa Seco, are dominant and obscure any magnetic patterns of lesser amplitude that might occur over the altered rocks.

GEOCHEMICAL SURVEY

Samples were collected for geochemical analyses in the Powderhorn Wilderness Study Area, Cannibal Plateau Roadless Area, and adjacent areas, and were analyzed by semiquantitative spectrograhic methods. Most samples were panned-concentrate stream-sediment samples. The heavy-mineral concentrates obtained are considered representative of the terrane drained by the streams sampled. Many bedrock samples were also collected; most of these are from the highly altered terrane south and southwest of the study area where some mining and prospecting has been done in the past. A few soil samples were collected, to check the results from stream-sediment samples, and to test soil analysis as a possible evaluation tool in places where stream sediments are not available.

The areas sampled, including the Cannibal Plateau Roadless Area, the Powderhorn Wilderness Study Area, and contiguous areas of the larger geologic province, were divided into five terranes that differ largely in lithologic character (Sharp and Lane, 1983). None of the analytical results indicated any anomalous metal contents that would indicate proximity to mineral deposits.

Thirty bedrock and stream-sediment samples were collected by the U.S. Bureau of Mines. Seven of

these samples are within the Cannibal Plateau Roadless Area; the remainder are from the contiguous Powderhorn Wilderness Study Area to the north. Semiquantitative spectrographic and fire-assay results for gold and silver showed no anomalous values.

MINING DISTRICTS AND MINERALIZATION

There are no mining districts in the study area, although several districts are to the west. Mines are scattered along Henson Creek west of Lake City and in the vicinity of Lake San Cristobal to the south. Silver, gold, and lead ore have been mined from vein-type deposits.

Courthouse records indicated that very few claims have been located within the study area. A few claims were located in the head of Slumgullion Slide and in Devils Canyon at and near the southwest corner of the study area. No patented claims are in the study area and the overall mineral interest has been small. One prospect was found within the study area.

Samples were taken during the field investigation to measure metal contents at these claim and prospect locations. Assay results showed no anomalous metal values.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

The mineral resource survey indicates that both the mineral potential and the energy potential for the study area are generally low if the southwest part of the Cannibal Plateau Roadless Area is excepted (fig. 3). Despite its proximity to known mineralized areas near Lake City on the southwest and Powderhorn on the north and northeast, no evidence was seen in the geologic, geochemical, or geophysical surveys that indicates any significant mineral resources occur within the study area except at the southwest edge near Lake City. Surface geology did not indicate exposed centers of mineralization, and no geologic environments were interpreted that might indicate other hidden centers of this kind. Virtually all geochemical sampling results can be explained by sources in the different bedrock terranes; anomalous metal concentrations that might indicate proximity to mineral deposits were detected only at the southwest edge near Lake City. Results of aeromagnetic and gravity surveys generally can be explained by the known or reasonably inferred distribution of bedrock types, without invoking special circumstances that might specifically indicate a mineral potential. Whereas several periods of mineralization can be documented in the volcanic rocks exposed in mining areas near Lake City to the southwest (Slack, 1976; Slack and Lipman, 1979), these episodes have affected rocks only within the area of the caldera that crosses the southwest edge of the Cannibal Plateau Roadless Area (fig. 2). None of these episodes has affected rocks within the Powderhorn Wilderness Study Area. The altered and mineralized rocks related to these periods of mineralization did contain anomalous concentrations of several metals. Gold and silver have been mined in this terrane near the Cannibal Plateau Roadless Area, and further exploration by mining, drilling, and geophysical methods has been considered. These altered and mineralized rocks do overlap the boundary of the study area; and, as part of the Lake City-Uncompahgre caldera complex, this part of the study area is considered to have moderate potential for the discovery of gold-silver vein deposits. Also, there is a potential for other metals such as molybdenum, disseminated in subvolcanic porphyries commonly associated at depth with silicic volcanism. No evidence was seen, however, to warrant projecting the altered and mineralized rocks northward or farther than the caldera rim into the study area.

Many small mines and prospects in the Precambrian rocks near Powderhorn, north of the study area, were established to explore for base and precious metals, thorium, niobium, titanium, and rare-earth elements. Some of these occurrences could well underlie the volcanic rocks exposed in the Powderhorn Wilderness Study Area. If so, they would be at depths of 1,300-5,000 ft (400- 1,500 m), and would have no geological, geochemical, or presently available geophysical expression.

REFERENCES CITED

Lipman, P. W., Steven, T. A., and Mehnert, H. H., 1970, Volcanic history of the San Juan Mountains, Colorado, as indicated by K-Ar dating: Geological Society of America, v. 81, no. 8, p. 2329-2352.

Martin, R. A., and Sharp, W. N., 1983, Aeromagnetic map of the Powderhorn Wilderness Study Area and the Cannibal Plateau Roadless Area, Gunnison and Hinsdale Counties, Colorado: U.S. Geological Survey Miscellaneous Field Studies Map MF-1483-B, scale 1:50,000.

Plouff, Donald, and Pakiser, L. C., 1972, Gravity study of the San Juan Mountains, Colorado: U.S. Geological Survey Professional Paper 800-B, p. 183-190.

Sharp, W. N., and Lane, M. E., 1983, Geochemical map of the Powderhorn Wilderness Study Area and the Cannibal Plateau Roadless Area, Gunnison and Hinsdale Counties, Colorado: U.S. Geological Survey Miscellaneous Field Studies Map MF-1483-C, scale 1:50,000.

Slack, J. F., 1976, Hypogene zoning and multistage vein mineralization in the Lake City area, western San Juan Mountains, Colorado: Palo Alto, Calif., Stanford University Ph. D. thesis, 397 p.

Slack, J. F., and Lipman, P. W., 1979, Chronology of alteration, mineralization, and caldera evolution in the Lake City area, western San Juan Mountains, Colorado, in Ridge, J. D., ed., Papers on mineral deposits of western North America: International Association on the Genesis of Ore Deposits, 5th Quadrennial Symposium, Salt Lake City, Utah, 1978, v. 2; Nevada Bureau of Mines and Geology Report 33, p. 151-158.

Steven, T. A., and Lipman, P. W., 1976, Calderas of the San Juan volcanic field, southwestern Colorado: U.S. Geological Survey Professional Paper 958, 35 p.

U.S. Geological Survey, 1972 [1973], Aeromagnetic map of the Ridgway-Pagosa Springs area, southwestern Colorado: U.S. Geological Survey Geophysical Investigations Map GP-840, scale 1:250,000.

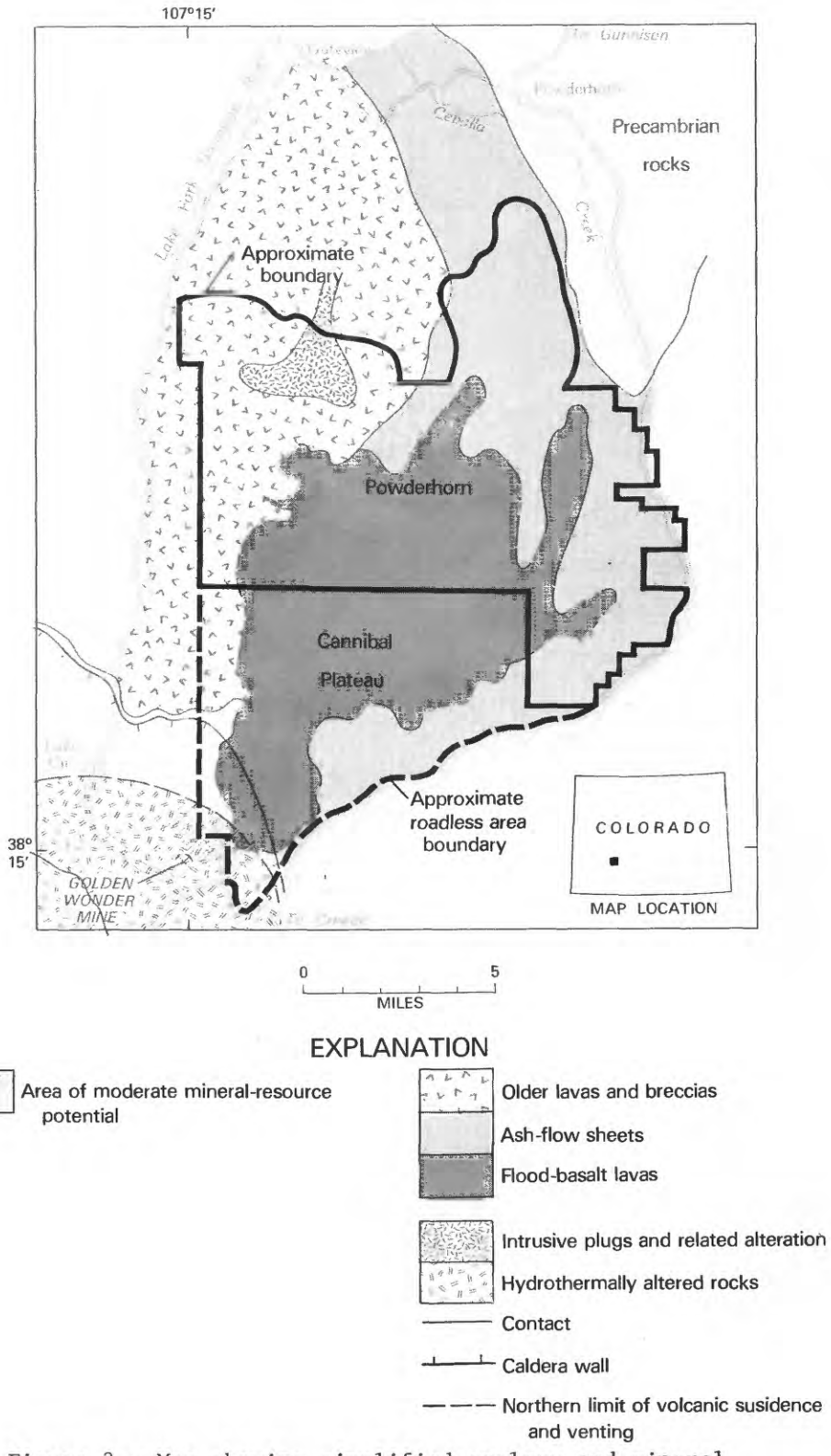

Figure 3.--Map showing simplified geology and mineral resources of the Powderhorn Wilderness Study Area and adjoining Cannibal Plateau Roadless Area, Colo. (modified from Steven and Lipman, 1976)