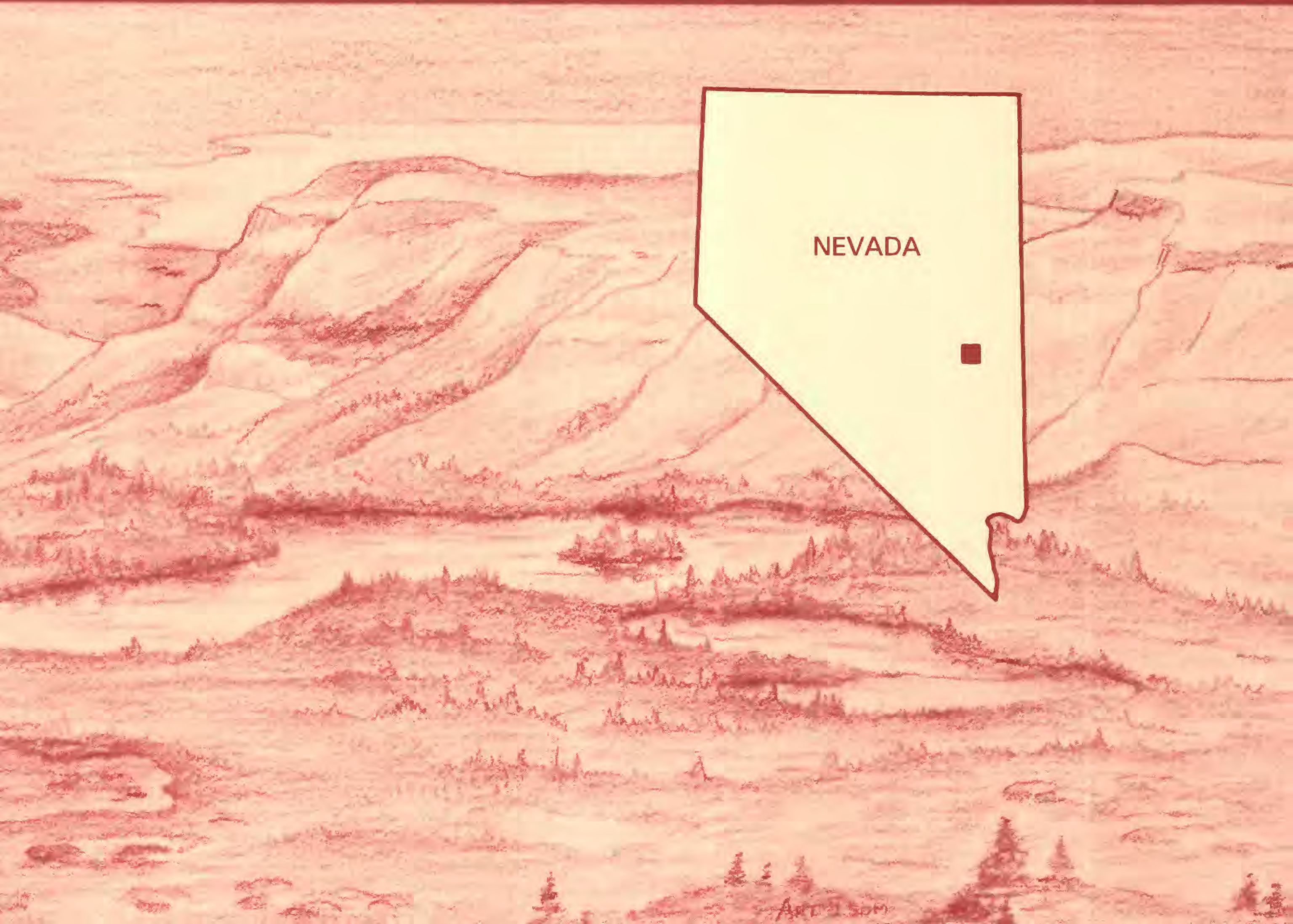
Mineral Resources of the Far South Egans Wilderness Study Area, Lincoln and Nye Counties, Nevada

U.S. GEOLOGICAL SURVEY BULLETIN 1728–C



DEFINITION OF LEVELS OF MINERAL RESOURCE POTENTIAL AND CERTAINTY OF ASSESSMENT

Definitions of Mineral Resource Potential

LOW mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics define a geologic environment in which the existence of resources is unlikely. This broad category embraces areas with dispersed but insignificantly mineralized rock as well as areas with few or no indications of having been mineralized.

MODERATE mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a reasonable likelihood of resource accumulation, and (or) where an application of mineral-deposit models indicates favorable ground for the specified type(s) of deposits.

HIGH mineral resource potential is assigned to areas where geologic, geochemical, and geophysical characteristics indicate a geologic environment favorable for resource occurrence, where interpretations of data indicate a high degree of likelihood for resource accumulation, where data support mineral-deposit models indicating presence of resources, and where evidence indicates that mineral concentration has taken place. Assignment of high resource potential to an area requires some positive knowledge that mineral-forming processes have been active in at least part of the area.

UNKNOWN mineral resource potential is assigned to areas where information is inadequate to assign low, moderate, or high levels of resource potential

NO mineral resource potential is a category reserved for a specific type of resource in a well-defined area.

Levels of Certainty

LEVEL OF RESOURCE POTENTIAL →

<table>
<tr><td rowspan="4">U/A
UNKNOWN
POTENTIAL</td><td>H/B
HIGH POTENTIAL</td><td>H/C
HIGH POTENTIAL</td><td>H/D
HIGH POTENTIAL</td></tr>
<tr><td>M/B
MODERATE POTENTIAL</td><td>M/C
MODERATE POTENTIAL</td><td>M/D
MODERATE POTENTIAL</td></tr>
<tr><td rowspan="2">L/B
LOW
POTENTIAL</td><td rowspan="2">L/C
LOW
POTENTIAL</td><td>L/D
LOW POTENTIAL</td></tr>
<tr><td>N/D
NO POTENTIAL</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td></tr>
</table>

LEVEL OF CERTAINTY →

A. Available information is not adequate for determination of the level of mineral resource potential.

B. Available information suggests the level of mineral resource potential.

C. Available information gives a good indication of the level of mineral resource potential.

D. Available information clearly defines the level of mineral resource potential.

Abstracted with minor modifications from:

Taylor, R. B., and Steven, T. A., 1983, Definition of mineral resource potential: Economic Geology, v. 78, no. 6, p. 1268–1270.

Taylor, R. B., Stoneman, R. J., and Marsh, S. P., 1984, An assessment of the mineral resource potential of the San Isabel National Forest, south-central Colorado: U.S. Geological Survey Bulletin 1638, p. 40–42.

Goudarzi, G. H., compiler, 1984, Guide to preparation of mineral survey reports on public lands: U.S. Geological Survey Open-File Report 84–0787, p. 7, 8.

Chapter C

Mineral Resources of the Far South Egans Wilderness Study Area, Lincoln and Nye Counties, Nevada

By D. C. HEDLUND, R. C. DAVIES,
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U.S. GEOLOGICAL SURVEY BULLETIN 1728

MINERAL RESOURCES OF WILDERNESS STUDY AREAS—
EAST-CENTRAL NEVADA AND PART OF ADJACENT BEAVER AND
IRON COUNTIES, UTAH

DEPARTMENT OF THE INTERIOR
DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

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STUDIES RELATED TO WILDERNESS

Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94–579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine the mineral values, if any, that may be present. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral survey of a part of the Far South Egans (NV-040–172) Wilderness Study Area, Lincoln and Nye Counties, Nevada.

RESOURCE / RESERVE CLASSIFICATION

	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range	
	Measured	Indicated		Hypothetical	(or) Speculative
ECONOMIC	Reserves		Inferred Reserves		
MARGINALLY ECONOMIC	Marginal Reserves		Inferred Marginal Reserves		
SUB-ECONOMIC	Demonstrated Subeconomic Resources		Inferred Subeconomic Resources		

Major elements of mineral resource classification, excluding reserve base and inferred reserve base. Modified from U. S. Bureau of Mines and U. S. Geological Survey, 1980, Principles of a resource/reserve classification for minerals: U. S. Geological Survey Circular 831, p. 5.

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PLATE

FIGURES

Mineral Resources of the Far South Egans Wilderness Study Area, Lincoln and Nye Counties, Nevada

By D. C. Hedlund, R. C. Davies, D. S. Hovorka, and H. R. Blank, Jr.,
U.S. Geological Survey *and*
S. E. Tuftin,
U.S. Bureau of Mines

SUMMARY

During 1983 and 1984, the U.S. Geological Survey and the U.S. Bureau of Mines conducted field investigations to assess the mineral resource potential and appraise the identified resources of a part of the Far South Egans (NV–040–172) Wilderness Study Area. The area studied encompasses about 63.5 mi^2 (square miles) (42,316 acres) in Lincoln and Nye Counties, Nevada (fig. 1), and is in the southern part of the Egan Range of east-central Nevada. The Egan Range consists of a coextensive series of eastward-tilted fault blocks. Within the study area, as much as 19,000 ft (feet) of tilted Paleozoic (see geologic time chart on the last page of this report) strata are locally overlain by both tilted and flat-lying mid- and early Tertiary volcanic rocks. The structural features of the study area are controlled by the Shingle Pass fault to the north, by the Trough Spring fault on the south, and by a major range-front fault largely concealed by piedmont-slope fan deposits along the eastern margin of White River Valley. Pleistocene lacustrine deposits younger than the Cave Valley Formation fill Cave Valley on the east.

The northeastern part of the Far South Egans study area has moderate mineral resource potential for gold and molybdenum related to Tertiary intrusive or volcanic rocks. Moderate potential for cadmium, molybdenum, lead, and zinc exists in the southern part of the study area related to a faulted jasperoid vein. The rest of the study area has low potential for all metals. The energy resource potential for oil, gas, and coal within the study area is low, based on the exposed rock units. The adjacent basins, such as the White River and Cave Valleys, have a moderate potential for oil and gas reservoir rocks in the subsurface (Sandberg, 1983). If the surface rocks in the study area have been thrust over these more favorable source rocks, the resource potential for oil and gas may be higher; however, because the underlying rocks are unknown, the potential for oil and gas in the underlying rocks is classed as unknown.

Industrial-mineral commodities, such as carbonate rocks, high-silica quartzite, and sand and gravel deposits are present within the study area; they constitute identified resources (see resource/reserve classification chart on p. IV of this report), but because of their size, composition, and distance from centers of industry, they are classed as subeconomic resources. Small outcrops of perlite within the volcanic flows and ash-flow tuffs north of Shingle Spring are in the same category.

INTRODUCTION

At the request of the U.S. Bureau of Land Management, 42,316 acres of the Far South Egans (NV–040–172) Wilderness Study Area, in eastern Nevada, were studied in order to assess the mineral resource potential and appraise the identified resources. In this report the studied area is called "wilderness study area" or simply "study area."

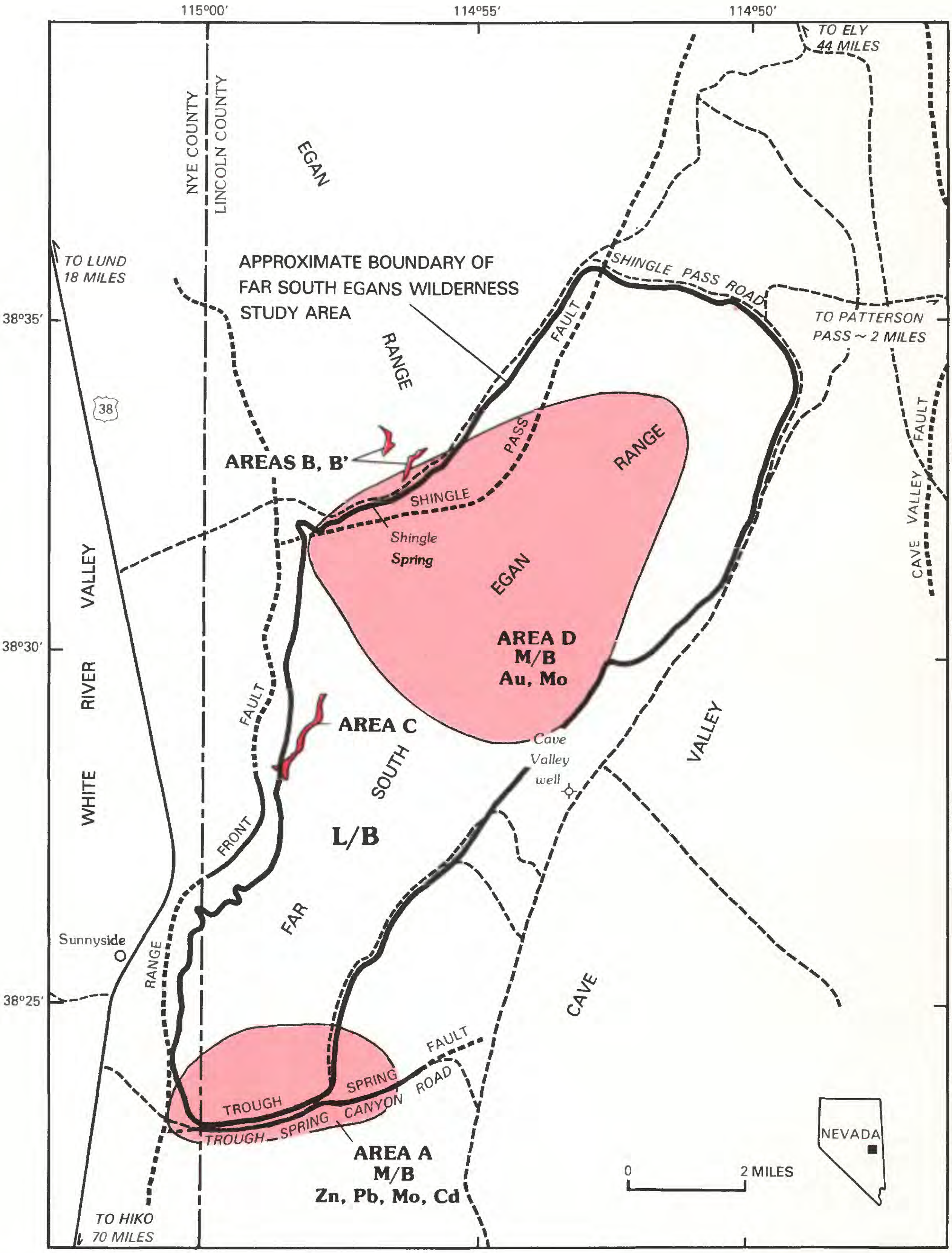

Figure 1 (above and facing page). Map showing identified resources, mineral resource potential, and location of the Far South Egans Wilderness Study Area, Nevada.

EXPLANATION

	Area of identified resources—Areas B, B′, perlite; area C, high-silica quartzite
M/B	**Geologic terrane having moderate mineral resource potential for metals shown (areas A and D), with certainty level B**
L/B	**Geologic terrane having low mineral resource potential for all metals, oil, gas, and coal, with certainty level B**
	Fault—Dotted where concealed
	Unpaved road

Location and Geographic Setting

The Far South Egans study area in Lincoln and Nye Counties, Nevada (fig. 1), occupies only a small part of the Egan Range and extends for about 16 mi (miles) from the Shingle Pass road on the north to the Trough Spring Canyon road on the south. At its widest part the study area is 7 mi east-west and is bordered by the White River Valley on the west and by Cave Valley on the east.

Access to the study area is from Nevada State Highway 38, which passes through Lund, to the north, and Sunnyside, about 33 mi to the south. Access to the northern part of the study area is from the Shingle Pass road, which extends east from Highway 38 about 8 mi north of Sunnyside. Access to the southern and eastern parts of the range is by the Trough Spring Canyon road, which extends east from Highway 38 about 1.3 mi south of Sunnyside; this secondary road turns north 4.5 mi east of Highway 38 and follows the eastern side of the Egan Range along Cave Valley where it eventually joins the Shingle Pass-Patterson Pass road near Cave Valley Well. Many poorly maintained secondary roads extend along the fan deposits of the eastern and western foothills of the range.

The study area is within the southern part of the Egan Range, which consists of a series of eastward-tilted fault blocks extending for about 110 mi through the Ely area to the southern end of the Cherry Creek Range to the north. The range is within the Basin and Range physiographic province of Nevada. The western part of the southern Egan Range front is steep and varies in elevation from 5,800 to 6,000 ft at the base to 9,823 ft at the northern end of the study area and 8,824 ft at the southern end.

Present Investigations

Present investigations by the U.S. Geological Survey and the U.S. Bureau of Mines included reconnaissance mapping at a scale of 1:50,000 of the study area and about 7,700 acres (about 12 mi^2) of small adjoining areas along the northern, southern, and southeastern margins of the study area in 1983 (D. C. Hedlund, unpub. data). In addition, geochemical sampling of rocks and stream sediments was conducted by the Geological Survey in early 1984. The Bureau of Mines reviewed past prospecting activity; no mine workings were observed, and the only prospect pits were along a fault just south of Trough Spring Canyon (Tuftin, 1985).

Previous Studies

Previous geologic studies in the southern Egan Range include a geologic map on a planimetric base (scale 1:62,500), a description of map units, and a summary of the stratigraphy and structure by Kellogg (1960, 1963, and 1964). The southern Egan Range was also described by Tschanz and Pampeyan (1970) in their comprehensive study of the geology and mineral deposits of Lincoln County. Upper Ordovician through Upper Devonian stratigraphic nomenclature, paleogeography, and ages of rocks in the range were discussed by Poole and others (1977). Poole and Claypool (1984) described oil-bearing concretions within the Chainman Shale of the Trough Spring area and defined the requirements for a petroleum source-rock evaluation in east-central Nevada. The stratigraphy of Tertiary volcanic rocks in eastern Nevada was described by Cook (1965), and the stratigraphy of the Sheep Pass Formation north of the study area was described by Winfrey (1960). The mineral deposits in the nearby Cave Valley and Patterson districts were described by Schrader (1931).

Acknowledgments.—Members of the U.S. Geological Survey provided assistance in this study. Fossil identifications were made by M. E. Taylor, L. A. Wilson, W. A. Oliver, J. T. Dutro, Jr., and E. L. Yochelson. R. F. Marvin determined a potassium-argon age for the rhyodacite plug at the northern end of the study area. Spectrographic analyses were performed by D. E. Detra, and atomic-absorption analyses for gold were performed by K. A. Romine. Results of an aeroradiometric survey carried out by the NURE (National Uranium Resource Evaluation) program were evaluated by J. S. Duval. The aeromagnetic data were acquired both from the NURE traverses and from a survey by the Geological Survey of the northwestern part of the Lund 1°×2° quadrangle. In addition, we benefited from discussions in the field with G. V. Zerfoss of Boulder City, Nev., who provided a background to the mining history of the Egan Range. The mineral resource potential was classified according to the system outlined by Goudarzi (1984) (see inside front cover of this report).

APPRAISAL OF IDENTIFIED RESOURCES

By S. E. Tuftin, U.S. Bureau of Mines

No metallic-mineral occurrences or deposits were found within the Far South Egans Wilderness Study Area, although a jasperized fault breccia containing anomalous amounts of zinc was discovered in the southern part of the study area (area A, fig. 1, pl. 1). Industrial-mineral commodities, such as carbonate rocks, high-silica quartzite (area C, fig. 1, pl. 1), sand and gravel deposits, and perlite (areas B, B′) are present within and near the study area. Small outcrops of perlitic vitrophyre within the volcanic rocks north of Shingle Spring (areas B, B′, fig. 1, pl. 1) lack the continuity and size to be a source of lightweight aggregate. Much of the study area is covered by oil and gas leases, and the adjacent basins of the White River and Cave Valleys have a moderate potential for petroleum and gas reservoir rocks in the subsurface (Sandberg, 1983).

Metallic-Mineral Commodities

No metallic-mineral deposits were discovered within the study area, and no current mining claims have been filed with the U.S. Bureau of Land Management. However, in one small area along the southern side of Trough Spring Canyon (area A, fig. 1, pl. 1), two prospect pits exposed a vein along a fault striking N. 40° E. that has displaced the Joana Limestone downward against the Guilmette Formation. The vein is along the fault, and a brown, brecciated jasperoid as much as 15 to 20 ft wide can be traced for about 50 to 70 ft. Analyses of the jasperoid sample (CW19–84, pl. 1) indicate low metal values, less than 0.1 ppm (parts per million) gold, less than 0.5 ppm silver, 10 ppm copper, 500 ppm zinc, and 200 ppm barium.

Industrial-Mineral Commodities

Carbonate Rocks

Carbonate strata make up about 90 percent of the Paleozoic section in the Far South Egans Wilderness Study Area. Both limestone and dolomite have important industrial applications, but they are common materials of low unit value and generally require local markets to be economically exploited. Demand for the carbonate rocks as a source for cement manufacture or road gravel is unlikely in the foreseeable future in the Far South Egans study area.

Quartzite

The Eureka Quartzite, a prominent cliff-forming unit in the Far South Egans study area, is a persistent but faulted formation about 550 ft thick that crops out for about 10 mi along the western side of the range (area C, fig. 1, pl. 1). It is highly quartzose, containing as much as 96 percent silica (SiO_2), and has a high potential value for use in metallurgical processes and glass manufacture, and as a source of silicon (Ketner, 1982). Close access to manufacturing sites or convenient transportation is critical to the development of the quartzite. Therefore, the quartzite in the Far South Egans study area, though of high quality and an identified resource, is unlikely to be developed in the foreseeable future because of its remote location.

Sand and Gravel

Sand and gravel deposits occur along the flanks of the Far South Egans study area and are used locally for road construction and fill. Most of these unconsolidated materials also occur outside the wilderness study area and are commonly quarried in fan deposits adjacent to Nevada State Highway 38.

Perlite

In an area of Tertiary volcanic rocks 0.5 to 1 mi north of the Shingle Pass road and the study-area boundary, perlitic vitrophyre units occur at the base of the Shingle Pass Tuff of Cook (1960) and also in an upper vitric welded tuff unit (areas B, B′, fig. 1, pl. 1). The vitrophyres dip steeply to the southeast, are generally less than 70 ft thick, and lack continuity. The perlitic vitrophyres are an identified resource and could be used as lightweight aggregate but lack sufficient size and continuity to be of economic importance in such a remote area.

Oil and Gas

The Far South Egans Wilderness Study Area is in a region rated as having a moderate potential for oil and gas discoveries, especially in the intermontane basins where reservoir rocks and stratigraphic traps occur in the subsurface. Source rocks, especially the Mississippian Chainman Shale (Poole and Claypool, 1984) and to a lesser degree the Devonian Simonson Dolomite and the Mississippian Joana Limestone, are favorable for oil and gas generation. Poole and Claypool (1984) indicated that the Chainman Shale is a major source rock in the Railroad and Pine Valleys northwest of the study area. Also to the north of the study area, the Eocene Sheep Pass Formation beneath the Garrett Ranch Volcanic Group of Winfrey (1960) is the probable source of oil in the Eagle Springs field and probably in the Currant field in Railroad Valley (Poole and Claypool, 1984), about 35 mi to the northwest of the study area.

Favorable geologic conditions for oil and gas exist in the basins on either side of the study area, and during the period of this study, seismic surveys were conducted by private industry in both the Cave and White River Valleys marginal to the study-area boundaries. Much of the study area is covered by oil and gas leases, and three dry exploration holes have been drilled for oil and gas within 4 mi east and west of the study area (Tuftin, 1985).

ASSESSMENT OF POTENTIAL FOR UNDISCOVERED RESOURCES

By D. C. Hedlund, D. S. Hovorka, and H. R. Blank, Jr., U.S. Geological Survey

Geology

Description of Rock Units

The southern Egan Range is a northeast-striking and eastward-tilted fault block consisting of about 19,000 ft of Paleozoic strata (pl. 1). The Paleozoic strata range in age from Late Cambrian to Late Pennsylvanian; Permian strata appear to be absent. Mesozoic rocks are also absent, and Cenozoic fan and basin-fill deposits cover about 30 percent of the study area. Tertiary volcanic rocks, including small epizonal rhyolitic to rhyodacitic plugs make up less than 1 percent of the outcrops; north of the study area, however, ash-flow tuffs and associated lava flows cover several square miles (pl. 1).

Upper Cambrian and Lower Ordovician rocks (unit O€w, pl. 1), in ascending order, are the Emigrant Springs Limestone (400 ft), Dunderberg Formation (310–370 ft), and the Whipple Cave Formation of Kellogg (1963) (1,400 ft). The Emigrant Springs Limestone is dark-gray to black, thinly bedded to massive, cryptocrystalline limestone. The Dunderberg Formation contains medium-gray to medium-dark-gray limestone and alternating fissile shale units. Trilobite spicules are especially common in the shaly units. The Whipple Cave Formation consists of a lower member of gray, massively bedded limestone and an upper member of gray dolomite with very minor thin interbeds of limestone. The upper member is of Early Ordovician age.

Ordovician rocks in the southern Egan Range (unit O€, pl. 1) consist of, in ascending order, the Pogonip Group and the Eureka Quartzite. The overlying Ely Springs Dolomite is mostly Late Ordovician, but it may include rocks of Silurian age. The Pogonip Group, mostly of Early and Middle Ordovician age, consists of five formations of limestone, shale, and minor dolomite 3,400 to 4,200 ft thick: the House Limestone (700 ft), which is Early Ordovician in age, and the Parker Spring Formation of Kellogg (1963) (1,800 ft), the Shingle Limestone of Kellogg (1963) (1,800 ft), the Kanosh Shale (440 ft), and the Lehman Formation (300 ft), all of Middle Ordovician age. This group thins appreciably to the south in Lincoln County (Tschanz and Pampeyan, 1970). The Parker Spring and Shingle have been assigned by some to the unnamed limestone unit of the Pogonip. The Eureka Quartzite, 500 to 600 ft thick, is a prominent white to light-gray, crossbedded orthoquartzite and is a conspicuous cliff-forming unit beneath the dark-gray-weathering finely crystalline to aphanitic Ely Springs Dolomite (450 ft).

The Lower and Upper Silurian Laketown Dolomite (mapped with the Ely Springs, unit SOl, pl. 1) (1,050 ft thick) is characterized by an upper medium-dark-gray, chert-rich dolomite and a lower, light-gray, thick-bedded, sugary-textured dolomite. The cherty dolomite unit weathers to dark-brown silicified crusts.

The Devonian strata (unit Dws, pl. 1), largely dolomite and limestone, are in four formations; in ascending order, they include the Sevy Dolomite, Simonson Dolomite, Guilmette Formation, and West Range Limestone. The aggregate thickness is about 3,250 ft. The Middle and Lower Devonian Sevy Dolomite (part of unit Dws, pl. 1) (1,250 ft) is a conspicuous white to light-gray-weathering formation that typically forms steep steplike slopes. A thin persistent sandstone or quartzite 5 to 85 ft thick is present at the top of the formation. The Middle Devonian Simonson Dolomite (1,300 ft) is composed of dark-brownish-gray dolomite with abundant internal laminations. The dolomite contains fossil algal mats, is vuggy in places, and has a fetid odor when fractured. The Simonson Dolomite is a source for petroleum in Railroad Valley near Currant (Sandberg, 1983). The Upper and Middle Devonian Guilmette Formation (1,730 ft) consists of alternating dolomite and limestone beds in equal amounts. The formation thins from 1,730 ft near Shingle Pass to about 1,000 ft near Trough Spring Canyon. The Upper Devonian West Range Limestone consists of platy argillaceous limestone, calcisiltite, and minor shale that typically form slopes between the massive limestones of the Guilmette Formation and the overlying Lower Mississippian Joana Limestone. The West Range Limestone is 0 to 150 ft thick in the Far South Egans study area and correlates with the Pilot Shale in the nearby Ely mining district (Tschanz and Pampeyan, 1970).

Mississippian strata (unit Msj, pl. 1), in ascending order, include the Lower Mississippian Joana Limestone (800 ft), the Upper and Lower Mississippian Chainman Shale (800 ft), the Upper Mississippian Scotty Wash Sandstone (350 ft), and the lower or Mississippian part of the Ely Limestone. Near Trough Spring Canyon the cliff-forming Joana Limestone is overlain by medium-bedded, cherty, silty limestone beds that typically weather to light-purplish-gray plates. This unit, about 500 ft thick, may correlate with the limestone of Timpi Canyon (F. G. Poole, oral commun., 1984). The Chainman Shale is commonly black to dark-olive-gray fissile shale that grades downward into a basal unit of platy brownish- and yellowish-gray siltstone. This siltstone unit was termed the Needle Siltstone Member by Poole and Claypool (1984). The Scotty Wash Sandstone consists of brown-weathering, crossbedded sandstone that commonly has a hematitic cement. Shale and siltstone interbeds are present in the upper part of the unit.

The Upper Mississippian and Lower and Middle Pennsylvanian Ely Limestone (unit PMe, pl. 1) is as much as 1,300 ft thick and consists of alternating medium- to thick-bedded, highly fossiliferous, silty limestone layers that form ledgy slopes throughout the Egan Range. An unnamed Middle(?) Pennsylvanian olive-gray to yellowish-brown calcisiltite unit (unit Ps) overlies the Ely Limestone.

In summary, most of the Paleozoic sedimentary rocks represent marine deposition within the Cordilleran geosyncline that was virtually continuous from Late Cambrian to Pennsylvanian time in this part of Nevada. Within this Paleozoic section about 90 percent of the rocks are of carbonate strata, of which 52 percent are limestone and 38 percent are dolomite; the remainder is 5 percent quartzite and sandstone, and 5 percent shale.

The Tertiary volcanic rocks (unit Tv, pl. 1) are mostly ash-flow tuffs and associated lava flows, and are north of Shingle Pass and the boundary of the study area. The rocks consist of cliff-forming, moderately to densely welded, crystal-rich ash-flow tuffs with phenocrysts of sanidine, smoky quartz, biotite, and oxyhornblende. Porphyritic lava flows are dacite and rhyodacite and contain 15–30 percent phenocrysts of plagioclase, quartz, hornblende, and iron oxide minerals. Some crystal-poor air-fall tuff is present. The volcanic rocks locally contain perlitic vitrophyres outside the northern boundary of the study area.

Tertiary intrusive rocks (unit Ti, pl. 1) are rhyolite and rhyodacite and crop out as two small plugs in the northern part of the study area. The rhyolite contains less than 5 percent phenocrysts of sanidine and quartz, and the rhyodacite contains 30 percent phenocrysts of hornblende, biotite, and quartz as much as ¼ in. (inch) across. Both rocks have columnar jointing. The rhyodacite yielded a potassium-argon age of 35.1 ± 1.3 m.y. (R. F. Marvin, written commun., 1985).

Postvolcanic basin-fill deposits of late Tertiary age are poorly exposed in the study area and consist of chiefly volcaniclastic sandstone, siltstone, and interbeds of conglomerate. These beds locally contain interbeds of vitric tuff and conglomerate. The Cave Valley Formation of Pleistocene and Pliocene age (unit QTs) consists largely of limestone and dolomite cobbles, boulders, and blocks as much as 20 ft across. This formation may represent a coarse fanglomerate that filled a steep-sided depression formed by the preexisting Shingle Pass fault.

Pleistocene lake sediments are well represented in Cave Valley by light-gray, poorly indurated silt and clay deposits. Numerous shoreline beach deposits surround the Cave Valley dry lake bed.

Structure

The predominant structural element within the study area is the northeast-striking Egan Range fault block that is tilted 20–55° east and southeast. The fault block is bounded on the west by a steeply dipping range-front boundary fault along the eastern margin of the White River Valley. This range-front fault is locally represented by small fault scarps within the alluvial-fan deposits.

The tilted fault block changes strike from N. 20–30° E. in the southern and medial parts of the study area to N. 40–65° E. in the northern part. With this change in strike, the dip steepens from 20–35° eastward in the medial and southern part of the range to 45–80° at the northern end. This northeast flexing of the tilted fault block is probably related to the Shingle Pass fault.

The Shingle Pass fault dips steeply to the north and northwest. The fault is concealed over most of its length, but fault breccias locally occur in limestone outcrops that project into the colluvium. Moreover, limestones of the Upper Cambrian Emigrant Springs Limestone are faulted against Pennsylvanian and Mississippian Ely Limestone on the north side of the fault; this stratigraphic throw is as much as 18,500 ft.

The age of the Shingle Pass fault is uncertain. Kellogg (1964) suggested that there had been displacement prior to the deposition of the Eocene Sheep Pass Formation and renewed movement after deposition. The fault displaces the steeply southeast dipping mid-Tertiary volcanic units (Oligocene–Miocene) but does not displace the Cave Valley Formation of Pliocene-Pleistocene age. The major displacement probably occurred at the same time as the displacement along the range-front fault, that is, about early Pliocene-Miocene time.

Numerous transverse faults cross the range, and most strike west-northwest to northwest with the southwest blocks downthrown. Undoubtedly some of these transverse faults represent an accommodation to the flexing to the northeast of the Far South Egans study area block by the left-lateral stress component of the Shingle Pass fault.

The Trough Spring fault is of uncertain age and displaces north-trending faults that probably are coeval with the range-front fault, that is, Pliocene-Miocene age. The displacement on the Trough Spring fault is about 1,500 ft.

Geochemistry

The geochemical survey of the study area involved the collection and analysis of 36 stream-sediment samples and 1 mineralized-rock sample within and near the wilderness study area, and interpretation of the analytical data. Sample localities are shown on plate 1. The stream-sediment samples were collected from first- and second-order drainages, all of which were dry washes. The sample density is varied because samples were collected from irregular drainage basins with areas ranging from 1 to 3 mi^2. At each location, 20 lbs (pounds) of sediment, screened to less than 10 mesh (0.066 in.), was collected and later concentrated by panning. The concentrates were then screened to 35 mesh (0.0165 in.), and the less-than-35 mesh fraction was processed through bromoform and subsequent magnetic separations. Because the heavy nonmagnetic fraction was present only in small amounts or was absent altogether, the heavy nonmagnetic fraction and the magnetic fraction at 0.6 amperes were combined and ground to less than 100 mesh (0.0059 in.) for analysis. A jasperoid sample from area A (pl. 1) was composed of about 0.5 lb of thumb-size rock chips of jasperized breccia. This sample was pulverized to less than 100-mesh size before analysis.

All samples were analyzed for 31 elements by six-step direct-current arc optical-emission semiquantitative spectrography (Grimes and Marranzino, 1968). The concentrates and jasperoid were additionally analyzed for gold using hot $HBr–Br_2$ digestion and methyl isobutyl acetone (MIBK) extraction followed by atomic-absorption spectroscopy (Thompson and others, 1968). Ten grams of sample are normally used in this procedure with a resultant limit of determination of 0.1 ppm gold. When only smaller amounts of material were available, the limit of detection was proportionally higher.

Anomalous analytical values vary with each element and are dependent on the statistical data for that element. Two to three times the geometric mean abundance of the element was used to define anomalous values. Elements such as silver, gold, molybdenum, tungsten, and zinc were considered anomalous wherever detected by spectrographic analysis.

Panned-concentrate samples and the one jasperoid sample showed detectable concentrations of B, Ba, Cd, Co, Cr, Cu, La, Mo, Nb, Ni, Pb, Sc, Sn, Sr, V, Y, Zn, and Zr. Of the elements detected, copper, molybdenum, lead, zinc, and tin are commonly indicators of base-metal mineralization. Copper was detected in all samples with a range of 10 to 100 ppm. Molybdenum was detected in 32 samples with concentrations ranging from 10 to 100 ppm; samples DHSE–08 and DHSE–49 (pl. 1) both contained 100 ppm molybdenum and are along the projected extensions of west-northwest-striking faults. Sample DHSE–32 contained 100 ppm molybdenum. Four panned concentrates in the drainage adjacent to the Shingle Pass road contained 200, 300, and 500 ppm thorium, and the panned concentrates had zirconium equal to or greater than 2,000 ppm. The high concentrations of thorium and zirconium are probably due to detrital minerals such as zircon or monazite. No mineralized rock was observed in any of the drainage basins, and no specific source for any of the anomalous values was found.

The highest gold values in the panned-concentrate samples, as determined by atomic absorption, were 2.2 ppm (DHSE–07), 3.9 ppm (DHSE–09), and 6.3 ppm (DHSE–43) (pl. 1). These values are equivalent to 0.06–0.18 ounce/ton of gold. Samples DHSE–07, –09, and –43 are from a drainage along or near the western part of the Shingle Pass fault (pl. 1). The presence of detectable gold in alluvium in a small, limited area suggests a nearby source, possibly the Tertiary intrusive rocks. The relation of the gold anomalies to the Shingle Pass fault is unknown.

The jasperoid sample from along the southern side of Trough Spring Canyon (CW19–84, area A, pl. 1) contained as much as 500 ppm zinc, 200 ppm barium, and 10 ppm copper, but the precious-metal content is less than 0.1 ppm gold and less than 0.5 ppm silver. To the north and west, panned-concentrate sample DHSE–15 contained 200 ppm cadmium and 70 ppm lead, and sample DHSE–13 contained 70 ppm molybdenum.

Geophysics

Reconnaissance geophysical data for the Far South Egans Wilderness Study Area and vicinity were obtained from aeroradiometric, aeromagnetic, and regional gravity surveys. These data do not reveal any structural or lithologic features that might indicate mineral deposits.

The aeroradiometric surveys were carried out under the auspices ofthe NURE program and consist of east-west traverses flown 400 ft above ground at 3-mi spacing. The results for the Far South Egans study area were evaluated by J. S. Duval of the U.S. Geological Survey. Duval noted (written commun., 1985) "overall low radioactivity, with values of 0–2.8 percent K^{40}, 0–2.5 ppm eU, and 2–8 ppm eTh."

Aeromagnetic data were acquired both from the NURE traverses and from a survey of the northwestern part of the Lund $1° \times 2°$ quadrangle. The latter survey was flown along north-south lines at 11,500-ft barometric elevation and 1-mi spacing (U.S. Geological Survey, 1976). About 10 lines of this survey crossed the study area. The

International Geomagnetic Reference Field has been removed from the U.S. Geological Survey data, and the data have been downward-continued to 1,000 ft above terrain. The resulting residual total-intensity anomaly map, with field values relative to an arbitrary datum, is shown on figure 2. The contours in the extreme northeastern corner of the map area incorporate unpublished data from a survey of Mt. Grafton and vicinity. There is little anomaly relief within the wilderness study area and no indication of the presence of any intrusive body beneath the nonmagnetic sedimentary strata that have been uplifted to form the range. A sharp dipole anomaly, with peak-to-trough amplitude of 360 nT (nanoteslas), is associated with Tertiary volcanic rocks near Shingle Pass on the northern boundary of the wilderness study area. A broader, positive anomaly of amplitude about 100 nT occurs west of Shingle Pass near the center of the White River Valley; the source of this anomaly lies buried beneath thick surficial deposits of the valley fill, as suggested by an associated gravity minimum. A somewhat weaker magnetic high is present just east of the wilderness study area near the center of Cave Valley. The concealed source in each case is probably a volcanic complex similar to that exposed near Shingle Pass. A prominent north-south magnetic gradient (east-west-trending contours) near the southern end of the southern Egan Range marks the northern boundary of a magnetically active province associated with igneous rocks, chiefly granite and rhyolite, of Tertiary to Jurassic age. This gradient roughly coincides with northeasterly to easterly gravity trends and probably represents a major structural discontinuity.

A regional Bouguer gravity anomaly map for the Lund 1°×2° quadrangle with contour interval 5 mGal (milligals) has been published by Snyder and others (1984). Only seven or eight gravity stations on this map lie within the study area; an additional nineteen stations were established within the study area during May-June 1985 for the present study. All gravity observations have been reduced by standard procedures at a Bouguer density of 2.67 grams per cubic centimeter and with terrain corrections to a radius of 100 mi. A complete Bouguer anomaly map of the wilderness study area and vicinity is shown on figure 3. This map clearly outlines the Far South Egans structural block as a gravity high with respect to the flanking alluvial basins. The high reaches an anomaly level more than 52 mGal above the minimum anomaly in the White River Valley and about 40 mGal above a low in Cave Valley. The gravity crest of the block is approximately at the southern margin of the wilderness study area where high-density carbonate rocks probably attain a maximum thickness. To the east and west the gravity high is delimited by steep gradients that are the expression of postvolcanic range-front faults. In the northeastern part of the study area, the gravity high extends as a subdued feature with diminishing amplitude into northern Cave Valley; the decrease in amplitude may be due to progressive elimination of the carbonate section by the normal fault on the eastern range margin. A narrow, north-trending gravity ridge north of the northwestern edge of the study area links the southern Egan Range high with a high associated with the Egan Range proper, at the northern fringe of the map area.

Mineral and Energy Resources

The presence of detectable gold in alluvium in a small, limited area indicates a nearby source. This gold, together with anomalous molybdenum amounts within a few miles of Tertiary intrusive plugs and volcanic rocks, suggests mineralization related to these rocks. However, mineralized rock was not observed in outcrop. Geophysical data do not indicate the presence of any large underlying plutonic bodies. The mineral resource potential for gold and molybdenum in the northeastern part of the study area (area D, pl. 1) is moderate, with certainty level B.

The southern part of the study area has moderate mineral resource potential for cadmium, molybdenum, lead, and zinc, with certainty level B. The source of the metals is unknown but may be related to the jasperoid southeast of the study area (sample locality CW19–84, area A, pl. 1). The jasperoid sample contained anomalous zinc and barium, and adjacent stream-sediment samples contained anomalous cadmium, molybdenum, and lead. Based upon geology and the results of geochemical analyses of stream-sediment samples, the remaining parts of the study area have low mineral resource potential for metal deposits, with certainty level B.

The wilderness study area has low mineral resource potential for oil, gas, and coal, with certainty level B. Because of a lack of information on rocks beneath a possible thrust fault, the potential for undiscovered resources of oil, gas, and coal is unknown beneath the fault. Sandberg (1983) rated the adjoining Cave Valley and White River Valley basins as having a moderate potential for oil. The Chainman Shale, Simonson Dolomite, and Joana Limestone are potential targets for oil and gas in these adjoining basins, especially where stratigraphic traps may exist in the subsurface.

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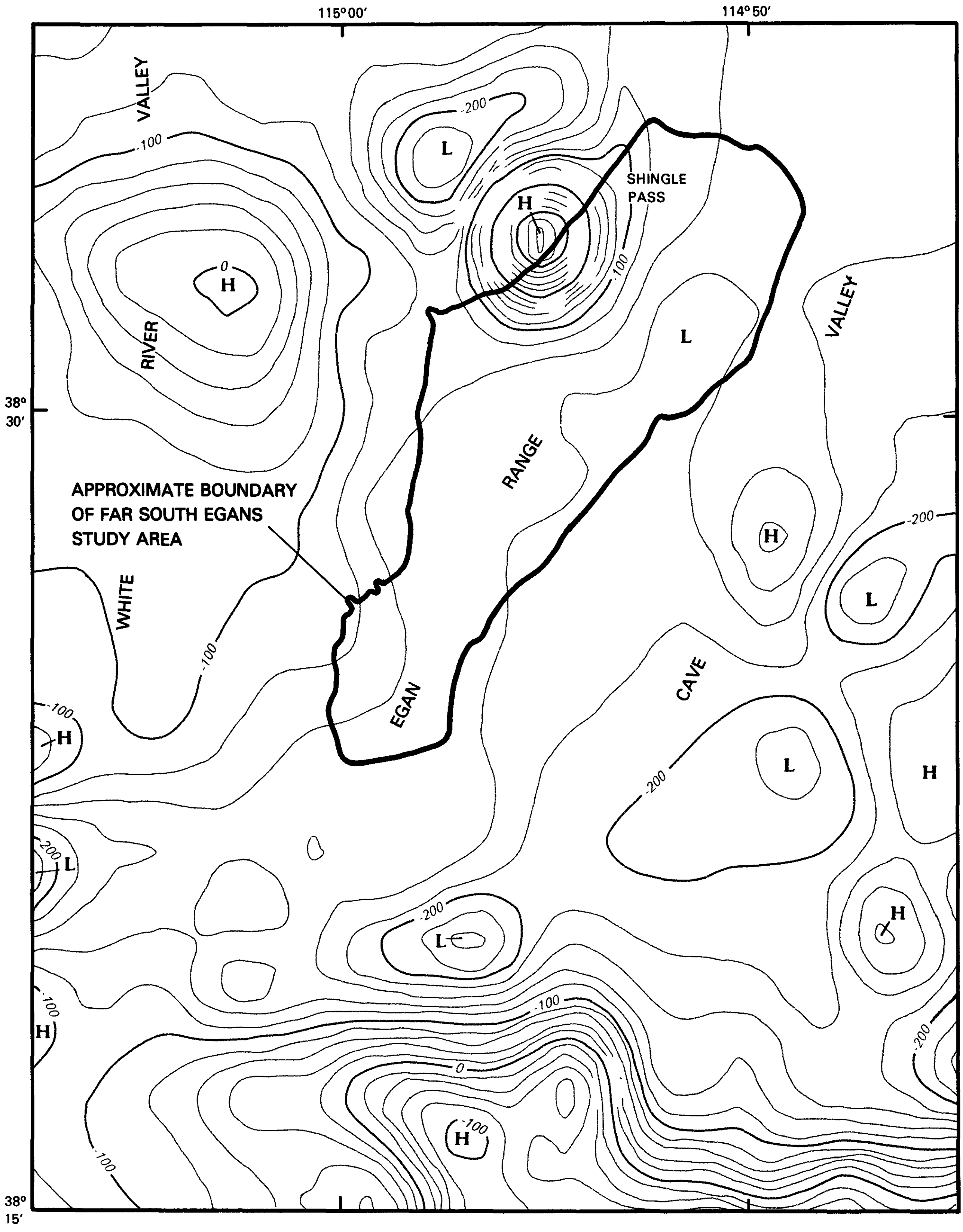

Figure 2. Residual total-intensity aeromagnetic anomaly map of the Far South Egans Wilderness Study Area and vicinity, Lincoln and Nye Counties, Nevada. The area was surveyed at 11,500-ft barometric elevation and draped 1,000 ft above terrain. Contour interval, 20 nT. H, anomaly high; L, anomaly low.

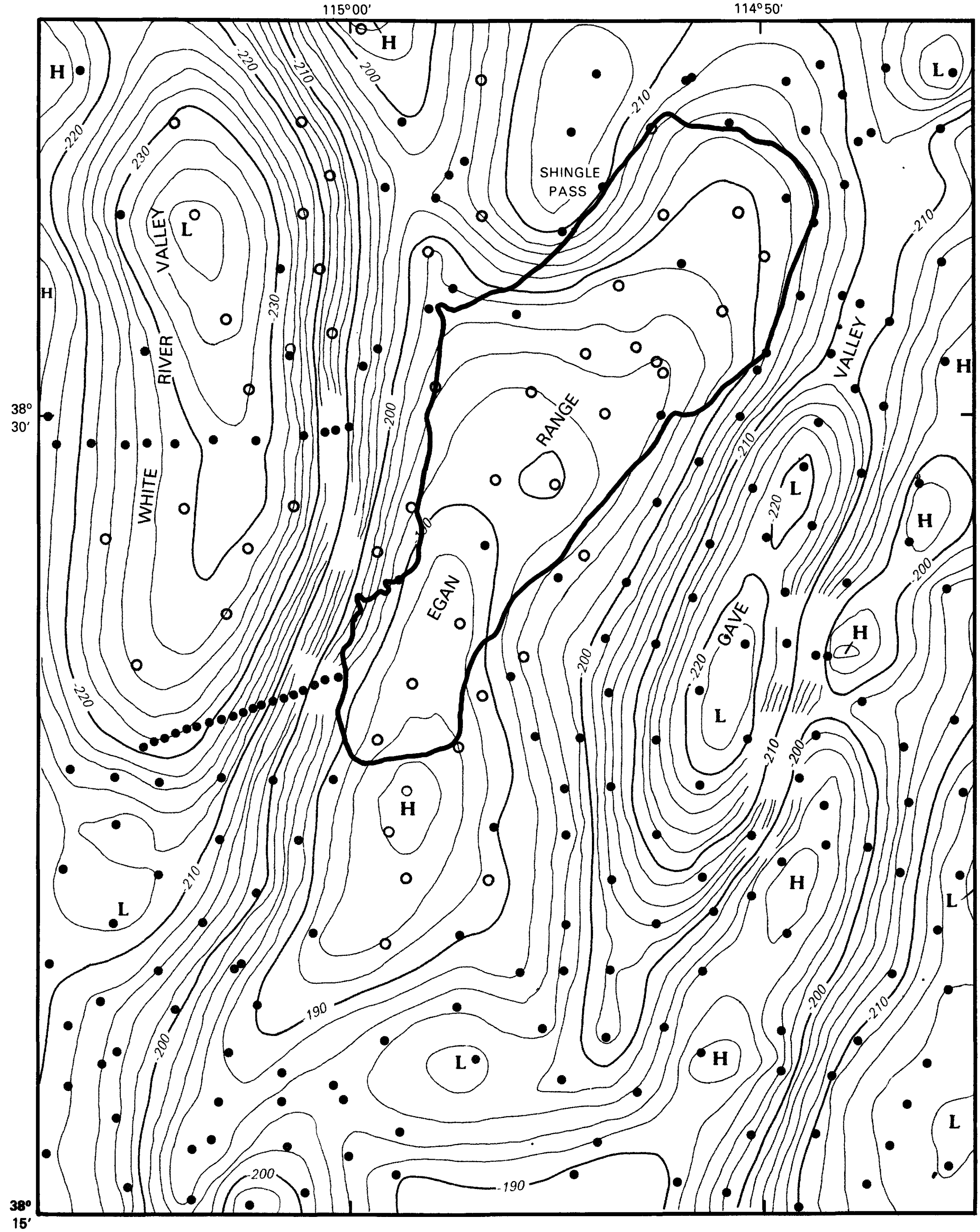

Figure 3 (above and facing page). Complete Bouguer gravity anomaly map of the Far South Egans Wilderness Study Area, Lincoln and Nye Counties, Nevada. Reduction density 2.67 gm/cm^3.

EXPLANATION

-200	**Gravity contour**--Contour interval 2 mGal
●	**Gravity station**--From Snyder and others (1984)
O	**Gravity station**--Established for this study
H	**Anomaly high**
L	**Anomaly low**
▬▬	**Approximate boundary of Far South Egans Wilderness Study Area**

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GEOLOGIC TIME CHART

Terms and boundary ages used by the U. S. Geological Survey, 1986

EON	ERA	PERIOD		EPOCH	BOUNDARY AGE IN MILLION YEARS
Phanerozoic	Cenozoic	Quaternary		Holocene	0.010
				Pleistocene	1.7
		Tertiary	Neogene Subperiod	Pliocene	5
				Miocene	24
			Paleogene Subperiod	Oligocene	38
				Eocene	55
				Paleocene	66
	Mesozoic	Cretaceous		Late	96
				Early	138
		Jurassic		Late Middle Early	205
		Triassic		Late Middle Early	~ 240
	Paleozoic	Permian		Late Early	290
		Carboniferous Periods	Pennsylvanian	Late Middle Early	~ 330
			Mississippian	Late Early	360
		Devonian		Late Middle Early	410
		Silurian		Late Middle Early	435
		Ordovician		Late Middle Early	500
		Cambrian		Late Middle Early	~ 570[1]
Proterozoic	Late Proterozoic				900
	Middle Proterozoic				1600
	Early Proterozoic				2500
Archean	Late Archean				3000
	Middle Archean				3400
	Early Archean				3800?
pre-Archean[2]					4550

[1] Rocks older than 570 m.y. also called Precambrian, a time term without specific rank.

[2] Informal time term without specific rank.

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