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# Geologic, geochemical, and geophysical investigations in the northern part of the Gilmore mining district, Lemhi County, Idaho

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# GEOLOGIC, GEOCHEMICAL, AND GEOPHYSICAL INVESTIGATIONS IN THE NORTHERN PART OF THE GILMORE MINING DISTRICT, LEMHI COUNTY, IDAHO

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## Abstract

Geologic, geochemical, and geophysical investigations in the northern part of the Gilmore (Texas) mining district, Lemhi County, Idaho, indicate an area of anomalous concentrations of lead and silver in glacial deposits. These deposits overlie the probable extensions of the main veins as they are projected northward from the central part of the district. The anomalous area is underlain by the Jefferson Formation, which is the most favorable host rock for mineral deposits in the district, and by quartz diorite and granodiorite of the Gilmore stock. The stock also appears to underlie part of the gravel-covered area east of the district, which suggests that this area is of possible interest for geochemical and geophysical prospecting.

## Introduction

The Gilmore (or Texas) mining district in east-central Idaho (fig. 1) has been the main source of lead-silver ores in Lemhi County, and also has yielded smaller amounts of silver ore and gold ore. The incomplete records available suggest a total value of ore from the district as $11-13 million. The main productive period was 1910-30, although leasing operations continued into the early 1940's; since then, most of the mines in the district have been inactive. Most of the ore was mined from a few veins in the central part of the district, at the United or Pittsburg-Idaho, Latest Out, and Gilmore Mercantile mines, but the Pittsburg-Idaho mine was by far the largest producer. The aggregate length of mine workings in the small area that forms the heart of the district must exceed 20 miles, but most of these old workings are now inaccessible or nearly so.

The principal mine in the southern part of the district is the Silver Moon, an early developed mine that has yielded an uncertain amount of silver ore, some of it extremely rich. The principal mine in the northern part of the district is the Hilltop, which reportedly has yielded about $1 million worth of lead-silver ore similar to the ores of the main mines.

The district has been the object of repeated small prospecting ventures in the past 20 years. These ventures, mostly unsuccessful, have been concentrated largely in the vicinity of the main mines. Lately, geochemical studies by private mining companies in various parts of the district away from the main camp have produced more encouraging results.

The area between the main mines, near Gilmore, and the Hilltop mine is blanketed by glacial deposits and has never been explored for mineral deposits, but the same geologic conditions that control the mineral deposits at Gilmore appear to exist under the blanket of glacial deposits. This area, about 2 square miles, seems from geologic evidence to be a reasonable prospecting target because: (1) there are many small lead-silver deposits in veins in bedrock at the fringe of glacial gravels; (2) the Jefferson Formation, host rock for the mineral deposits in the main mines, extends beneath the glacial gravels and is also the principal host rock at the Hilltop mine and other mines in Sourdough Gulch; (3) a quartz diorite stock, probably genetically related to the mineral deposits, seems to underlie the entire district.

The geochemical and geophysical investigations discussed in this report were designed to test the possiblity of locating mineral deposits and obtaining supplementary geologic data beneath the blanket of glacial gravel. Geochemical investigations included collection of almost 500 soil samples at the localities shown on the accompanying geochemical maps. Most samples were analyzed in the field in a mobile spectrographic laboratory of the U.S. Geological Survey. Geophysical investigations included collection of both gravity and magnetic data.

The geology and mineral deposits of the Gilmore district have been described by Umpleby (1913, p. 89-109), and the geology of the Gilmore area has been discussed by Hait (1965). This report on geochemical and geophysical investigations near Gilmore is a product of a broader study by the U.S. Geological Survey of the geology and mineral deposits of the central part of the Lemhi Range, Idaho.

We are indebted to Russell G. Tysdal, R. T. Hopkins, and William C. Crim, who assisted us in various phases of the geological and geochemical investigations. The field headquarters and mobile laboratories were based in Leadore, Idaho, during the fieldwork leading to this report, and we appreciate the interest, assistance, and hospitality of the residents of that community.

## General geology

The Gilmore district (fig. 2) is underlain by a succession of sedimentary rocks of Paleozoic age that were intruded in Tertiary time by dioritic and andesitic igneous rocks. In the Quaternary, the mountains in and west of the district were repeatedly glaciated, and the glaciers carved deep U-shaped valleys and left widespread moraine.

Sedimentary rocks and surficial deposits

The sedimentary rocks include the Ordovician Kinnikinic Quartzite, the Ordovician Saturday Mountain Formation, the Silurian Laketown Dolomite, the Devonian Jefferson Formation, and the Devonian Three Forks Formation and Mississippian rocks not exposed in the area shown on the accompanying geologic map (fig. 2). The Kinnikinic Quartzite, probably about 2,000 feet thick, is white or light-gray, fine- to medium-grained vitreous, massive quartzite that is partly mottled with irregular lenses and blebs of reddish-brown sandstone cemented by ferrodolomite. It overlies Precambrian quartzites exposed west of the Gilmore area with angular unconformity, and is in turn overlain conformably by the Saturday Mountain Formation, which consists of a lower unit 50 feet thick of interbedded sandstone, shale, and quartzite overlain by about 1,100 feet of medium- to medium-light-gray, thick-bedded to massive dolomite. The top of the Saturday Mountain is an erosional unconformity, overlain by the Laketown Dolomite, a light-olive-gray to light-gray dolomite unit from 0 to 200 feet thick. The Laketown is unconformably overlain by the Jefferson Formation, the principal ore-bearing formation in the Gilmore district.

The Jefferson Formation at Gilmore has been described by Hait (1965, p. 32-36), who divides the formation into six units having an aggregate thickness of almost 3,000 feet. Much of the formation is medium- to dark-gray dolomite, and most of these dark rocks have the characteristic fetid odor of the Jefferson in other areas. The basal part of the formation (member 1) is cyclically bedded dolomite and includes many interbeds of sandy dolomite and dolomitic sandstone, and at the base, lenses of yellowish-gray sandstone as much as 30 feet thick are common. This basal member, 200-300 feet thick, is overlain successively by 200-300 feet of light- to medium-gray, partly sandy dolomite and subordinate interbeds of dark-gray dolomite (member 2); about 600 feet mainly of medium- to dark-gray dolomite with many algal beds (member 3); about 400 feet of light- to medium-gray limestone and sandy limestone, with interbeds of sandstone and dark-gray dolomite (member 4); about 500-800 feet of medium- to dark-gray partly sandy dolomite, with interbeds of sandstone, limestone, and breccia (member 5); and an uppermost member, more than 500 feet thick, that is largely light- to medium-gray limestone breccia (member 6). Detailed sections, measured near Gilmore by R. G. Tysdal of the U.S. Geological Survey are given on pages 39-55.

Members 1 through 3 of the Jefferson Formation contained most of the ore mined in the central part of the Gilmore district and at the Hilltop mine in the northern part of the district. These members seem the most favorable hosts for mineralization.

The Jefferson is overlain by the Three Forks Formation, which apparently is about 300 feet thick in the vicinity of Gilmore and consists of yellowish-gray to light-gray thin-bedded, platy limestone, silty limestone, and calcareous siltstone. The Three Forks is overlain by the Milligen Formation, a few hundred feet of dark-gray argillite and shale, and by the thin limestone beds of the lower part of the Madison Limestone. The Three Forks, Milligen, and Madison are not exposed in the central and northern parts of the Gilmore district (fig. 2), but are concealed beneath the cemented gravels immediately south of Gilmore.

The cemented gravel deposits consist of subrounded to angular fragments as much as 1 foot in diameter of limestone, chert, argillite, and less abundant dolomite and sandstone in a matrix of sand cemented by calcite or silica. The deposit, probably no more than 400 feet thick, is restricted to the area from Gilmore south about 1 mile to Silver Moon Gulch. The age of the deposit is uncertain, but Hait (1965, p. 44) tentatively considered it early Tertiary because the deposit rests with angular unconformity on the Paleozoic rocks and seemingly has been metamorphosed locally by early(?) or mid(?)-Tertiary dioritic intrusive rocks. Ross (1947, p. 1122-1124) described a very similar but more extensive deposit, the Donkey Fanglomerate, in the Donkey Hills about 20 miles southwest of Gilmore, and similar deposits are widespread in Sawmill Canyon 6 or 8 miles west of Gilmore. Ross suggested that the Donkey Fanglomerate might be Pliocene in age, but noted the hazards of attempting to correlate fanglomerate deposits in a region that must have been mountainous throughout Cenozoic time. The matter remains unsolved. For the purposes of this study, the deposit is important mainly in that it conceals the potentially mineralized rocks of the Three Forks, Milligen, and Madison Formations.

Pediment veneer gravels and glacial deposits blanket much of the northern part of the Gilmore district and conceal the bedrock and a large area that possibly is mineralized. The pediment veneer gravels are composed mainly of quartzite pebbles and cobbles derived from the core of the Lemhi Range, in a tuffaceous silt and sand matrix. Thickness of the gravels is not known with certainty, but probably they form a wedge-shaped deposit that thickens eastward from a few tens of feet near the mountain front to perhaps a few hundred feet where they are interrupted by the fault that here controls the west side of the Lemhi Valley (fig. 2). The gravels probably range in age from Miocene and Pliocene, when most of the range-front faulting took place (Ruppel, 1964, p. C16), to Holocene. Near the mountain front, the pediment veneer gravels are overlain by moraine, but farther east they merge almost imperceptibly with glacial outwash gravels in broad alluvial fans.

The most conspicuous glacial deposits are the cresentic terminal moraines at the mouth of Meadow Lake Creek, Deer Creek, and near the Little Hill mine, but ground moraine is widespread, and lateral and medial moraines form parts of prominent ridges. The moraine is a coarse, unsorted mixture of fragments of quartzite, dolomite, and limestone derived mainly from the Precambrian quartzite, Kinnikinic Quartzite, and Saturday Mountain Formation that form the cirque headwalls and upper parts of the glacial canyons. A substantial proportion of Jefferson dolomite is found in the moraine locally. The terminal moraines are compound, including both an older, subdued and rounded outer moraine and a younger, high and little dissected inner moraine (Ruppel, 1968). The terminal moraines are the thickest glacial deposits, and probably the Meadow Lake Creek and Deer Creek terminals are 400-500 feet thick in their central parts. The Little Hill terminal moraine appears to be at least partly cored with Jefferson dolomite and is not as thick as the other terminal moraines. The moraine-covered ridge that forms the north flank of Meadow Lake Creek superficially resembles a thick lateral moraine, but near outcrops and outcrops of bedrock in places along the ridge crest, the appearance of fragments in the moraine of different lithologic units of the Jefferson Formation almost exactly where projection suggests they should appear, and the presence of vein material in moraine above projected veins, indicates a bedrock core with a thin veneer of moraine. Northeast of the 7,840-foot contour line on the ridge, moraine becomes progressively thicker, but southwest of there ground moraine only partly conceals the underlying

Jefferson Formation. The short north-trending ridge east of the Iron Dyke mine is a similar rock-cored ridge, underlain by quartz diorite, that separated lobes of ice from cirques on Portland Mountain and Meadow Lake Creek. Most of the glacial gravels thus appear to be thin ground moraines except in the major terminal moraines and at the downstream or lee ends of partly buried bedrock ribs. The previously mentioned outwash gravels of unknown thickness form large alluvial fans northeast and east of moraine deposition, and merge into pediment gravels. Like the pediment veneer gravels, they probably are relatively thin near the mountain front and thicken eastward.

The composition and distribution of glacial deposits, particularly those containing fragments of Precambrian rock derived from the Meadow Lake Creek cirque, indicate the flow of glacier ice as shown on figure 3. The Meadow Lake glacier, which was the largest, overflowed its valley walls and left them thinly mantled with boulder gravel. Near the Iron Dyke and Mountain Boy mines, it joined a much smaller glacier from the Mountain Boy cirque; the line of covergence is marked now by the rock-cored medial moraine near the Iron Dyke mine. Because the glaciers deposited transported material from veins, as well as rock, the moraines are locally contaminated with such material; the directions of ice flow shown on figure 3 suggest that some anomalously high amounts of metals in the moraine (see figs. 6-15) reflect contaminating vein material glacially eroded and transported, and deposited with the moraine, rather than underlying mineral deposits.

Igneous rocks and metamorphism

Igneous rocks are exposed in the northern part of the Gilmore district (fig. 2) in many irregular dikes and larger masses that are apophyses of a stock. These rocks are massive, medium-gray, fine- to medium-grained porphyritic quartz diorite and granodiorite, probably of early or mid-Tertiary age. Although quartz diorite is exposed in only a few places farther south in the district, calc-silicate hornfels and marble are widespread throughout the district and probably reflect closeness to quartz diorite as they do in the northern part of the district. Geophysical and geochemical evidence (figs. 15-17) strengthen this conclusion, and a buried igneous mass probably extends from exposed rocks in the northern part of the district southeast along the mountain front for several miles. The small basin at Gilmore probably is underlain at shallow depth by igneous rocks, judging from the widespread thermally metamorphosed rocks there. Also, geophysical data (fig. 16) suggest that a buried igneous mass underlies the pediment southeast of Gilmore. It is continuous with exposures of quartz diorite and of thermally metamorphosed rocks at the mouth of Silver Moon Gulch, south of the mapped area. The known mineral deposits of the Gilmore district are in sedimentary rocks on the west side of this stock, and there appears to be a close genetic relationship between the stock and the mineral deposits.

Younger igneous rocks, in dikes that cut the veins at Gilmore (Umpleby, 1913, p. 98), crop out near Gilmore. The dark, fine-grained andesitic rocks are of uncertain but post-ore age. Perhaps they are related to the Challis Volcanics of about mid-Tertiary age.

Structural geology

The northern part of the Gilmore district is bounded on the east and west by steep faults, but the rocks between these bounding faults do not appear to be broken by large faults. The sedimentary rocks near the Hilltop mine are overturned, in the west limb of an asymmetric syncline, but elsewhere in the district such extreme folding is absent. In general, the structure of the district seems to be far less complex than that of adjacent parts of the Lemhi Range (Hait, 1965; Ruppel, 1964, 1968).

The Hilltop syncline is the oldest of these structures, and probably was formed in the early Tertiary during a period of intense folding and faulting along flat thrusts (see Ruppel, 1964, p. C14). No flat thrust faults are known in the Gilmore district, but a zone of several thrusts is present near Deer Creek north of the district (fig. 2) (Ruppel, 1968), and the overturned west limb of the Hilltop syncline probably reflects overturning and drag beneath these thrusts. South of the Hilltop mine, the overturned limb disappears, and dips in the sedimentary rocks are uniformly to the east. East of the Hilltop mine, dips are right side up and progressively flatten to the east, and near the mouth of Sourdough Gulch a single outcrop of intensely metamorphosed sandstone suggests that the basal Jefferson is there in contact with the Gilmore stock.

The fault along the foot of Middle Ridge is an east-dipping normal fault along which there has been thousands of feet of movement. The fault bounds the west side of the Lemhi structural trench, which gravity data suggest is at least 9,000 feet deep here (Ruppel, 1964). The most recent fault movement has been a few hundred feet in the opposite direction to form the west face of Middle Ridge. The pediment mentioned earlier lies between this fault and the mountain front to the southwest.

The north-trending vertical fault east of the Brown Bull mine cuts Ordovician rocks and quartz diorite, and farther north (Ruppel, 1968) it probably cuts both the thrust responsible for the Hilltop overturned syncline and the range-front fault system. The trend and near-vertical dip of the fault suggest that it is a strike-slip fault related to the young faults of similar trend and dip near Leadore (Ruppel, 1964, 1968). The fault cuts off the west-trending veins of the Brown Bull mine and other prospects, and, like the range front fault, the principal movement was later than mineralization.

In addition to the major structural features, the rocks in the northern part of the district are broken by near vertical west-trending faults and veins of several trends. Some faults are mineralized, as in the Brown Bull mine. The displacement along west-trending faults probably rarely exceeds a few tens of feet. West-trending faults are clearly older than north-trending faults, probably are older than the range-front faults, and at least some of them are younger than the quartz diorite stock, which they cut. Similar faults are known in the northwest corner of the Gilmore quadrangle where they cut the Challis Volcanics. The west-trending mineralized small faults at the Carrie Cody and Murphy mines, in the southwest part of the map area (fig. 2), change trend to northwest south of Meadow Lake Creek, and there are reverse faults that dip steeply east and have displacements that range from a few feet to about 200 feet. Many of these reverse faults have breccia zones as much as 30 feet thick, and several contain lead-silver mineralization.

The veins that contain the major mineral deposits of the district are probably small faults or fractures along which there has been brecciation but little or no displacement.

## Mineral deposits[1]

[1] See Umpleby (1913, p. 63-69, 89-109) for a broader discussion of the Gilmore mining district. Figures on grade of ore are drawn largely from Umpleby (1913), the Annual Reports of the Idaho Inspector of Mines for the years 1903-21, and from Minerals Resources and Minerals Yearbooks.

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The principal known mineral deposits of the Gilmore district are in an area of about half a square mile, west of the remnants of the town of Gilmore. They occur in a narrow belt of near north-trending veins and associated replacement deposits of lead and silver (fig. 3). A single vein in the eastern part of the mineralized zone contained gold. Ore from the lead-silver veins consisted almost entirely of secondary minerals, principally lead carbonate, in an earthy iron- and manganese-rich gangue. Umpleby (1913, p. 89-109) discussed the replacement origin of the mineral deposits and the effects of later oxidation.

The average ore mined in the central part of the district contained about 23 percent lead, 4 percent zinc, and 11 ounces silver per ton; the richest ores contained 35-40 percent lead, as much as 10 percent zinc, and about 18 ounces silver per ton. Silver typically occurred in a ratio of about 1 ounce silver for each 2 percent lead. The deepest mine workings the 950-foot level in the Pittsburg-Idaho mine, apparently reached the top of the sulfide zone, but only a little development work was done on this level before the mine was closed. The nature of the major veins in the sulfide zone and the grade of the ore are unknown, but local reports suggest that the sulfide-bearing veins cut on this level contained only about half as much lead as average oxidized ore, although the silver and zinc content was about the same as in average oxidized ores.

The major known lead-silver deposits are restricted to the lower and middle parts of the Jefferson Formation, a favorable host for mineralization, and occur in or near fissures known locally as "steep veins" and "flat veins." The steep veins, which trend N. 10°-15° E. and dip 70°-90° W., are the most prominent structures in the district. The flat veins parallel the steep veins in trend, but generally dip 40°-60° W. The deposits in the Pittsburg-Idaho mine occurred in several steep veins and a major flat vein that connected them and continued beyond to the west. In the Latest Out mine, and others west of the Pittsburg-Idaho, the major deposits appear to have been closely related to flat veins, and the steep veins contained little ore except near intersections with flat veins. The ore bodies were lenticular, generally up to about 15 feet thick,[1] and had strike lengths up to 500 feet, although the common strike length was 100-300 feet. The main flat vein in the Pittsburg-Idaho mine was stoped continuously from the 600-foot level to the surface, and several veins in the Pittsburg-Idaho and other mines were stoped through two or three levels.

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[1] Umpleby (1913, p. 106), however, illustrates a lens 40 feet thick between the 100- and 200-foot levels in the Latest Out mine.

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In the north and northwestern parts of the Gilmore district, mines and prospects explore deposits of similar mineralogy to those in the central part of the district, but the veins have differing trends. The Carrie Cody and Murphy prospects explored west-trending, steep veins in the Saturday Mountain Formation, and have yielded little ore. The Mountain Boy mine explored a north-trending, steep, west-dipping fissure and a west-trending, steep, south-dipping vein in Saturday Mountain Formation, in which the principal ore bodies reportedly were located near the intersections of the structures. The mine reportedly yielded 5,000-7,000 tons of lead-silver ore. The Little Hill mine explored a northwest-trending, west-dipping vein in the lower part of the Jefferson Formation and yielded several hundred tons of oxidized silver-lead ore. The mine was described by R. T. Walker (1924) as a glacially transported block containing mineralization, because the lower mine workings were all in glacial gravels. The block supposedly had been carried a half-mile downstream by a glacier and deposited in the terminal moraine. This explanation seems untenable because the only dolomitic rocks upstream are Saturday Mountain Formation, and the Little Hill vein is in dolomite of the Jefferson Formation in a place where the Jefferson should be present. An explanation more likely than Walker's is that the mine explores a vein in an ice- and melt-water-carved cliff buried beneath moraine, and the lower workings were too far south to encounter bedrock.

The Hilltop mine, the largest mine in the northern part of the district, explores a northwest-trending, steep, west-dipping vein in the lower part of the Jefferson Formation, and reportedly has yielded about 10,000 tons of lead-silver ore similar to the ore from the mines near Gilmore. East and northeast of the Hilltop, a number of small mines and prospects have yielded from a few tons to a few hundred tons of lead-silver ore from steep veins of differing trends in the Jefferson Formation.

In summary, all the major mineral deposits in the northern and central parts of the Gilmore district, except those at the Mountain Boy mine, are in the middle and lower parts of the Jefferson Formation. The Jefferson Formation has been an especially favorable host for lead-silver mineralization in this area. The principal veins in the central part of the district trend N. 10°-15° E. and may be either steep or flat. Mineral deposits occur at the intersections of steep and flat veins, at intersections of veins with favorable beds of wall rock and, to a minor extent, at intersections of veins with east-west vertical fractures. Mineralization was most persistent on the main flat vein in the Pittsburg-Idaho mine, and reportedly, the strongest mineralization in the Latest Out mine and others immediately west was also in flat veins paralleling the one in the Pittsburg-Idaho. Probably, flat fractures were the principal channelways through which mineralizing solutions were transported.

Deposits in the northern part of the district are mostly in northwest-trending, steeply dipping veins. The relation of these veins to those in the central part of the district is uncertain, because most of the intervening area is covered by glacial deposits, but there is some suggestion in the vicinity of the Carrie Cody prospect that north-trending fractures tend to swing to the northwest. Perhaps the steep, northwest-trending veins in the northern part of the district are extensions of those that trend N. 10°-15° E. in the main mines at Gilmore.

## Geochemical investigations

Sampling procedure

Traverses in the study area (fig. 4) were designed to cut potential ore bodies at right or oblique angles and, if possible, more than once. Projection of trends of known veins in adjacent areas suggested an orientation of N. 43° E. and spread of about 1,100 feet for traverse lines. Other traverses were undertaken where additional information was needed.

The rock-cored ridge topped by glacial drift north of Meadow Lake Creek was selected for preliminary study and an initial traverse (traverse P on fig. 4). A 200-foot sample interval was used throughout for sampling program, except in critical areas, where 100-foot intervals were used or where other intervals seemed warranted. Initially, samples were collected at depths of 1 foot and 2 feet at each location. By sampling at two different depths, we hoped to determine variations in metal content with depth, if they existed. Sampling at depths of 2 feet was abandoned after a few samples were collected and comparison of metal content in the -80-mesh fraction at the two sample depths indicated no significant difference in metal values within the intervals sampled.

The remainder of the samples were collected at a depth of about 18 inches in a zone of yellow-brown, glacially and glaciofluvially transported sand, silt, clay, and cobbles. Well-drained overburden is being slightly leached, as evidenced by iron oxide accumulation at about 18 inches from the surface. However, there has been very little development of soil horizons in the glacial drift and minimal selective concentration of metal. Under sagebrush vegetation, an upper horizon of fine-textured, dark-brown material containing abundant roots extends to a depth of 1 to 1 1/2 feet. Below this zone, the yellow-brown sample horizon occurs. The yellow-brown sample horizon is found just below the root zone under forest cover.

Two types of samples were collected at most locations: (1) A sample consisting of about 1 pound of glacial till and soil that was dried, sieved to -80 mesh, and analyzed spectrographically and by other methods. (2) A sample, also consisting of glacial overburden and soil, weighing about 10 pounds when collected. This sample was a composite of material removed from the sample hole at each site. The sample was subsequently panned in a 10-inch gold pan at the field laboratory, dried, magnetite and ilmenite were removed, and the remaining heavy minerals were pulverized and analyzed spectrographically. Supplementary data were provided by chip and float samples of bedrock collected in areas of outcrop or where additional information was desired.

Comparison of metal-content values obtained from -80-mesh material with analytical results on the pan-concentrate fraction at the same sample location, indicates a greater contrast of anomaly over background with pan-concentrate data on some elements, such as lead, but not with all elements. We conclude that both types of sample would be useful in any more extensive geochemical studies in gravel-concealed parts of the Gilmore district.

We believe that metalliferous veins underlying 1 foot to about 20 feet of glacial debris can be detected by the methods we were employing.

Analytical procedure

Six-step semiquantitative spectrographic analysis for 30 elements was performed on 454 samples, the total number collected. Much of the analysis was accomplished in the field while sample collection was still in progress. A 0.86-meter, truck-mounted ARL Spectrograph and D. C. arc excitation was utilized in the analysis. The analytical procedure is routine for Field Services Section of the U.S. Geological Survey and has been described by Ward and others (1963), and by Grimes and Marranzino (1968).

Sample preparation consisted of drying, sieving to -80 mesh, pan concentrating bulk samples, and pulverizing, all of which were performed at the mobile field laboratory. Sample preparation and semiquantitative spectrographic analysis on as many as 48 samples could be carried out by two men in an average workday.

In addition to spectrographic analysis, all of the -80-mesh material and some pan concentrates were analyzed for antimony, arsenic, and mercury using methods described by Ward and others (1963) and Vaughn and McCarthy (1967). These analyses were made at the Denver Field Services Section Laboratory.

## Results of investigation

The geochemical maps (figs. 4-15) show the distribution of metal values along traverse lines over the sample area, and outline many areas that contain anomalous amounts of several metallic elements. High metal content in samples is commonly reflected by more than one metallic element. Comparison of data on -80-mesh and pan-concentrated heavy-mineral fractions, as plotted on the geochemical maps, brings out differences that suggest the mode of occurrence for some metal concentrations. For example, the anomaly-to-background contrast on lead is greater, for the most part, in the pan-concentrate fraction than it is in -80-mesh material. High concentration of lead in the heavy-mineral fraction suggests its occurrence in secondary lead minerals or hydrous manganese or iron oxides. Silver, on the other hand, exhibits a diffuse distribution in the -80-mesh fraction and is found in anomalous amounts over a more limited area in the heavy-mineral fraction. This suggests the high mobility of silver in solution under some circumstances and its occurrence in clay- and silt-size material as well as in heavy-secondary minerals. Zinc data on both pan-concentrate and -80-mesh fractions seem to outline somewhat the same anomalous areas as lead and silver. Zinc is being transported in solution as well as concentrating in heavy-secondary minerals. The same anomalies are apparent on both sample fractions although a slightly broader pattern is exhibited in -80-mesh materials.

Antimony data correlate closely with information on lead, zinc, and silver. Where anomalous amounts of these metals occur, antimony content usually is high also.

Molybdenum displays a close affinity for quartz diorite bedrock. The distribution of detectable molybdenum in both fine- and heavy-mineral fractions closely corresponds, with some exceptions, to areas known or inferred to be near quartz diorite.

Geochemical data on the distribution of barium and strontium (fig. 15), supplemented by geophysical data, suggest the approximate margins of the quartz diorite stock that is exposed in the northern part of the area but concealed beneath glacial and alluvial deposits farther south. Table 1 compares values of barium and strontium in quartz diorite and in dolomite of the Jefferson Formation. The higher barium-strontium values in -80-mesh soil samples, shown on figure 15, are those falling within the quartz diorite range with a slight dilution factor considered. The isolated high values on some traverses may represent quartz diorite dikes like those that cut the Jefferson east of the Hilltop mine, or barite gangue, which occurs in a few veins in the western and southern parts of the Gilmore district in the outer part of the mineralized area.

Table 1.--Barium and strontium values in quartz diorite and dolomite of the Jefferson Formation

[Determined by semiquantitative spectrographic analysis. N.d., not detected]

| Field No. | Barium content (ppm) | Strontium content (ppm) |
|---|---|---|
| Quartz diorite | | |
| QD-1----------- | 2,000 | 700 |
| QD-2----------- | 2,000 | 700 |
| QD-3----------- | 3,000 | 700 |
| A-5f----------- | 2,000 | 300 |
| B-7f----------- | 1,500 | 700 |
| H-6f----------- | 3,000 | 700 |
| D-6f----------- | 2,000 | 500 |
| Jefferson Formation | | |
| JD-1---------- | N.d. | < 100 |
| JD-2---------- | N.d. | < 100 |
| JD-3---------- | N.d. | < 100 |
| JD-4---------- | < 10 | < 100 |

NOTE: No data were collected on quartzite bedrock in the area, but values for this lithology are listed as: barium 100-500 ppm (Hawkes and Webb, 1962), strontium < 26 ppm (Rankama and Sahama, 1950).

Contamination

The cross-hatched areas on the geochemical maps are considered valid exploration targets. Other parts of the study area also exhibit high values that we believe reflect contamination through glacial transport, lateral transport in ground water, or surface contamination from ore trucks or wagons.

Along B-traverse, a train of anomalous metal values occurs in lateral moraine derived from near the Mountain Boy mine. At the margins of the moraine, metal values fall to background, and we infer that this train of anomalous values reflects glacially transported vein material from the vicinity of the Mountain Boy mine.

A part of the northeastern edge of the study area (traverse C) exhibits markedly anomalous metal values on both heavy-mineral and -80-mesh fractions. Interpretation of the data is complicated by the existence of the Little Hill mine and others upslope, and by abundant ground-water seepage in the sample area. The anomalous metal values show correlation with high iron and manganese content and are more pronounced in the heavy-mineral fraction. We believe that these anomalous values possibly reflect lateral transport in ground water. Some of the high metal values in this area are near a road long used for hauling ore, and we regard these metal concentrations as strongly suspect. It should be pointed out, however, that projection of trends from significant anomalies suggests possibilities for buried mineralization in this general area, but our information does not permit a more confident interpretation.

## Heavy minerals

A selected few pan-concentrate samples were examined under the binocular microscope. Before viewing under the microscope, the pan-concentrated material was passed through bromoform and cleaned. The principal heavy-mineral components found were: zircon, limonite, hematite, manganese oxides, apatite, rutile, sphene, epidote, and hornblende. The most abundant heavy minerals near areas underlain by marble were: limonite, hematite, manganese oxides, tremolite-actinolite, sphene, brown tourmaline, spinel, phlogopite, epidote, fluorite, and garnet.

One heavy-mineral sample contained abundant cerussite as well as limonite with anomalous metal content. Other secondary lead minerals were probably present although not detected.

Samples were immersed in 10 percent HCl and tested with potassium iodide crystals for the distinctive lemon-yellow coating characteristic of lead iodide. Samples in which spectrographic results indicated > 1,000 ppm lead also exhibited some mineral grains with a lemon-yellow coating. For most of the material tested, limonite and manganese oxides usually were the constituents that reacted.

A few individual mineral grains were separated out for semiquantitative laser microprobe analysis. The results indicate anomalous metal concentrations in some iron and manganese oxide grains.

## Geophysical investigations

Gravity and magnetic surveys were made in the Gilmore mining district and vicinity in an attempt to detect subsurface features that might be related to mineralization.

The gravity survey (fig. 16) was made with a Worden gravimeter with a sensitivity of about 0.5 mgal (milligal) per scale division. Fifty gravity stations were occupied over an area of about 18 square miles. About one-fifth of the station elevations are from bench marks and other points of known elevation. Elevations for the remaining stations were determined by altimetry. A terrain correlation was computed out to a radial distance of 19 km (kilometers) for each station using Hayford-Bowie templates (Swick, 1942). A density of 2.67 grams per cubic centimeter has been assumed for the rock between sea level and station elevations in reducing the data to complete Bouguer anomaly. The data are referenced to an earlier gravity survey (Kinoshita, Davis, and Peterson, 1969).

Two positive gravity anomalies occur along the front of the Lemhi Range (fig. 16). The larger anomaly is located at Gilmore and southward and extends over the pediment for a short distance. The smaller anomaly is centered about 2 1/2 miles northwest of Gilmore along the edge of the range front. The maximum amplitudes of these anomalies cannot be determined from the existing data but are probably equal to several milligals. A trough of more negative gravity values separates the two positive anomalies. The steeply dipping gravity gradient along the northeast edge of the surveyed area probably reflects vertical displacement along a major range-front fault.

Ground magnetometer measurements were made with a portable, vertical field, fluxgate magnetometer. The contoured data (fig. 17) are relative to an arbitrary datum. The magnetic data approximately coincide with the gravity data. A positive magnetic anomaly occurs south-southeast of Gilmore and extends partly over the pediment. The anomaly has 300 gammas or more of amplitude. Another positive anomaly is indicated about 2 miles northwest of Gilmore. This anomaly is offset from the northernmost gravity anomaly; however, more data are needed to define the magnetic field in this area.

Although the geophysical data presented here are reconnaissance, they show that anomalies are present along the front of the Lemhi Range at Gilmore and vicinity. Because of the higher magnetic susceptibility and higher density associated with the positive anomalies, it is reasonable to assume that their source may be an intrusive igneous mass of intermediate composition. The trough of negative gravity values coincides with the moraine-covered ridge of Jefferson Formation north of Meadow Lake Creek.

## Exploration targets

Geologic, geochemical, and geophysical investigations suggest that a number of areas in the northern part of the Gilmore district warrant further exploration, some by conventional prospecting and mining techniques to expose the bedrock and determine their economic potential and others by more extensive geochemical and geophysical investigations. Although most of the northern part of the district is concealed by glacial or alluvial gravels, the bedrock at the margins of the concealing blanket contains many mineral deposits that suggest mineralization extended well beyond the main veins at Gilmore. The Jefferson Formation, known to be a favorable host rock for mineralization, extends beneath the gravel blanket, and geologic and geophysical evidence show that it underlies the ridge north of Meadow Lake Creek. Geochemical sampling indicates that a primary target for exploration is at the northeastern end of this ridge, where the strongest anomalous concentrations of metals are found in an area that coincides with the projection of the main vein zone from the central part of the district. This primary target area extends south to the moraine-covered ridge on the south side of Meadow Lake Creek, and north into the NW. cor. sec. 7, T. 13 N., R. 27 E. Farther northwest, the geochemical results are confused by contamination, but the zone may continue into the area of anomalous metal concentrations west of sec. 6, T. 13 N., R. 27 E., above the Hilltop mine road. A parallel zone of apparent mineralization to the west swings toward the Little Hill mine, and there is some suggestion that this zone continues to the Hilltop mine. Part of the area crossed by these two zones is underlain by quartz diorite, which here seems a less likely host rock for significant lead-silver deposits than the dolomite of the Jefferson Formation. However, there are small lead-silver deposits in quartz diorite in adjacent areas, and lead-silver deposits occur in veins in quartz diorite in Big Eightmile Creek farther north in the Lemhi Range, so the areas underlain by quartz diorite must be considered as potential mineralized areas if not primary areas for further exploration.

We did not find contact deposits like those in the Spring Mountain district to the south in the contact zone around the quartz diorite stock, nor did we detect tungsten or other metals commonly associated with contact zones. But this zone is only here and there exposed, and because the quartz diorite stock underlies so much of the concealed area near the Gilmore district (figs. 15-17) the metamorphosed zone around it must also be extensive; it constitutes a zone of possible, if somewhat peripheral, economic interest.

Recognition of the approximate outline of the buried Gilmore stock suggests a broader area for further geochemical prospecting for mineral deposits similar to those at Gilmore. The sedimentary rocks intruded by the stock and immediately beneath the glacial, alluvial, and pediment gravels probably are mostly dolomite and limestone of Ordovician to Mississippian age, which could contain replacement deposits of lead-silver similar to the Gilmore deposits. Thus the entire pediment area from Sourdough Gulch southeast along the mountain front to Silver Moon Gulch is an area of possible interest for geochemical and geophysical prospecting.

Jefferson Formation on ridge south of Liberty Gulch, Gilmore mining district, Lemhi County, Idaho

| | Thickness (feet) |
|---|---|
| Three Forks Formation: | |
| Yellowish-gray platy limestone, silty limestone, and siltstone | |
| Jefferson Formation: | |
| Member 6 | |
| 69. Covered, underlain by limestone breccia for 200-300 more feet. Dip slope---------------------- | 250± est. |
| 68. Limestone breccia, similar to unit 64------------- | 100 |
| 67. Limestone, similar to unit 65-------------------- | 50 |
| 66. Limestone breccia, similar to unit 64------------- | 30 |
| 65. Limestone, light-gray, thick-bedded, aphanitic---- | 40 |
| 64. Limestone breccia, medium-gray, weathers light-gray------------------------------------------ | 80 |
| Approximate thickness member 6------------- | 550 |
| Member 5 | |
| 63. Limestone, medium-gray to medium-light-gray and medium-dark-gray, thick-bedded to massive------- | 103 |
| 62. Limestone breccia, medium- to dark-gray, medium- and thick-bedded. Sedimentary breccia---------- | 2 |
| 61. Limestone, pale-yellowish-brown to light-gray, thin- and medium-bedded----------------------- | 15 |

Jefferson Formation on ridge south of Liberty Gulch, Gilmore mining district, Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 5--continued | |
| 60. Dolomite, similar to unit 56--------------------- | 45 |
| 59. Sandstone, calcareous, pale-yellowish-brown, thin-bedded, fine-grained---------------------------- | 5 |
| 58. Dolomite, similar to unit 56--------------------- | 70 |
| 57. Limestone, medium-gray, medium- and thick-bedded-- | 35 |
| 56. Dolomite, interbedded, dark-gray, medium- and thick-bedded; and medium-gray, medium- and thick-bedded; in units 2-10 ft thick----------- | 33 |
| 55. Breccia, dolomite, medium- and dark-gray, thick-bedded, probably sedimentary------------------- | 5 |
| 54. Dolomite, dark-gray, medium-bedded, sugary, finely crystalline, fetid, laminated------------------ | 27 |
| 53. Sandstone, calcareous, pale-yellowish-brown, thin-bedded. Sand is quartz, medium grained, well rounded------------------------------------------ | 7 |
| 52. Limestone breccia, sedimentary, looks like redeposited ripped up bottom clasts------------- | 3 |
| 51. Dolomite, medium-dark-gray, thick-bedded, fetid, sugary, laminated------------------------------ | 8 |

| | Thicknes (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 5--continued | |
| 50. Dolomite breccia, probably sedimentary------------ | 2 |
| 49. Concealed, float suggests similar to unit 48------ | 45 |
| 48. Dolomite, interbedded, 10- to 20-ft-thick units similar to units 47 and 44---------------------- | 56 |
| 47. Dolomite, medium-gray, weathers light-gray, medium-bedded, finely crystalline, sugary------- | 4 |
| 46. Dolomite, dark-gray, medium-bedded, finely crystalline, sugary, fetid, laminated. Upper one-third includes interbedded sandy dolomite--- | 175 |
| Total thickness member 5------------------ | 640 |
| Member 4 | |
| 45. Limestone, medium-gray, weathers light-gray, medium-bedded, finely crystalline. Upper 10 ft has interbedded sandy limestone, pale-yellowish-brown, thin-bedded; quartz sand, medium grained, rounded------------------------------------------ | 35 |
| 44. Dolomite, dark-gray, medium-bedded, sugary, fine- and medium-crystalline, fetid------------------ | 5 |

Jefferson Formation on ridge south of Liberty Gulch, Gilmore mining district, Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 4--continued | |
| 43. Sandstone and dolomite interbedded, sandstone, whitish, thin- and medium-bedded, fine- to medium-grained; dolomite, medium-gray, medium-bedded, sugary, finely crystalline---------------------- | 60 |
| 42. Concealed----------------------------------------- | 22 |
| 41. Quartzite, light-gray, medium-bedded, fine- to medium-grained---------------------------------- | 3 |
| 40. Concealed----------------------------------------- | 10 |
| 39. Limestone, medium-gray, medium- and thick-bedded-- | 70 |
| 38. Limestone breccia--------------------------------- | 30 |
| 37. Limestone, medium-gray, medium- and thick-bedded, interbedded with sandstone and sandy limestone-- | 20 |
| 36. Sandstone, calcareous, moderate-red, thick-bedded- | 3 |
| 35. Dolomite, dark-gray, thick-bedded, fetid, sugary-- | 2 |
| 34. Calcite dike. Rock on both sides of dike is brecciated--------------------------------------- | 5 |
| 33. Limestone and sandy limestone, similar to unit 31- | 45 |
| 32. Dolomite, dark-gray, thin-bedded, fetid, sugary--- | 20 |

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 4--continued | |
| 31. Limestone and sandy limestone, light-gray to pale-yellowish-brown, and locally a very-pale-red, thin- and medium-bedded. Sand is quartz, well-rounded, medium- to coarse-grained---------------------- | 45 |
| Total thickness member 4------------------ | 375 |
| Member 3 | |
| 30. Dolomite, dark-gray, medium-bedded, sugary, fetid, vuggy, gives mottled appearance----------------- | 25 |
| 29. Dolomite, medium-gray, medium-bedded, sugary, finely crystalline. Interbedded with dolomite, dark-gray, medium-bedded, finely crystalline, fetid, sugary. Units are 5-30 ft thick--------- | 160 |
| 28. Limestone, sandy, pale-yellowish-brown, thin- and medium-bedded, quartz grains are medium to coarse and well rounded------------------------ | 6 |
| 27. Dolomite, dark-gray, thick-bedded, finely crystalline, sugary, fetid--------------------- | 5 |
| 26. Dolomite, similar to unit 24--------------------- | 15 |

Jefferson Formation on ridge south of Liberty Gulch, Gilmore mining district, Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 3--continued | |
| 25. Dolomite, similar to unit 23, with white calcite hairline veinlets------------------------------ | 24 |
| 24. Dolomite, medium-gray, thick-bedded, sugary, fetid, finely crystalline----------------------------- | 21 |
| 23. Dolomite, dark-gray, medium- and thick-bedded, sugary, fetid, finely crystalline-------------- | 95 |
| 22. Dolomite, light-gray, pale- and medium-brown, finely crystalline, sugary--------------------- | 10 |
| 21. Light-brown-weathering soil zone, abundant calcite, prospect pit. Probable shear zone or small fault, displacement probably negligible--------- | 6 |
| 20. Interbedding of 5- to 10-ft-thick units of dolomite similar to units 14 and 13; sedimentary breccia, 6 ft thick, in middle------------------ | 130 |
| 19. Dolomite, similar to unit 14--------------------- | 10 |
| 18. Dolomite, similar to unit 13--------------------- | 10 |
| 17. Dolomite, similar to unit 14--------------------- | 33 |
| 16. Dolomite, shaly, pale-yellowish-brown, thin-bedded | 2 |
| 15. Dolomite, similar to unit 13--------------------- | 15 |

Jefferson Formation on ridge south of Liberty Gulch, Gilmore mining district. Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 3--continued | |
| 14. Dolomite, medium-gray, thin- and medium-bedded, finely crystalline, sugary---------------------- | 23 |
| 13. Dolomite, dark-gray, medium-bedded, finely crystalline, sugary, fetid---------------------- | 7 |
| Total thickness member 3------------------ | 591 |
| Member 2 | |
| 12. Dolomite, light-gray, thin- and medium-bedded, aphanitic---------------------------------------- | 65 |
| 11. Sandstone, calcareous and dolomitic, pale-yellowish-brown, medium-bedded, quartz sand is fine grained---------------------------------------- | 20 |
| 10. Dolomite, very pale-yellowish-brown, thin- and medium-bedded, aphanitic----------------------- | 10 |
| 9. Dolomite, dark-gray, medium- and thick-bedded, sugary, fetid, locally laminated. Unit contains much fossil material, including brachiopods and gastropods------------------------------------ | 40 |

Jefferson Formation on ridge south of Liberty Gulch, Gilmore mining district, Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 2--continued | |
| 8. Dolomite, similar to unit 6, interbedded with dolomite, medium-gray, weathering light-gray, medium-bedded, finely crystalline--------------- | 15 |
| 7. Dolomite, pale-yellowish-brown, medium- and thick-bedded------------------------------------------ | 5 |
| 6. Dolomite, dark-gray, medium- and thick-bedded, sugary, fetid, fine- to medium-crystalline, laminated---------------------------------------- | 20 |
| 5. Dolomite, sandy, light-brown to moderate-brown, medium-bedded; partly sedimentary breccia------- | 5 |
| 4. Dolomite, medium-gray, weathers light-gray, very finely crystalline, medium- and thick-bedded---- | 5 |
| 3. Dolomite, dark-gray, medium- and thick-bedded, finely crystalline, sugary, fetid-------------- | 40 |
| Total thickness member 2------------------ | 225 |

Jefferson Formation on ridge south of Liberty Gulch, Gilmore mining district, Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 1 | |
| 2. Sandstone, calcareous and dolomitic, yellowish-gray, thin- and medium-bedded-------------------- | 10 |
| 1. Cyclic bedded unit,[1] includes pale-yellowish-brown, thin- and medium-bedded, sandstone, dolomitic; medium-gray cyclic bedded dolomite becomes prominent in formation 140 ft above base-------------------------------------------- | 310 |
| Total thickness member 1------------------- | 320 |
| Total measured and estimated thickness of Jefferson Formation---------------------- | 2,701± |
| Contact of Jefferson Formation with Silurian Laketown Dolomite | |

[1] See following section, measured south of Latest Out Mine, for more detailed description of member 1.

Partial measured section of members 1 and 2, Jefferson Formation, on ridge south of Latest Out mine. Gilmore district, Lemhi County, Idaho

| | Thickness (feet) |
|---|---|
| Jefferson Formation: | |
| Member 2: | |
| Fault zone, top of measured section | |
| 60. Dolomite, light-gray to very-light-gray, aphanitic, thick-bedded | 34 |
| 59. Dolomite, yellowish-brown, fine-grained, thick-bedded; contains sparse sand grains | 7 |
| 58. Dolomite, light-gray, apahnitic, medium- and thick-bedded, thinly laminated; lower 1 ft contains mud chips and is sandy | 58 |
| 57. Sandstone, dolomitic, medium-light-gray to pale-yellowish-brown, fine-grained, thick-bedded, cross-laminated (same as unit 11 of Liberty Gulch section) | 20 |
| 56. Dolomite, medium-gray, fine-grained, medium- and thick-bedded, sugary, fetid, top 1 ft is flat pebble conglomerate | 15 |
| 55. Dolomite, medium-gray, thick-bedded, irregularly laminated, sugary, locally cherty; upper 5 ft sandy | 14 |

Partial measured section of members 1 and 2, Jefferson Formation, on ridge south of Latest Out mine, Gilmore district, Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 2--continued | |
| 54. Dolomite, medium-gray, very fine grained, medium- and thick-bedded---------------------------------- | 25 |
| 53. Dolomite, grayish-black, thick-bedded, laminated, sugary, fetid, upper half contains abundant fragments of fossil brachiopods and gastropods-- | 31 |
| 52. Dolomite, medium-gray, medium-grained, medium- and thick-bedded, laminated, sugary, fetid--------- | 25 |
| Measured thickness of member 2 (partial)--- | 229 |
| Member 1 | |
| 51. Sandstone, pinkish-gray, medium-grained dolomitic, medium- and thick-bedded----------------------- | 4 |
| 50. Dolomite, medium-gray, medium- and thick-bedded, laminated, fetid------------------------------- | 6 |
| 49. Concealed--------------------------------------- | 4 |
| 48. Dolomite, medium-gray, very fine grained, thick-bedded----------------------------------------- | 2 |
| 47. Concealed--------------------------------------- | 4 |

Partial measured section of members 1 and 2, Jefferson Formation, on ridge south of Latest Out mine, Gilmore district, Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 1--continued | |
| 46. Dolomite, dark-gray, thick-bedded, laminated, sugary fetid | 2 |
| 45. Dolomite, pale-yellowish-brown, very fine grained, medium- and thick-bedded, thinly laminated | 7 |
| 44. Dolomite, medium-gray, medium- and thick-bedded, laminated, vuggy, with vugs lined with calcite, silty | 16 |
| 43. Dolomite, medium-gray, very fine grained, thick-bedded, laminated | 6 |
| 42. Dolomite, dark-gray, medium-grained, sugary, fetid, laminated | 2 |

Partial measured section of members 1 and 2, Jefferson Formation, on ridge south of Latest Out mine, Gilmore district, Lemhi County, Idaho--continued

| | | | Thickness (feet) |
|---|---|---|---|
| Jefferson Formation--continued | | | |
| Member 1--continued | | | |
| 41. | Dolomite breccia | Zone of small faults that thin member 1 about 50-75 ft (units 37-41) | 24 |
| 40. | Concealed | | 3 |
| 39. | Dolomite, dark-gray, very fine grained, medium-bedded, thinly laminated, fetid | | 8 |
| 38. | Concealed, probably underlain by sandstone similar to unit 35 | | 3 |
| 37. | Dolomite breccia | | 9 |
| 36. | Dolomite, similar to unit 34--------------------- | | 4 |
| 35. | Sandstone, light-gray, dolomitic, fine-grained, medium-bedded; quartz grains well-rounded------- | | 2 |
| 34. | Dolomite, medium-dark-gray, thin- and medium-bedded, very fine grained, thinly laminated, fetid----------------------------------------- | | 13 |
| 33. | Dolomite, similar to unit 23--------------------- | | 2 |
| 32. | Dolomite, similar to unit 24--------------------- | | 1.5 |
| 31. | Dolomite, similar to unit 23--------------------- | | 4 |
| 30. | Dolomite, similar to unit 24--------------------- | | 1 |

Partial measured section of members 1 and 2, Jefferson Formation on ridge south of Latest Out mine, Gilmore district, Lemhi County, Idaho--continued

| | | Thickness (feet) |
|---|---|---|
| Jefferson Formation--continued | | |
| Member 1--continued | | |
| 29. | Dolomite, similar to unit 23--------------------- | 4.5 |
| 28. | Dolomite, similar to unit 24--------------------- | 1.5 |
| 27. | Dolomite, similar to unit 23--------------------- | 10 |
| 26. | Dolomite, similar to unit 24--------------------- | 2 |
| 25. | Dolomite, similar to unit 23--------------------- | 5.5 |
| 24. | Dolomite, light-gray, thin-bedded, silty, locally contains mud chips, partly laminated----------- | 1.5 |
| 23. | Dolomite, dark-gray, thin- to thick-bedded, fetid, sugary, laminated------------------------------ | 12 |
| 22. | Dolomite, medium-dark-gray, medium-bedded, sugary- | 2 |
| 21. | Concealed, probably similar to units 19-20-------- | 20 |
| 20. | Dolomite, dark-gray, medium-bedded, fetid, sugary, laminated, stromatolitic----------------------- | 2 |
| 19. | Dolomite, medium-gray, very fine grained, medium- and thin-bedded, partly irregularly laminated--- | 5 |
| 18. | Sandstone, medium-gray, dolomitic, fine- to medium-grained---------------------------------------- | 1 |

Partial measured section of members 1 and 2, Jefferson Formation on ridge south of Latest Out mine, Gilmore district, Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 1--continued | |
| 17. Dolomite, similar to unit 14, irregularly laminated, stromatolitic---------------------------------- | 7 |
| 16. Dolomite, very-pale-orange, medium-bedded, sandy, quartz grains fine----------------------------- | 5 |
| 15. Dolomite, medium-dark-gray, medium-bedded, very fine grained------------------------------------ | 4 |
| 14. Dolomite, dark-gray, medium-bedded, laminated, sugary, fetid, vuggy---------------------------- | 2 |
| 13. Dolomite, medium-gray, medium-crystalline, medium-bedded, laminated, sugary, sandy--------- | 3 |
| 12. Dolomite, light-gray, thin-bedded, sandy--------- | 4 |
| 11. Sandstone, pale-yellowish-brown to pale-reddish-brown, medium- to thick-bedded, cross-laminated- | 3 |
| 10. Sandstone, light-gray, calcareous and dolomitic, thin bedded; sand is medium-grained, rounded, quartz------------------------------------------ | 3 |
| 9. Dolomite, similar to unit 2---------------------- | 10 |
| 8. Sandstone, light-gray, thin-bedded, calcareous---- | 1 |

Partial measured section of members 1 and 2, Jefferson Formation on ridge south of Latest Out mine, Gilmore district, Lemhi County, Idaho--continued

| | Thickness (feet) |
|---|---|
| Jefferson Formation--continued | |
| Member 1--continued | |
| 7. Dolomite, similar to unit 2---------------------- | 5 |
| 6. Sandstone, light-gray to pale-red, calcareous, medium-bedded; sand is fine- to medium-grained-- | 4 |
| 5. Concealed, probably underlain by sandstone-------- | 7 |
| 4. Dolomite, similar to unit 2---------------------- | 2.5 |
| 3. Sandstone, similar to unit 1--------------------- | 1.5 |
| 2. Dolomite, medium-dark-gray, finely laminated, fetid, sugary, medium-bedded------------------- | 5 |
| 1. Sandstone, light-gray, calcareous and dolomitic, medium- to thick-bedded; sand grains well-rounded, fine----------------------------------- | 3 |
| Measured thickness of member 1, excluding fault zone-------------------------------- | 217.5 |

Laketown Dolomite (Silurian):

Light-gray, medium-crystalline, thick-bedded, vuggy dolomite.

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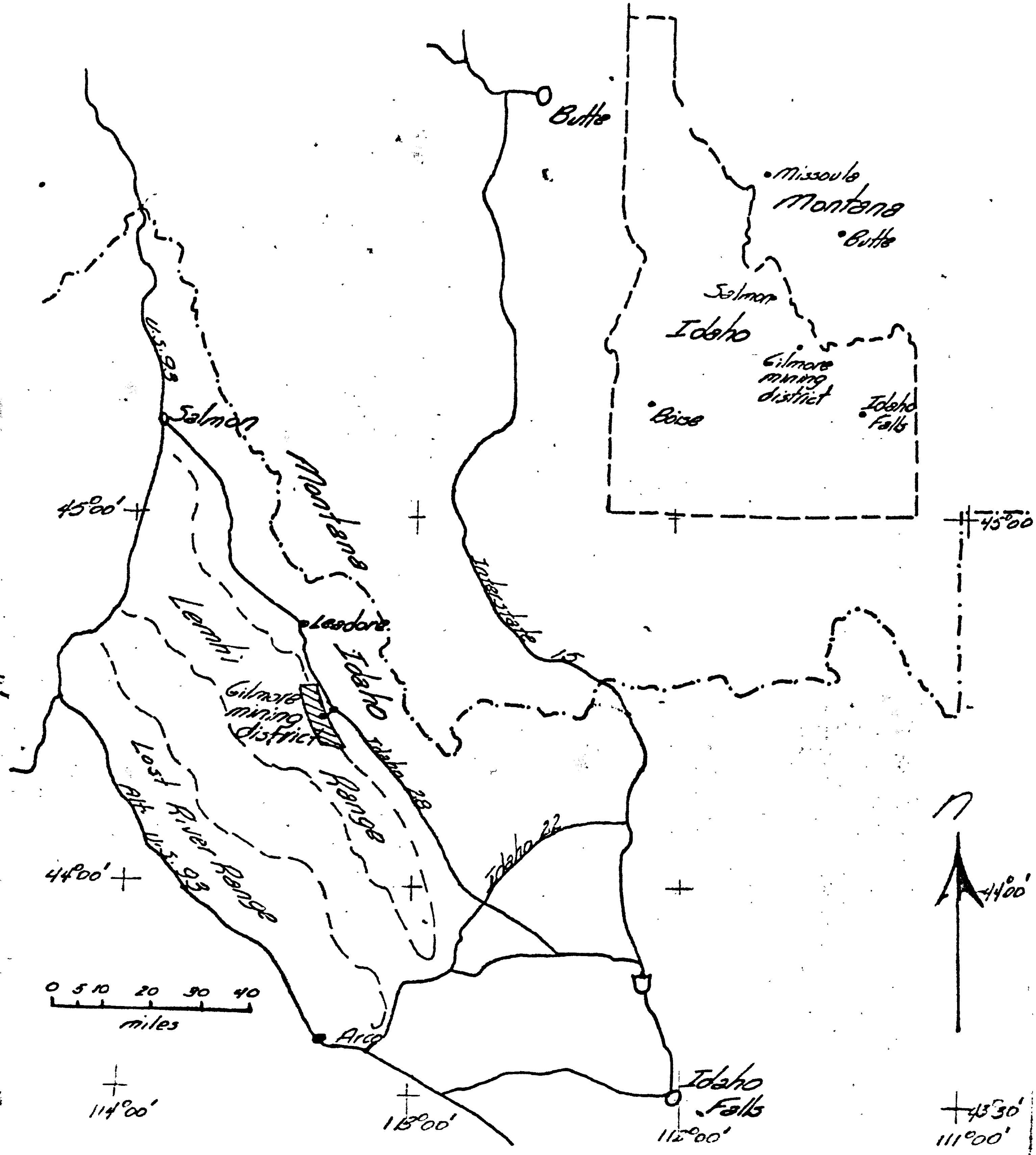
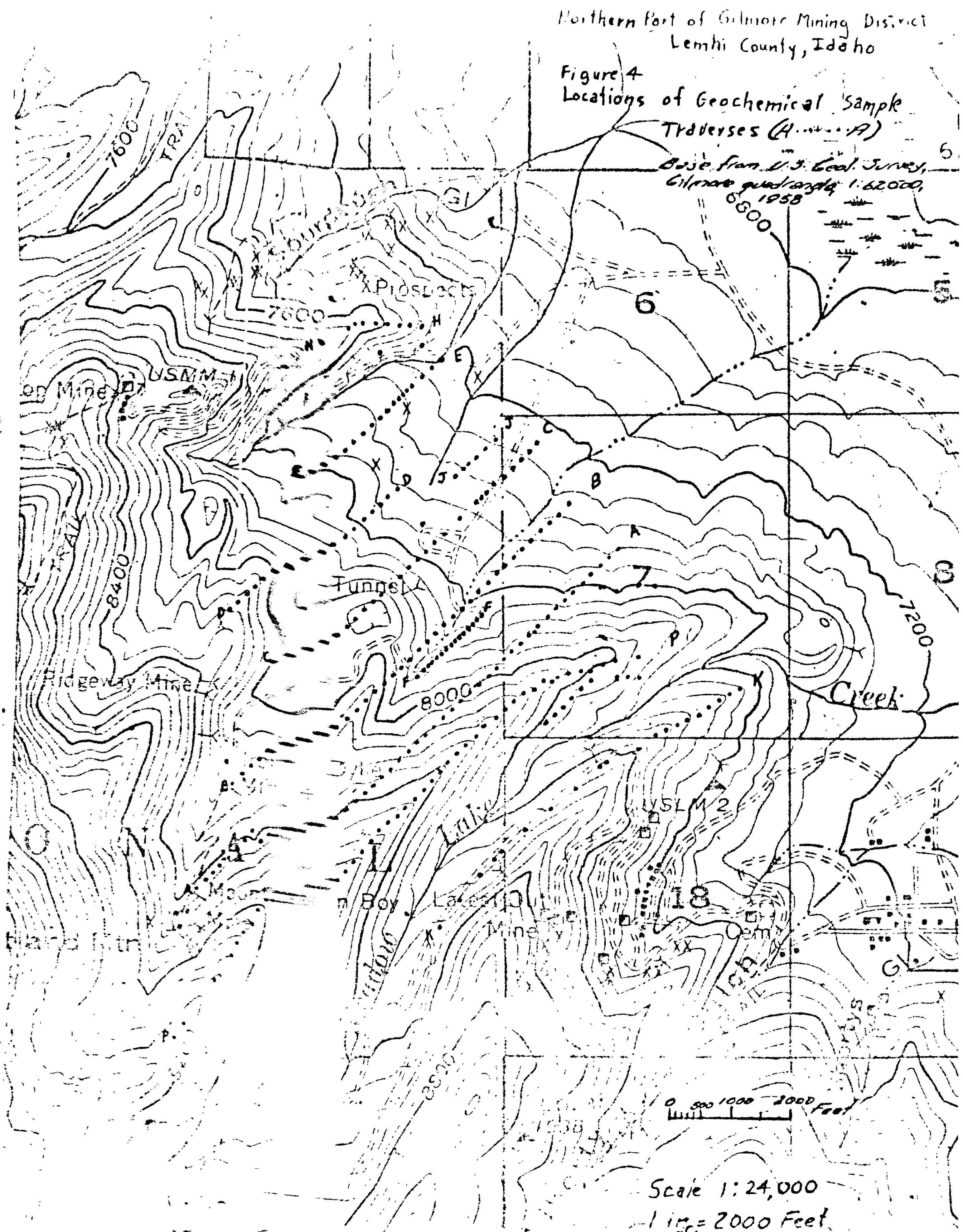
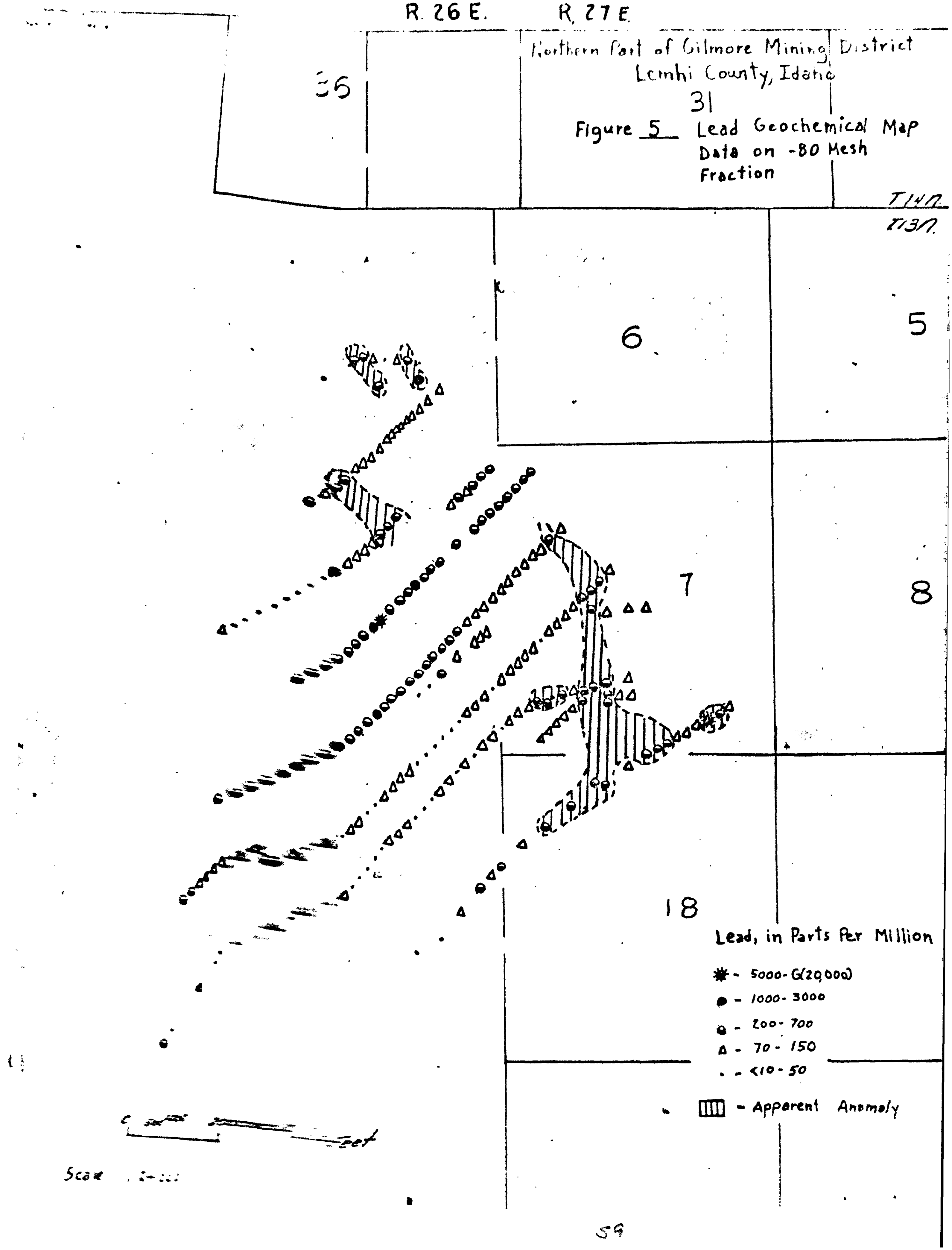


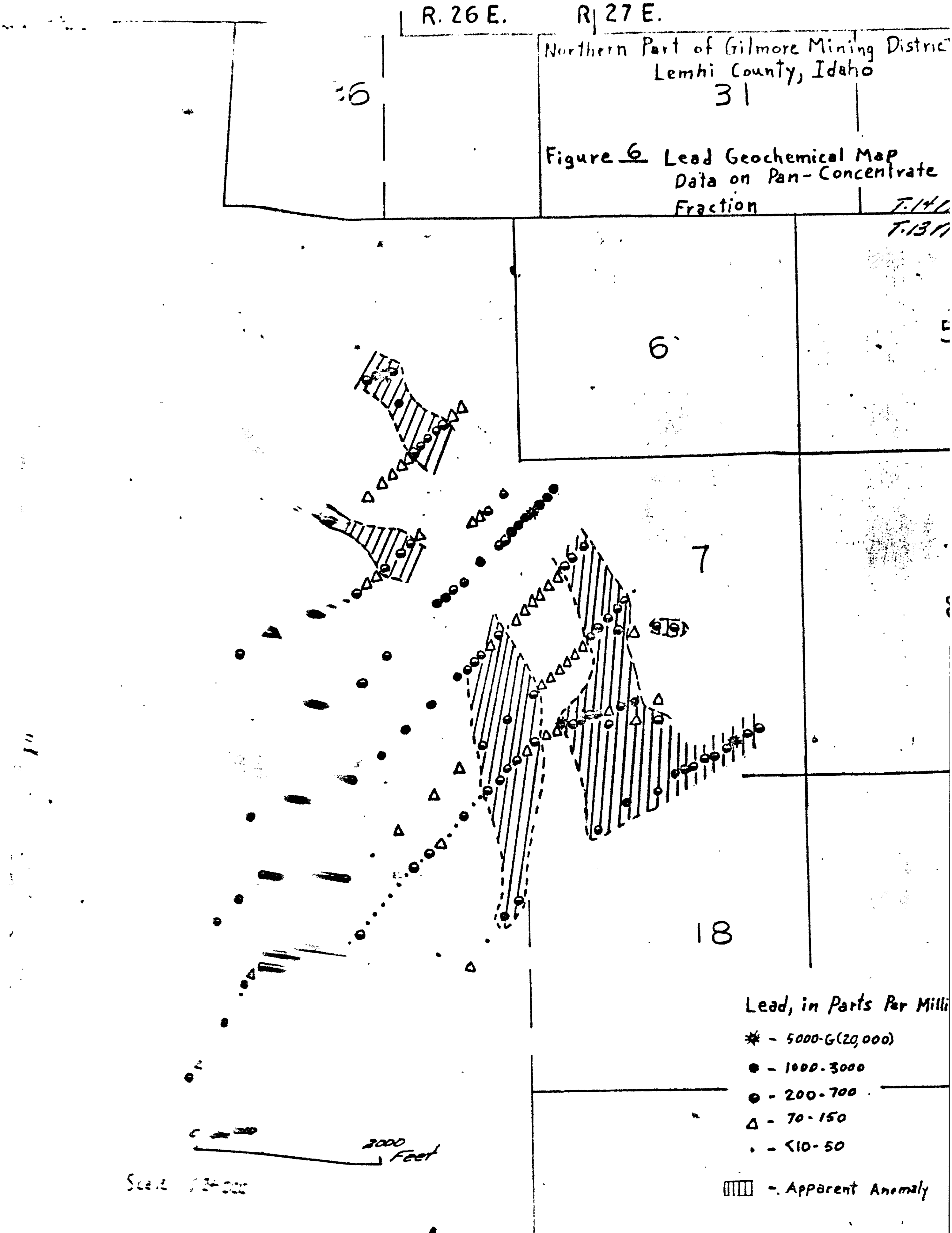

Fig. 1, Index map, showing location of Gilmore (Texas) mining district Lemhi County, Idaho

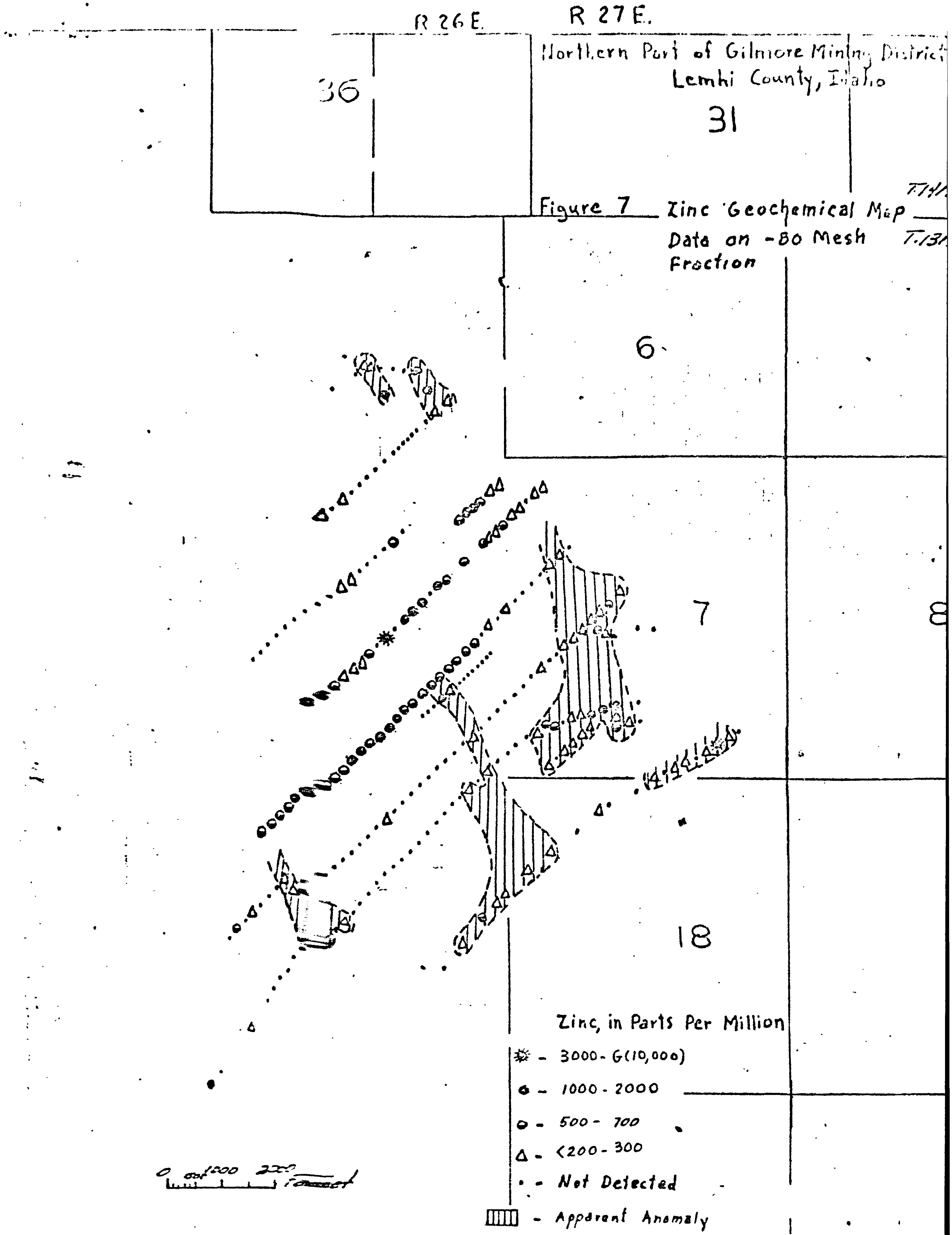


Northern Part of Gilmore Mining District
Lemhi County, Idaho
Figure 4
Locations of Geochemical Sample Traverses (A.......A)
Base from U.S. Geol. Survey, Gilmore quadrangle 1:62000, 1958
7600
Prospects
USMM
Tunnel
Ridgeway Mine
8400
8000
6600
7200
Creek
USLM 2
6
7
18
Cem
0 500 1000 2000 Feet
Scale 1:24,000
1 in = 2000 Feet



R. 26 E.
R. 27 E.
Northern Part of Gilmore Mining District
Lemhi County, Idaho
Figure 5 Lead Geochemical Map
Data on -80 Mesh
Fraction
36
31
T14N.
T13N.
6
5
7
8
18
Lead, in Parts Per Million
- 5000-G(20,000)
- 1000-3000
- 200-700
- 70-150
- <10-50
- Apparent Anomaly


R. 26 E.
R. 27 E.
Northern Part of Gilmore Mining District
Lemhi County, Idaho
Figure 6 Lead Geochemical Map
Data on Pan-Concentrate Fraction
36
31
6
7
18
T.14 N.
T.13 N.
Lead, in Parts Per Million
- 5000-G(20,000)
- 1000-3000
- 200-700
- 70-150
- <10-50
- Apparent Anomaly
2000 Feet


R 26 E.
R 27 E.
Northern Part of Gilmore Mining District
Lemhi County, Idaho
36
31
Figure 7 Zinc Geochemical Map
Data on -80 Mesh Fraction
6
7
8
18
Zinc, in Parts Per Million
3000 - G(10,000)
1000 - 2000
500 - 700
<200 - 300
Not Detected
Apparent Anomaly
0 1000 2000 Feet

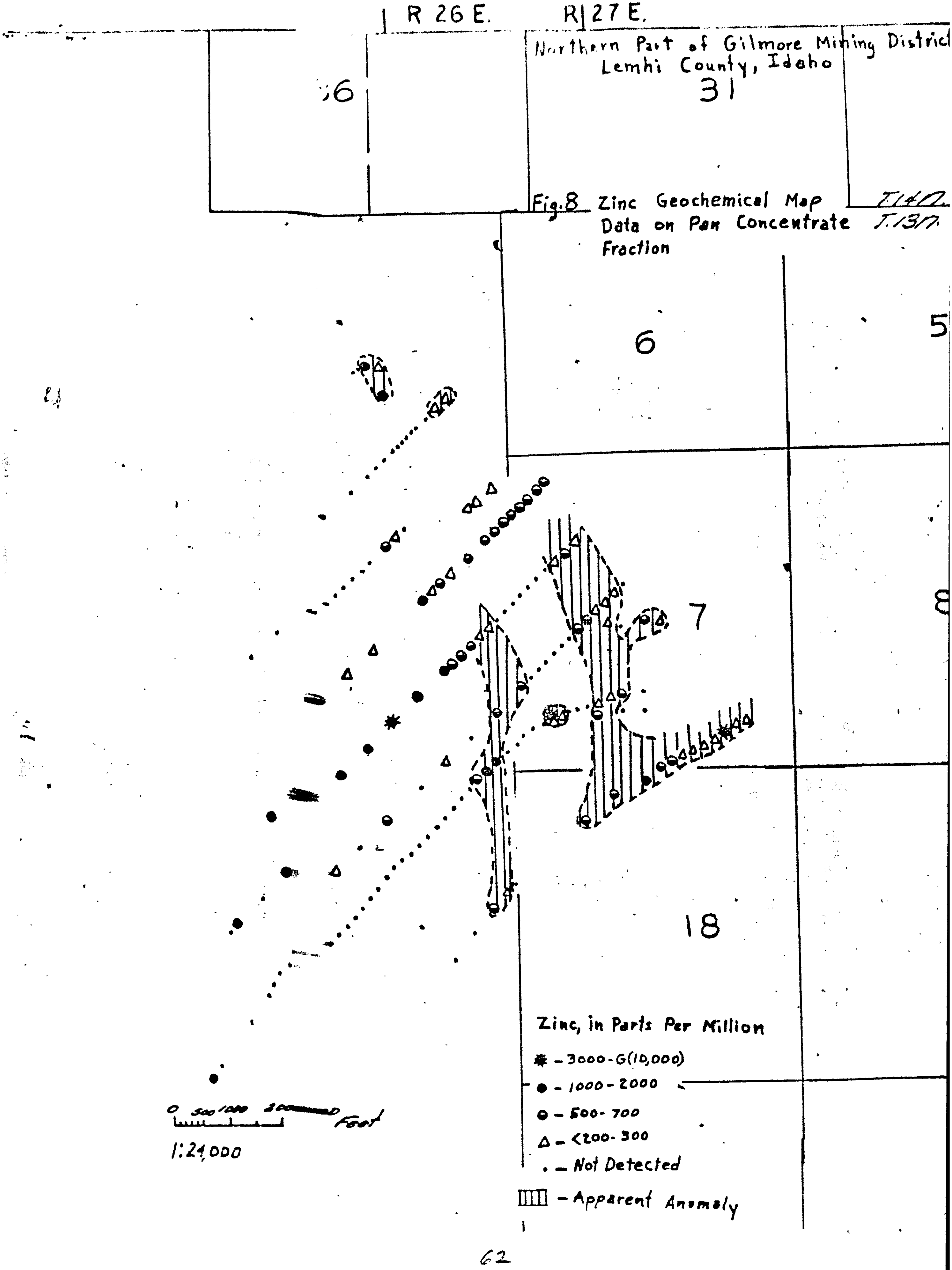
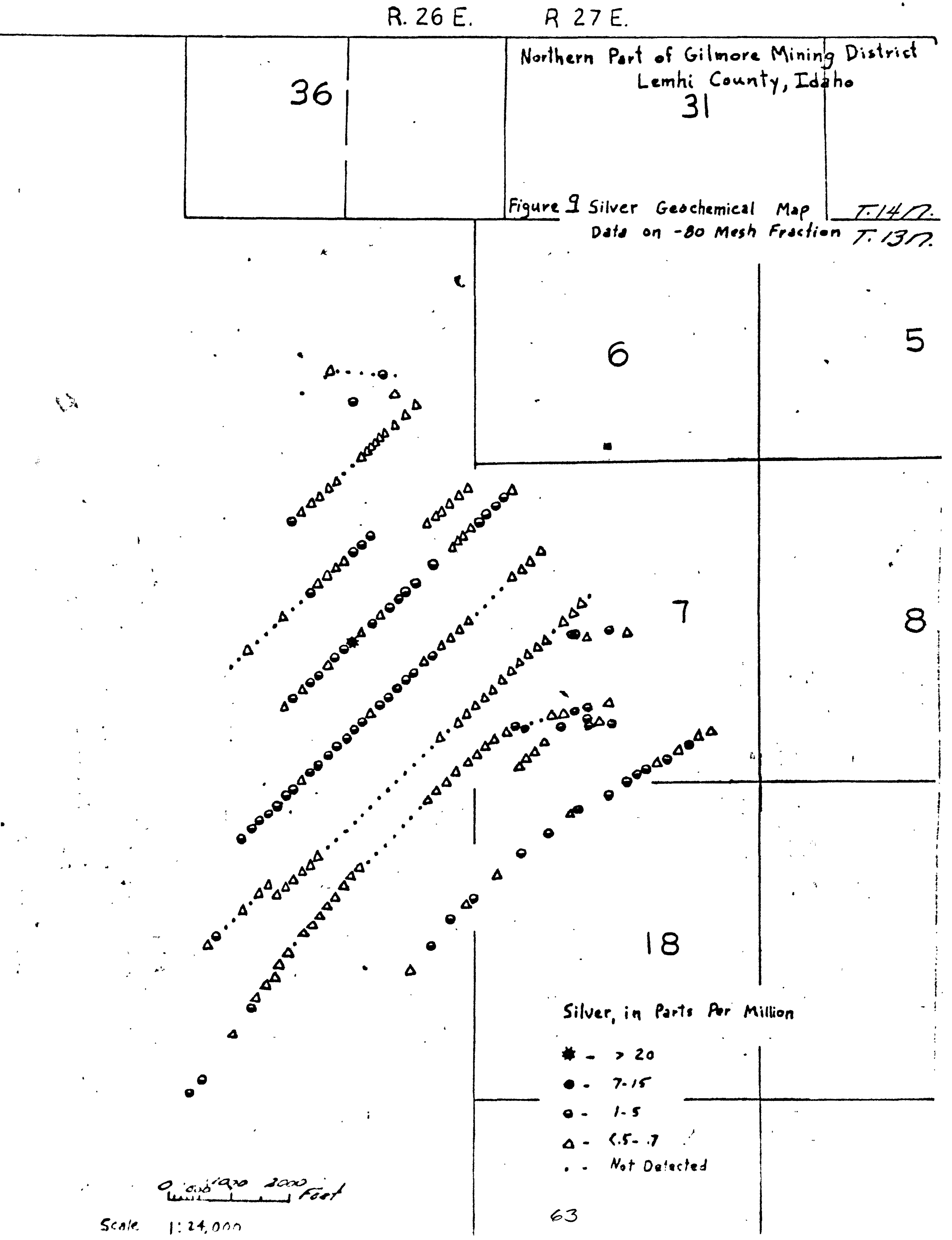



Fig. 8 Zinc Geochemical Map Data on Pan Concentrate Fraction


R. 26 E.
R 27 E.
Northern Part of Gilmore Mining District
Lemhi County, Idaho
36
31
Figure 9 Silver Geochemical Map
Data on -80 Mesh Fraction
T. 14 N.
T. 13 N.
6
5
7
8
18
Silver, in Parts Per Million
> 20
7-15
1-5
<.5-.7
Not Detected
Feet
Scale 1:24,000

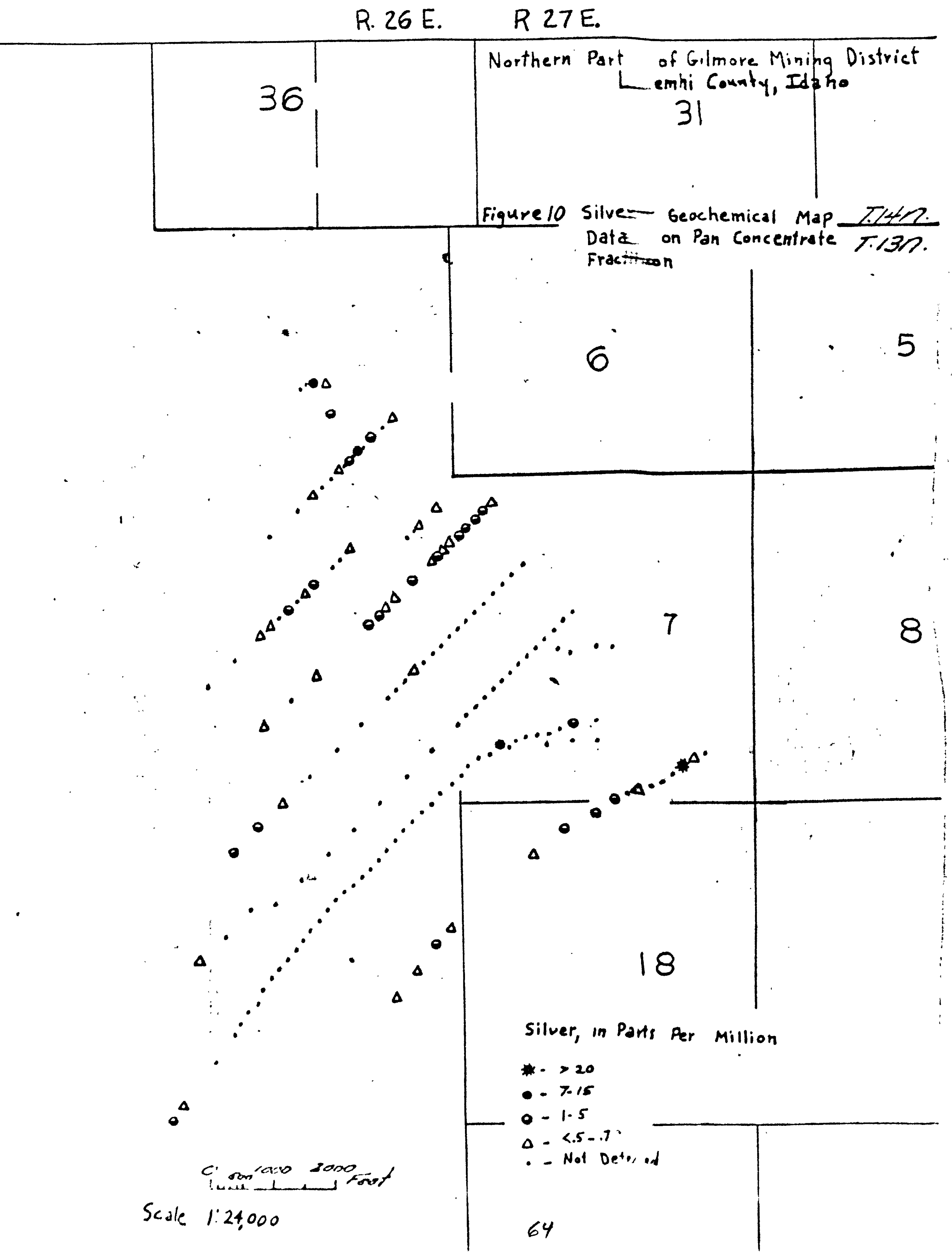
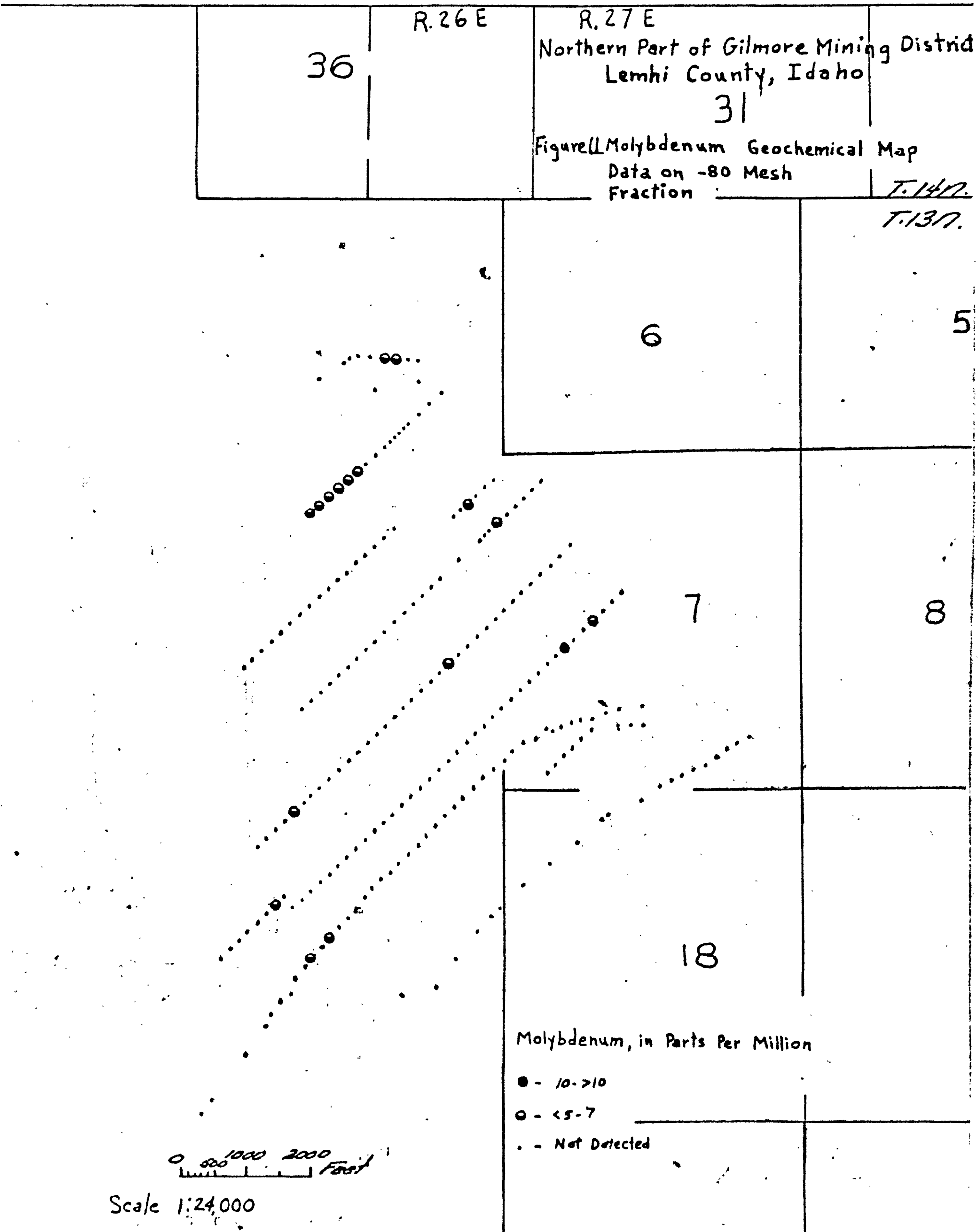
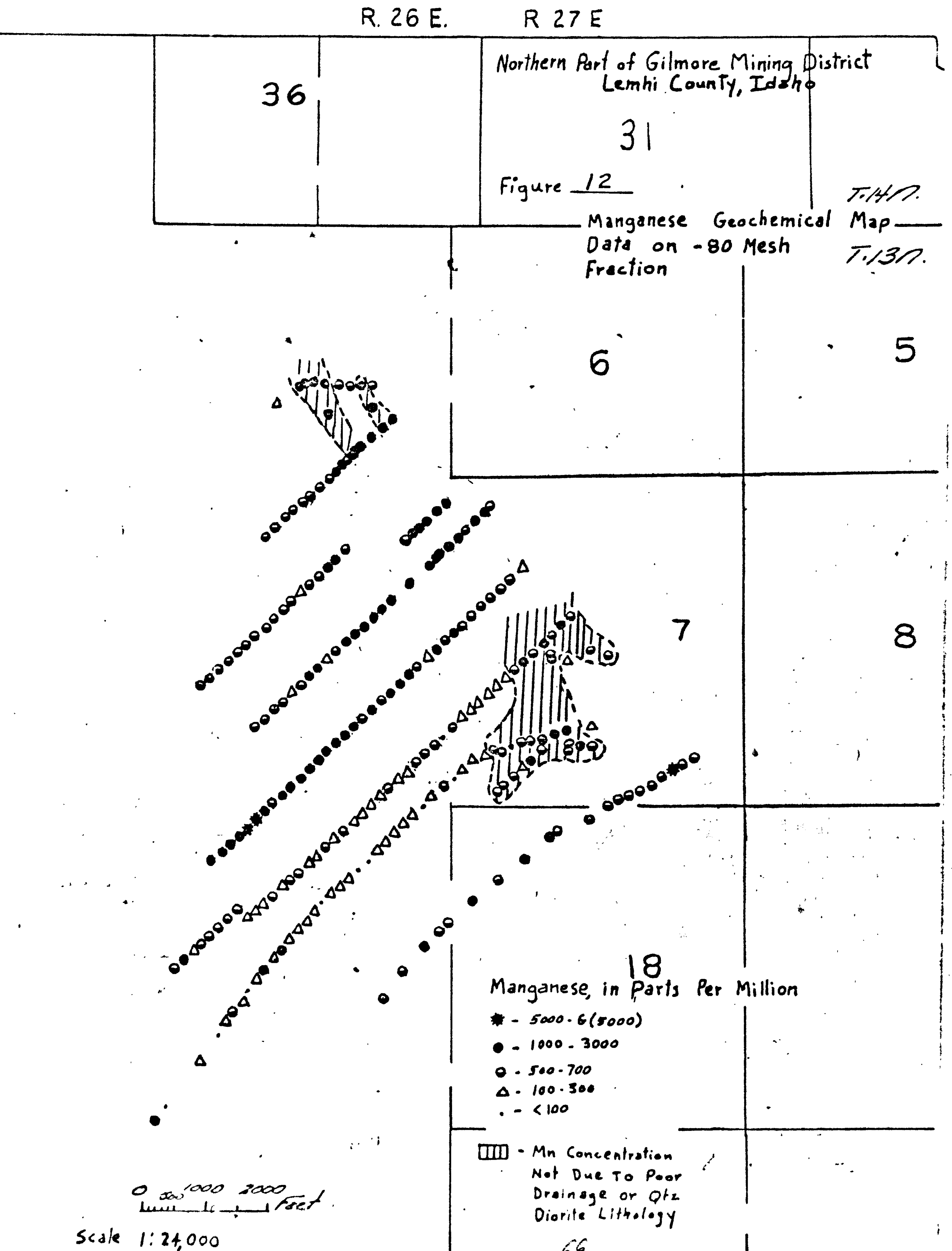



Figure 10 Silver Geochemical Map Data on Pan Concentrate Fraction



R. 26 E
R. 27 E
Northern Part of Gilmore Mining District
Lemhi County, Idaho
Figure 11 Molybdenum Geochemical Map
Data on -80 Mesh Fraction
T. 14 N.
T. 13 N.
36
31
6
5
7
8
18
Molybdenum, in Parts Per Million
● - 10->10
◉ - <5-7
. - Not Detected
0 500 1000 2000 Feet
Scale 1:24,000


R. 26 E.
R 27 E
Northern Part of Gilmore Mining District
Lemhi County, Idaho
36
31
Figure 12
T.14N.
T.13N.
Manganese Geochemical Map
Data on -80 Mesh Fraction
6
5
7
8
18
Manganese, in Parts Per Million
- 5000-6(5000)
- 1000 - 3000
- 500-700
- 100-300
- < 100
- Mn Concentration Not Due To Poor Drainage or Qtz Diorite Lithology
0 500 1000 2000 Feet
Scale 1:24,000

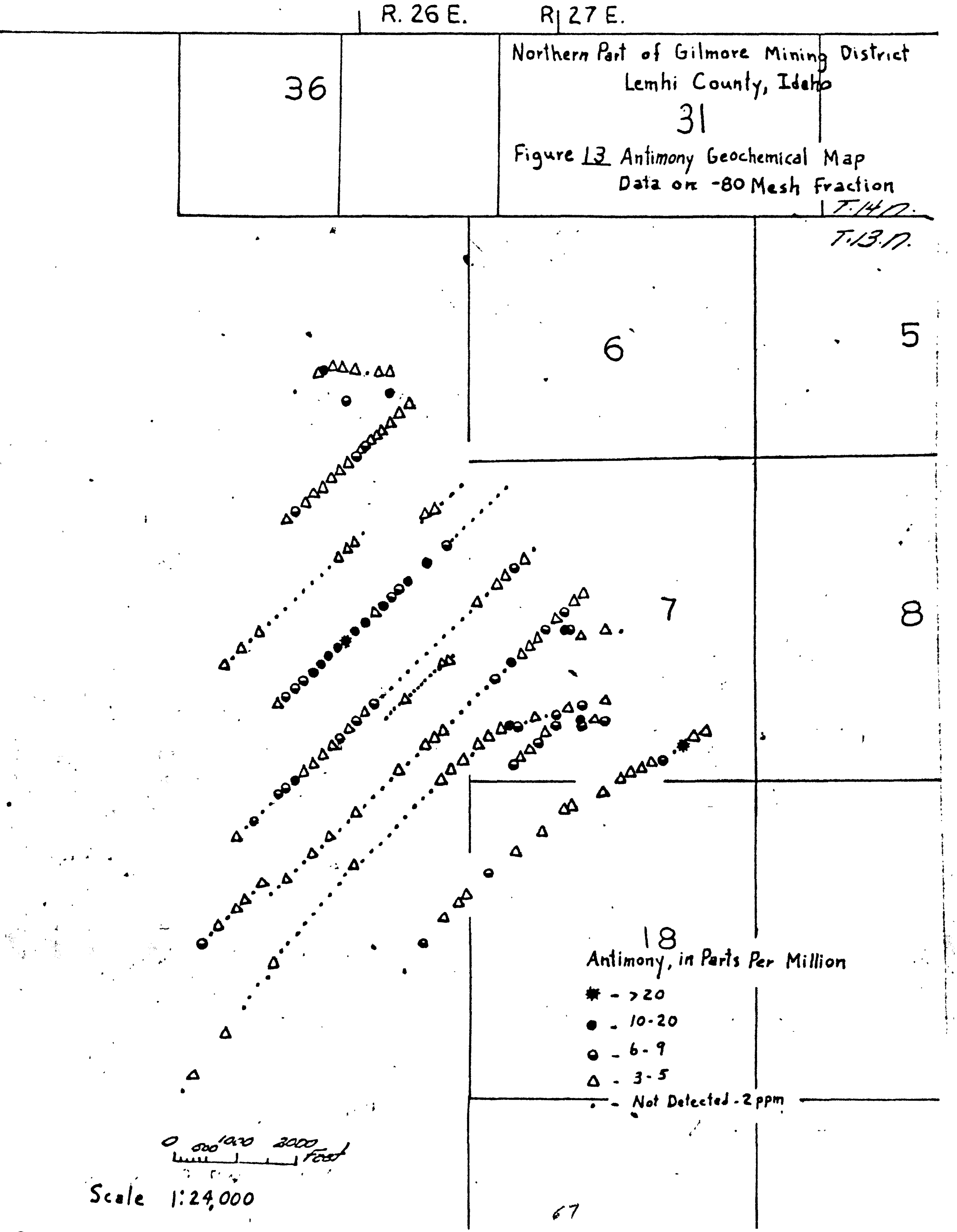
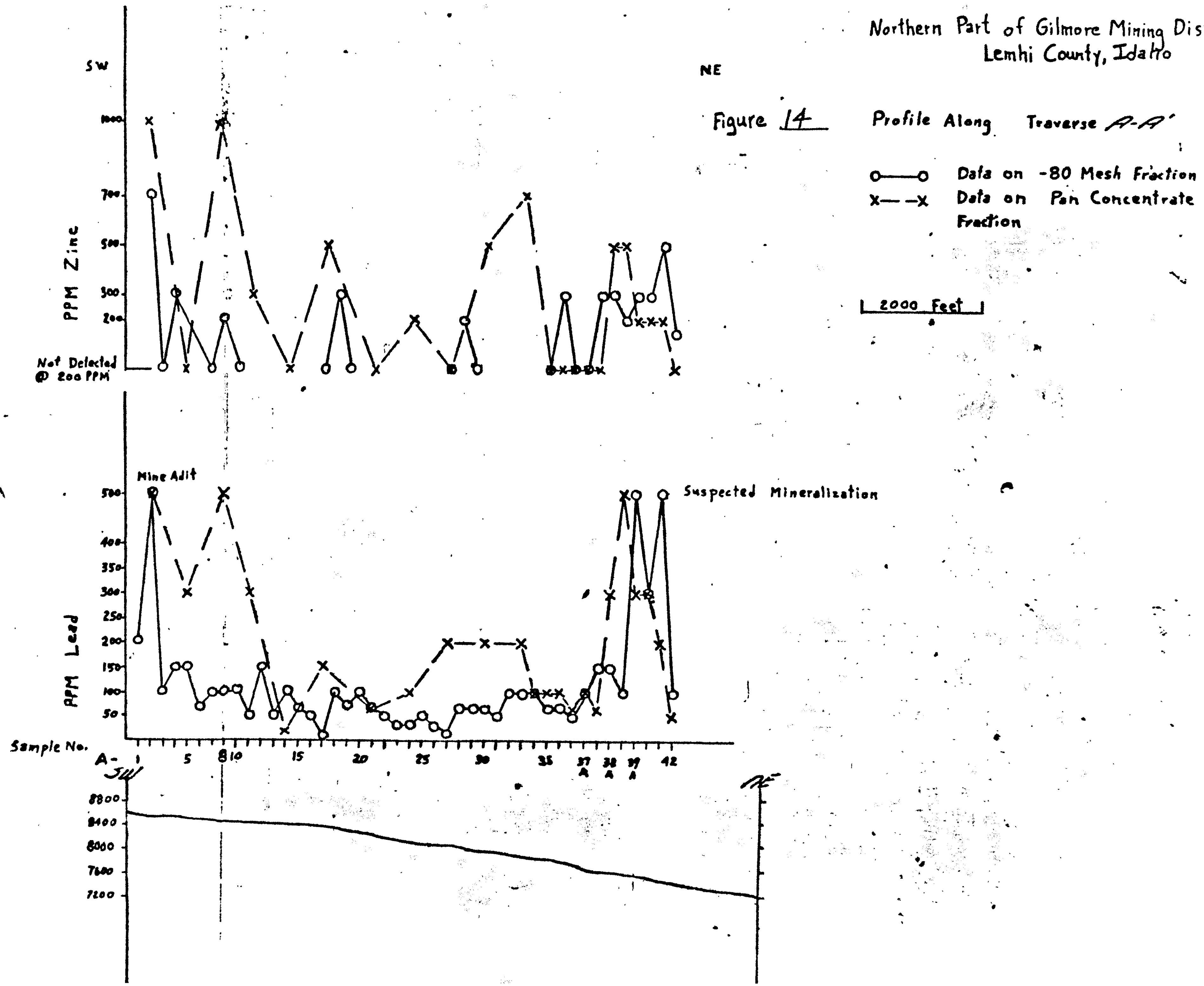
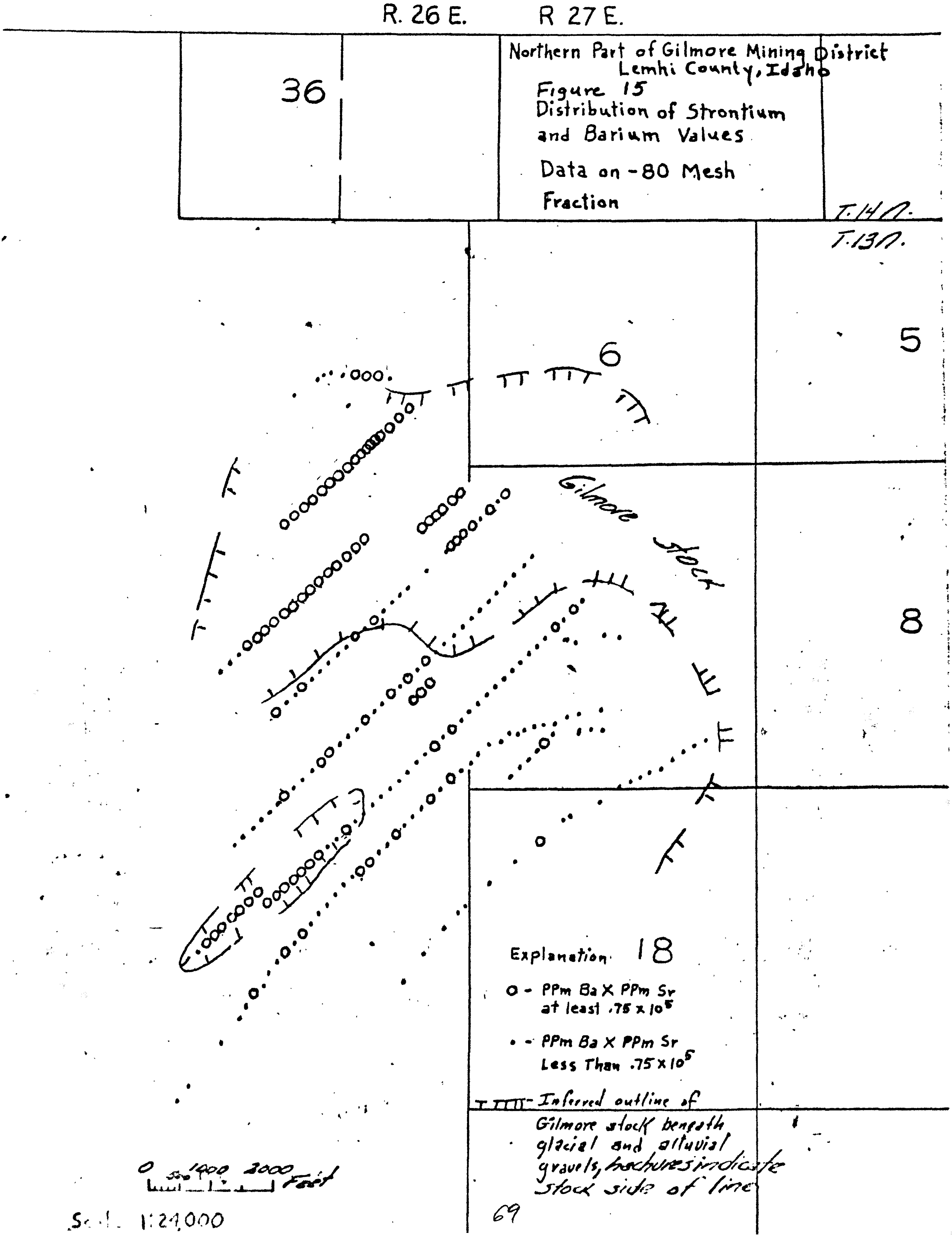



Figure 13 Antimony Geochemical Map
Data on -80 Mesh Fraction

# Northern Part of Gilmore Mining District
Lemhi County, Idaho

Figure 14 Profile Along Traverse A-A'




R. 26 E.
R 27 E.
Northern Part of Gilmore Mining District
Lemhi County, Idaho
Figure 15
Distribution of Strontium and Barium Values
Data on -80 Mesh Fraction
T. 14 N.
T. 13 N.
36
6
5
8
18
Gilmore Stock
Explanation
o - PPm Ba X PPm Sr at least .75 x 10^5
• - PPm Ba X PPm Sr Less Than .75 x 10^5
Inferred outline of Gilmore stock beneath glacial and alluvial gravels, hachures indicate stock side of line
0 1000 2000 Feet
Scale 1:24,000

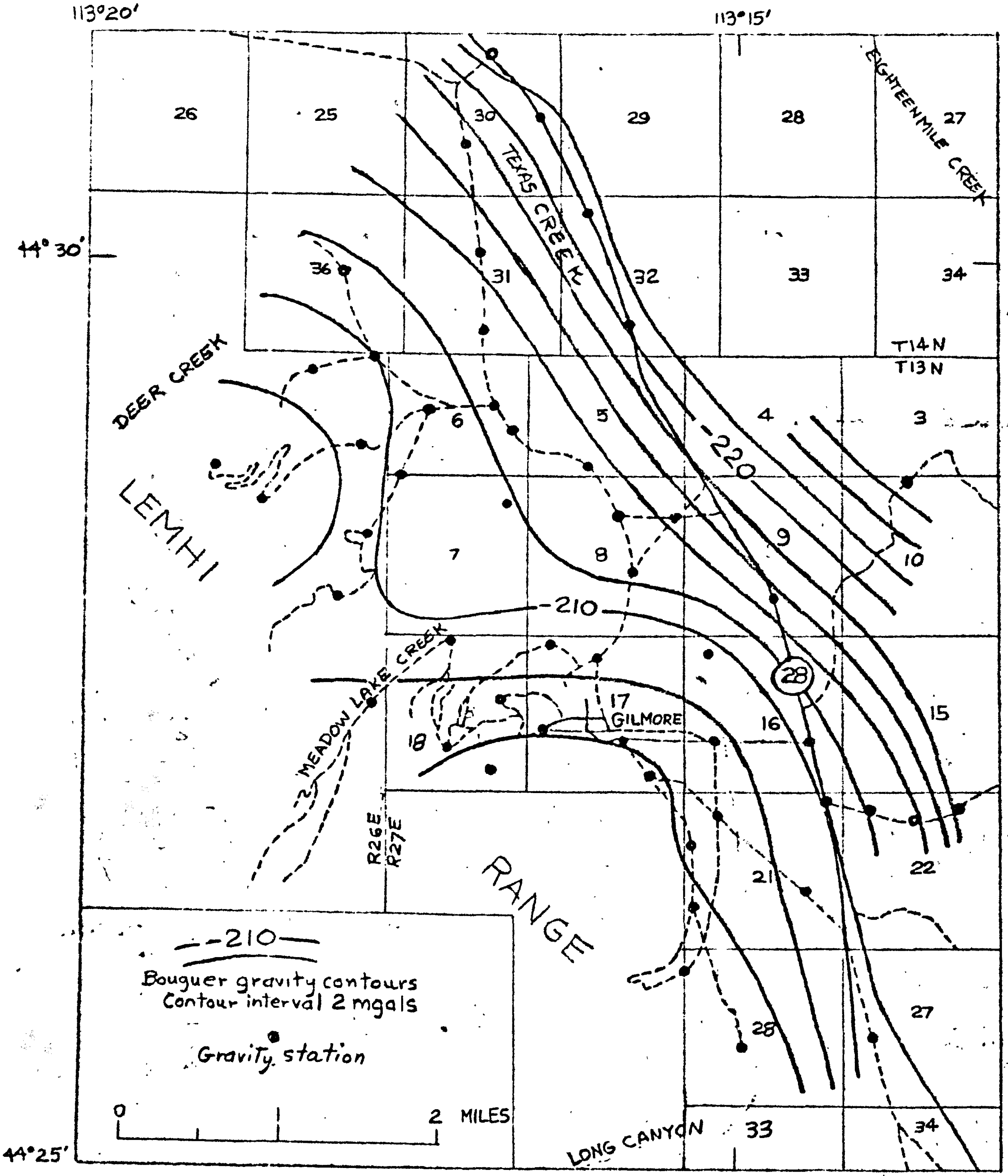



Figure 16. Bouguer gravity map at Gilmore, Idaho and vicinity.

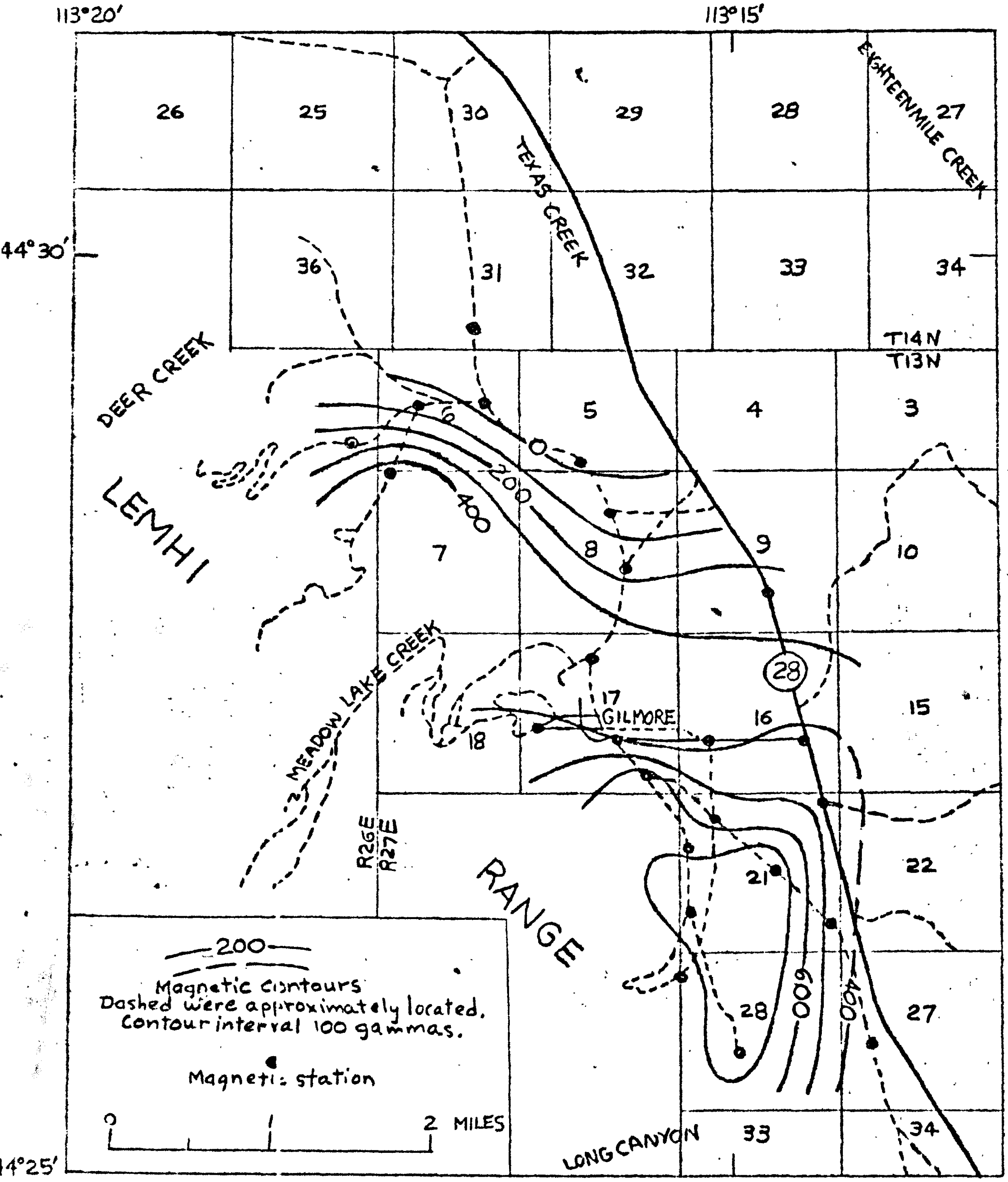



Figure 17. Ground magnetic map at Gilmore, Idaho and vicinity.

(200)
R290
no. 1420
70-292


Explanation

Inferred direction of ice movement

Approximate medial zone between Meadow Lake and Mountain Boy glaciers

Approximate margin of moraine

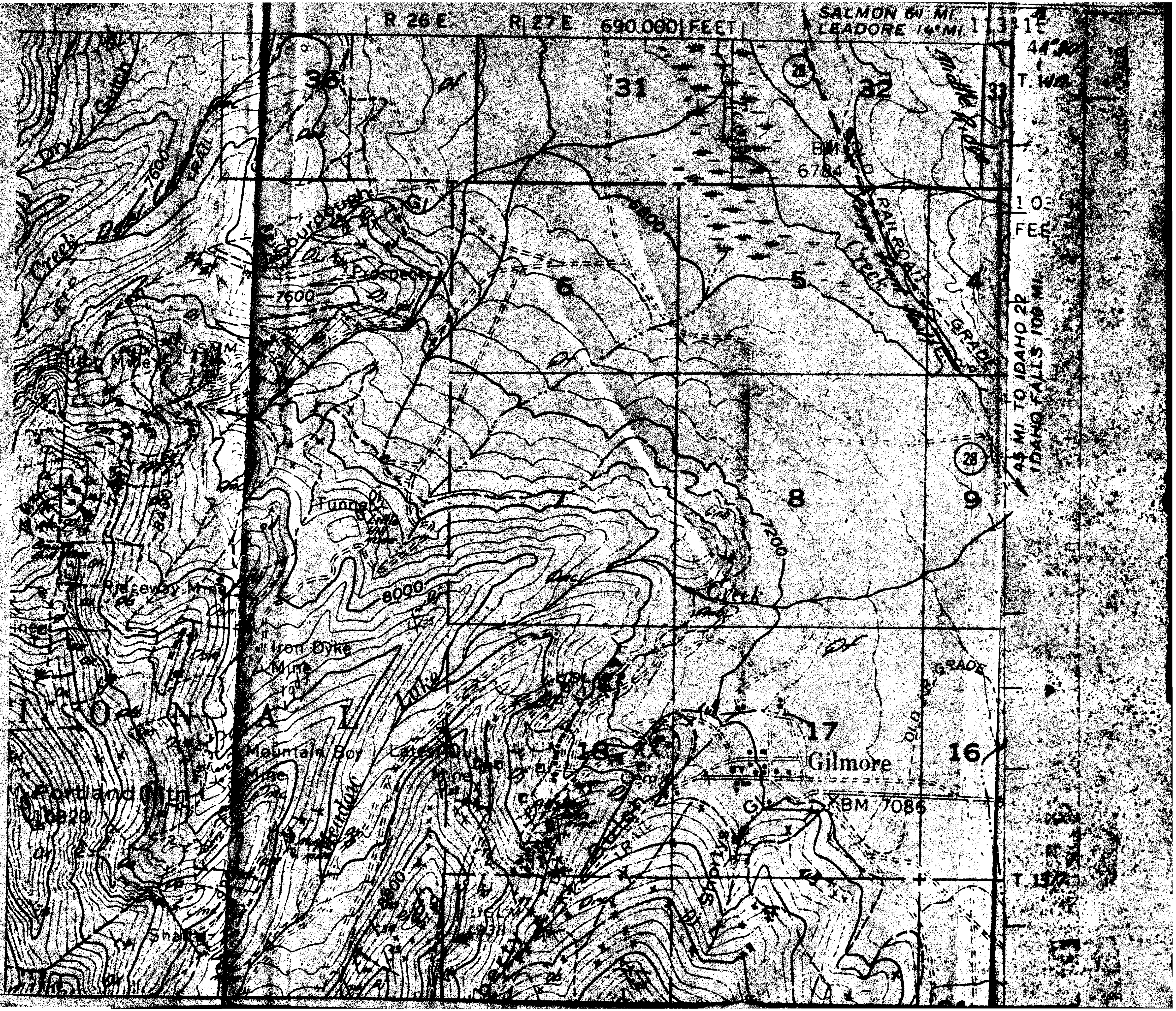
Zone of main veins, projected beneath glacial deposits

Geochemical sample traverse

Scale: 1:24,000

1 in = 2,000 ft

Figure 3. Map of morainic deposits and directions of ice movement, northern part of Gilmore mining district Lemhi County, Idaho. Base from U.S. Geological Survey, Gilmore quadrangle, 1:62,500, 1958.


R 26 E
R 27 E
690 000 FEET
SALMON 64 MI.
LEADORE 14 MI.
T. 14 N.
T. 13 N.
36
31
32
33
6
5
4
7
8
9
18
17
16
28
BM
6784
RAILROAD
GRADE
Creek
Dry
Gulch
Prospect
Tunnel
7600
8000
7200
6800
Iron Dyke
Mine
Mountain Boy
Mine
Latest Out
Mine
Ridgeway Mine
Lake
Gilmore
XBM 7086
OLD
GRADE
45 MI. TO IDAHO 22
IDAHO FALLS 100 MI.
Portland Mtn
10820
Shorty's

## Explanation

**Qf**

Alluvial fan, outwash fan, and pediment veneer gravels

Pediment veneer gravels may be as old as Miocene

**Qa**

Avalanche deposits

**Qls**

Landslide deposits

**Qmc**

**Qmb**

Glacial deposits

Qmc, younger glacial deposits

Qmb, older glacial deposits

Quaternary

**[illegible]**

Cemented gravel near Gilmore

**Ta**

Andesitic intrusive rocks

**qd**

Quartz diorite and granodiorite

Tertiary(?)

(200)
R290
no. 1420
70-282

Dj

Jefferson Formation

Sl

Laketown Dolomite

Osm

Saturday Mountain Formation

Ok

Kinnikinic Quartzite

Devonian

Silurian

Ordovician

Contact

Dashed where approximately located; short dashed where indefinite; dotted where concealed

Fault

Dashed where approximately located; short dashed where indefinite or inferred

Anticline showing crestline

Syncline showing troughline

40

Strike and dip of beds

Strike and dir of overturned beds

Strike of vertical beds

Vein

Shaft

Adit

Caved adit

Mine or prospect

Figure 2, Geologic map of part of the Gilmore (Texas) mining district, Lemhi County, Idaho. Base from U.S. Geological Survey, Gilmore quadrangle, 1:62,500, 1958. Geology mapped 1968-69 by E. T. Ruppel, assisted by M. F. Gregorich and R. G. Tysdal.

Scale

0 500 2000 Feet

1:24,000

1 in = 2,000 ft