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James Doyle Sell Mining Collection

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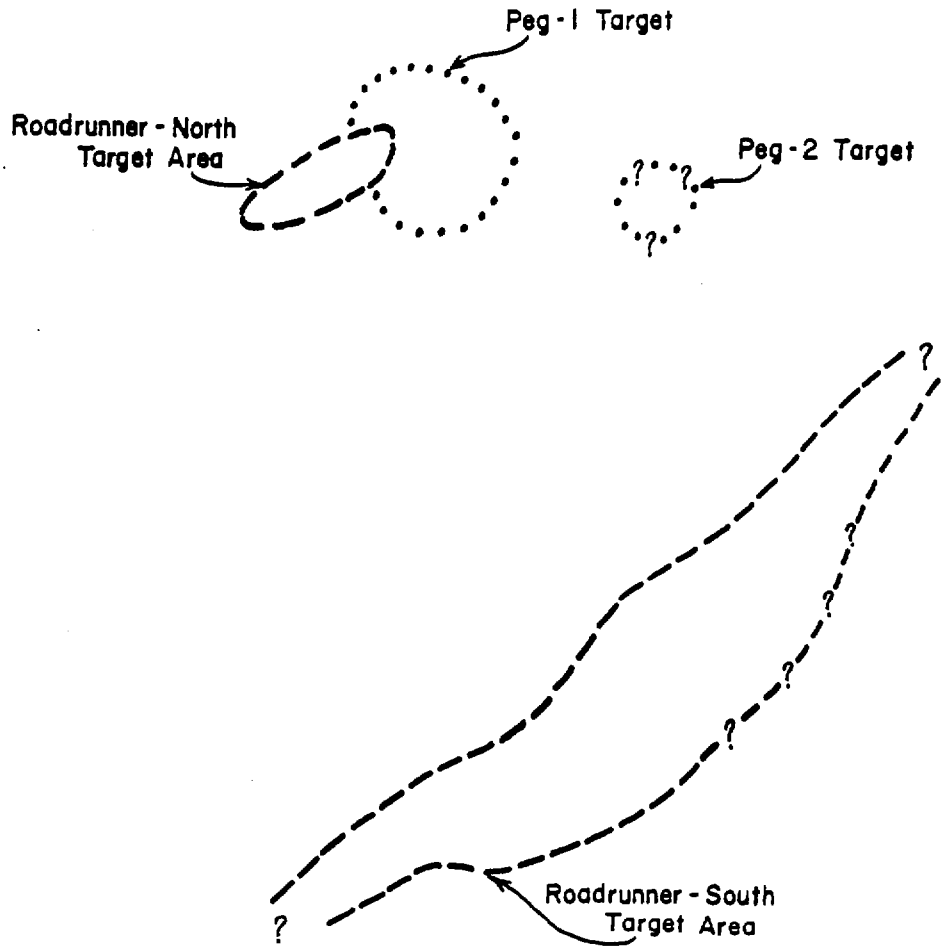
May 1990

Property Name:	Roadrunner
Location:	Sections 15, 16, 17, 20, 21, 22 and 28, T28N, R18W Mohave County, Arizona
Acreage:	Approximately 2100 acres
Land Status:	76 unpatented lode claims located by ECM. 27 unpatented lode claims and 2 patented claims held by lease.
Underlying Royalty:	3% on leased lands.
Work to Date:	The Roadrunner property includes several of the past-producing gold mines in the Gold Basin district. In addition, numerous lode and placer prospects, that were explored at several times in the past, denote the widespread nature of gold mineralization at Roadrunner. A USGS regional study of gold mineralization in the Gold Basin district concludes that the geochemical signature of gold from the placers is similar to gold samples from some porphyry copper deposits. ECM mapping and sampling in 1989 has already defined at least three gold anomalous zones that are likely to quickly evolve to exploration target status.
Target:	Multiple exploration targets at Roadrunner consist of the following primary types: 1) shear zone hosted and intrusive contact related auriferous sulfide systems at two locations, and 2) possible pegmatite (leucogranite) and fracture system related low-sulfide gold systems similar to the Picacho mine deposit in SE California.
Positive Data:	High-grade gold deposits localized by major fissures that formed along a large, regional shear zone. An abundance of fracture related gold anomalies spatially associated with the contact zone of a granodiorite pluton and leucocratic pegmatites. Broad dispersion of silification, Fe-carbonates, K-rich silicates, and limonites accompanied by anomalous concen-trations of gold, arsenic, and base metals.



TARGET AREAS

SCALE: 1" = 2000'

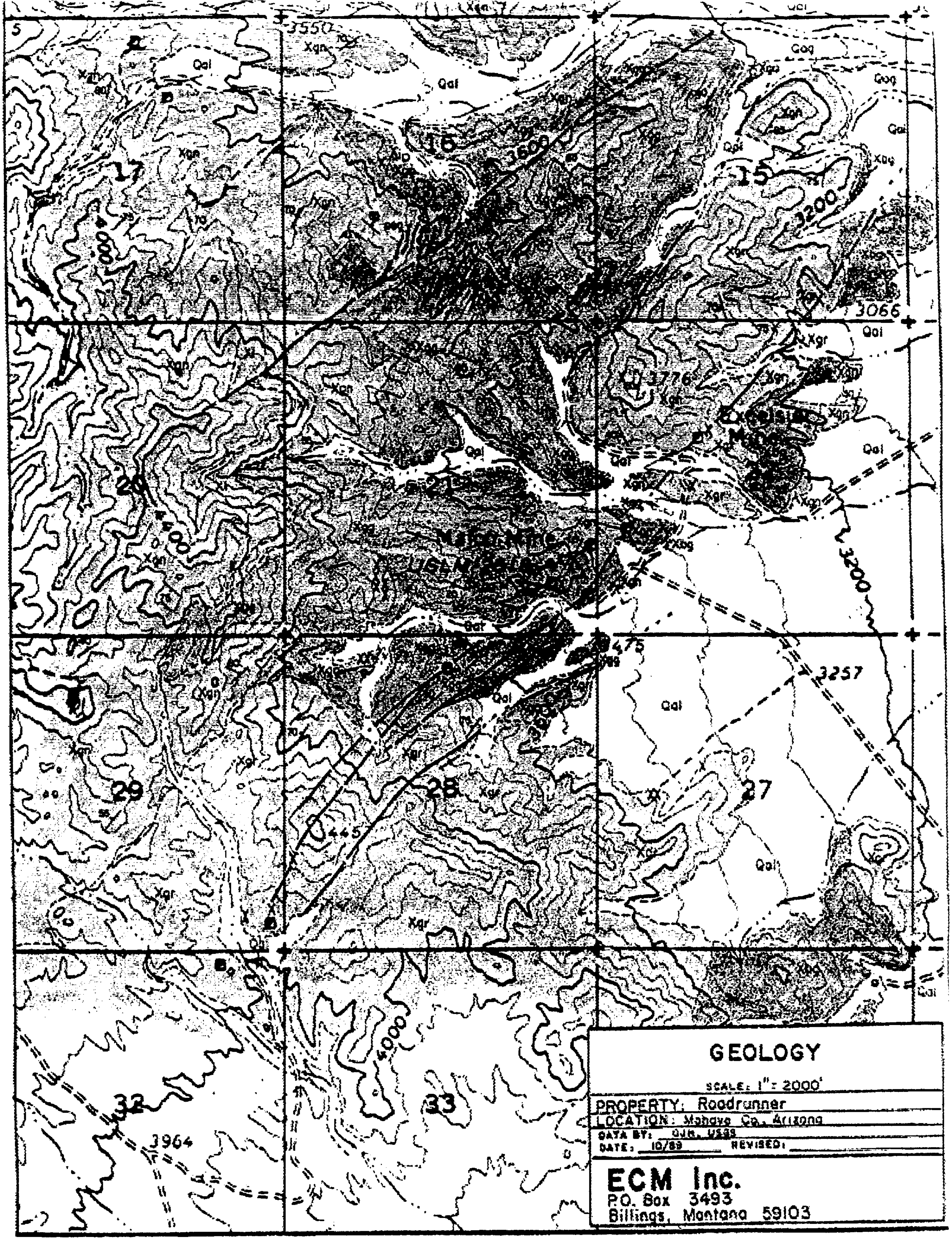
PROPERTY: Roadrunner

LOCATION: Mohave Co., Arizona

DATA BY: GJH

DATE: 10/89 REVISED:

ECM Inc.
P.O. Box 3493
Billings, Montana 59103


GEOLOGY
SCALE: 1" = 2000'
PROPERTY: Roadrunner
LOCATION: Mohave Co., Arizona
DATA BY: GJH, USGS
DATE: 10/89 REVISED:
ECM Inc.
P.O. Box 3493
Billings, Montana 59103
16
17
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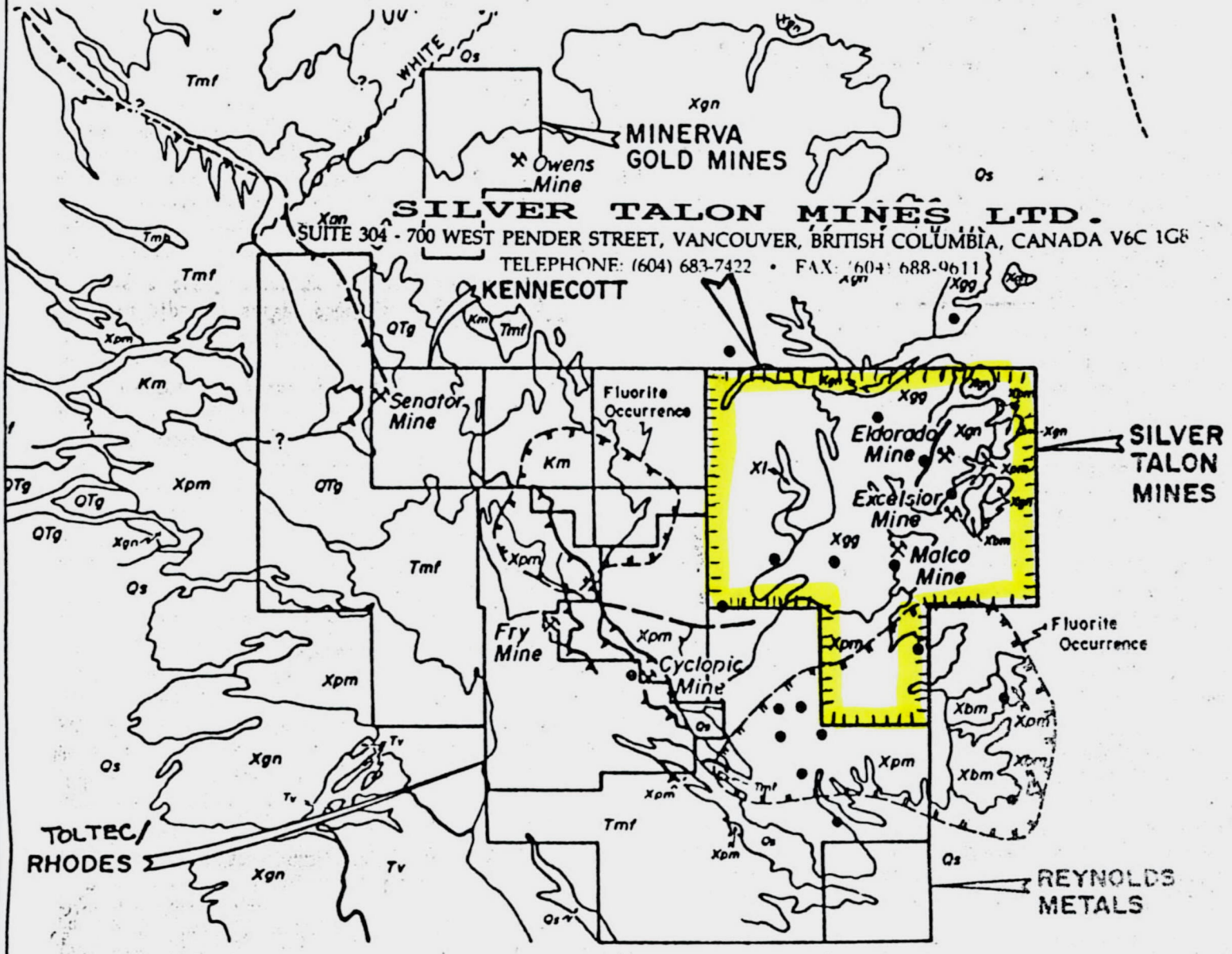
3550
3600
3200
4000
3066
3776
3475
3257
3445
3964
Excelsior Mine
Qal
Xgn
Xgr

GEOLOGY and LAND HOLDINGS in the GOLD BASIN DISTRICT

Mojave County ; Arizona



Os	Sedimentary deposits (Quaternary)	Xgg	Gneissic granodiorite (Early Proterozoic)
QTg	Conglomerate (Quaternary and (or) Tertiary)	Xl	Leucogranite (Early Proterozoic)
Tmb	Basalt	Xml	Migmatitic leucogranite complex (Early Proterozoic)
Tmf	Conglomerate - alluvial conglomeratic deposits	Xgn	Gneiss (Early Proterozoic)
Tv	Volcanic rocks (Tertiary)		
Km	Two-mica monzogranite (Cretaceous)		
Xpm	Porphyritic monzogranite of Garnet Mountain (Early Proterozoic)		

Contact (defined, assumed)

Fault (defined, approximate, concealed)

Detachment Fault - teeth on upper plate (defined, approximate, concealed)

month period to $3,000. Immigration fund sales have [illegible]

FOR THE RECORD

[redacted]

Roadrunner Property
Sections 15-16-17-
20-21-22-
27-28-
T. 28N R 18W
White Hills Area
Gold Basin District
Mohave Co, AZ

ROADRUNNER PROPERTY

EMC Inc.

Mohave County, Arizona

Gordon J. Hughes, Jr.

ECM, Inc.

November, 1989

ROADRUNNER PROPERTY

Mohave County, Arizona

Location - The Roadrunner property is located near the southeastern corner of the White Hills in northwestern Mohave County, approximately 65 miles north of Kingman, Arizona. Access from Kingman is 30 miles north on U.S. highway 93 to the Pierce Ferry road, then northeast for a distance of about 20 miles to the Malco mine road which is traveled for about another four miles to the southern edge of the property. There are several old mine roads on the property as well as a number of more primitive trails passable by four-wheel drive vehicles.

The Roadrunner property is located on the Garnet Mountain 15-minute topographic sheet.

Land Status - ECM has staked 48 claims and is in the process of staking approximately 28 additional claims within the area outlined on the Land Status map. These cover some or all of the targets identified. ECM is now negotiating with three other parties in an attempt to acquire mining leases covering approximately 1200 acres within the area.

Historic Activities - The Roadrunner property is within the Gold Basin mining district of northwestern Arizona. District production of gold since the 1870's is estimated to be in the range of 40,000 - 60,000 ounces. Silver, copper, and lead were also recovered from several of the mining operations in the district.

Some of the past producing mines are located on lands that border the ECM claims. The most important of these were the Eldorado (SW/4 Sec.21), Malco (SE/4 Sec.21), Excelsior (NW/4 Sec. 22), and the O.K. (NW/4 Sec.28). The ores extracted from these mines were largely confined to northeast trending fissure veins hosted by gneissic granodiorite and biotite-rich quartzofeldspathic gneisses. At the Excelsior mine the veins occurred along a fault separating coarse grained, porphyritic monzogranite from biotite-rich paragneisses. The run-of-the-mill grade for most of these mines was 0.3 - 0.75 opt Au.

Many of the small arroyos and washes in this part of the district were prospected for placer gold. However, no large areas with economic concentrations were apparently found.

General Geology - The Gold Basin district is in the southeastern corner of the Basin and Range province and only 15 miles west of the Colorado Plateau. It straddles a small north trending, block-faulted range called the White Hills. These are separated from the Virgin Mountains to the north by the Colorado River canyon at Lake Mead.

The White Hills are cored by Early Proterozoic metamorphic rocks that date back to at least 1.7 b.y. ago (see accompanying regional geologic map). This central metamorphic complex is mainly comprised of paragneiss with locally significant subordinate amounts of orthogneiss.

The peak dynamothermal metamorphic event overprinted on the gneissic and schistose rocks occurred sometime before the emplacement of large masses of porphyritic monzogranite at about 1.65 b.y. ago. The regional northeast trending gneissic and schistose foliations in these metamorphic rocks were locally contorted into complex fold patterns near the intrusives, as well as near some of the larger, regional faults and shear zones.

The gneissic terrane consists of a dominant assemblage of biotite-rich quartzofeldspathic gneiss with fairly abundant quantities of interlayered amphibolite, biotite-muscovite schist, and quartz-muscovite schist. The protolith for these rocks is believed to have been a thick sequence of deep-water clastics, probably dominated by turbidites. Mixed within this sedimentary sequence are metamorphosed volcanic and plutonic rocks representing either parts of an ancient arc terrane or a back arc tectonic basinal setting.

Gneissic diorite and granodiorite are common in the southeastern portion of the White Hills, and especially in the vicinity of the Roadrunner property. These well foliated plutons were, themselves, intruded by a coarse grained, rapakivi-type, porphyritic monzogranite at about 1.65 b.y. ago. This intrusive is generally not foliated or only weakly foliated near some shear zones and intrusive contacts. However, many of the large, tabular microcline phenocrysts show a well developed preferred orientation that parallels the foliation in the surrounding gneisses.

Leucocratic granites are quite plentiful in the southern White Hills. Many are in sill-like bodies that were apparently intruded into the gneissic rocks. These conformable intrusives probably belong to an older age of igneous activity since they are well foliated and even intensely mylonitized at some exposures. Many of the leucogranites show a strong spatial relationship to gold prospects throughout the Gold Basin district.

The Proterozoic rocks in the southern portions of the White Hills were also intruded by an undeformed leucocratic two-mica peraluminus granite. This pluton is Late Cretaceous in age and comprises many smaller bodies of aplite, episyenite, and pegmatite. Further, it reresents one of many such plutons that form a regionally extensive inner-cordilleran belt of two-mica granites extending from northeastern Washington to southeastern Arizona. Two major gold districts in the southwestern U.S., Mesquite and Cargo Muchacho, are associated with igneous rocks of this type.

The major structural grain in the White Hills region consists of north-south trending fault blocks that formed during Mid-Tertiary extensional tectonism. These are in turn made up of rocks exhibiting older northwest and northeast tectonic fabrics. The northeast appear to be more abundant or better displayed in the areas around the Roadrunner property. Several N40-65E fault and shear zones that cut across the property account for rapid lithologic changes, mylonitized rock textures, alteration, and, most importantly, localized gold occurrences.

A large low-angle fault is intermittently exposed throughout portions of the southern White Hills. This detachment structure is considered to be Miocene in age since it involves volcanic rocks and fanglomerate deposits of that age. This same fault probably extends northward along the west flank of the White Hills. Several of the larger gold mines in the district were located within the brecciated and mylonitized rocks associated with this large regional structure.

Middle to Late Tertiary volcanics were erupted in the region during an episode of block-faulting and local tilting. These young igneous rocks are mainly found along the western side of the White Hills or the eastern side of the Lost Basin Range to the east. The Tertiary volcanic sequences and their intercalated deposits of coarse fanglomerates are moderately to steeply dipping

along some of the north trending normal faults.

Late Tertiary gravels are present throughout the region as dissected alluvial fan remnants. Many of these gravel deposits are auriferous and have yielded small, economic placers where they were reworked by younger stream systems.

Local Geology - The Roadrunner property is situated in a portion of the Gold Basin district where the geology is considerably more complex than in the surrounding areas. Attributing to the complexity of the area are a) at least three major plutonic masses, b) intersecting zones of large, regional structures, and c) multiple events that contributed hydrothermal alteration products to rocks already exhibiting both pro- and retrograde metamorphic assemblages. Notably, the property also lies within an area where the known gold deposits are at their greatest density.

The central feature in the Roadrunner area is an Early Proterozoic gneissic granodiorite. This northeasterly elongated pluton was probably intruded as a stock into a clastic-dominated sedimentary sequence sometime between 1.7 and 1.8 b.y. ago. Foliations in this pluton are very well developed and conspicuously displayed in outcroppings due to a relatively high biotite content (15 - 20 percent). Much of the gneissic granodiorite has been altered to a chlorite-rich rock that also contains variable amounts of sericite and carbonate. This alteration is frequently found in association with gold-bearing fissure veins that formed at dilational sites along several of the major northeast trending fault and shear zones.

The gneissic granodiorite and rocks in immediate contact with it are some of the most important host rocks for gold mineralization in the southern White Hills. These include several of the largest vein deposits in the district which are located along the eastern fault-bounded contact of the pluton. This contact displays rocks that have been repeatedly disturbed by major fault movements along northeast trending zones of weakness. The intensity of deformation along these faults and their extension over large distances suggest that this zone is part of a major crustal-scale shear system that probably controlled the emplacement of the granodiorite pluton to begin with.

The northern portion of the gneissic granodiorite hosts an impressive number of coarsely crystalline and locally

mylonitized leucogranite occurrences. These relatively small igneous bodies typically contain central cores of pegamtitic minerals, notably quartz, K-feldspar, muscovite, biotite, Fe-carbonate, and some moderately coarse sulfides, probably pyrite. Most leucogranite and pegmatite occurrences are conformable with the foliation in the granodiorite, but can also have highly complex shapes that cut across the structural fabric of the host rocks. Interestingly, these pegmatitic rocks are frequently located near gold prospects, especially in the S/2 of Section 16. Here, they seem to have a higher sulfide content than normal as indicated by the amount of limonite that has developed on the weathered surfaces. Some of these more Fe-stained rocks also contain appreciable amounts of jarosite indicating that the local sulfide contents may have exceeded 10 volume percent.

A much larger mass of leucocratic granite is present in the E/2 of Section 20. This sill-like intrusive(?) mass dips shallowly to the west beneath several gold prospects as well as the Never-Get-Left gold mine located in the SE/4 of Section 20. Some portions of this igneous rock appear to be pervasively silicified by a vitreous, bluish-gray quartz that locally grades into irregular networks of thin vein-like streaks. A finely developed fibrous amphibole may also be associated with these silicified zones.

The pegmatites and leucogranites in the southern White Hills could have formed as felsic differentiates from the granodiorite magma. It is also possible that they are genetically related to the porphyritic monzogranite that lies mainly south of the Roadrunner property.

The large mass of coarse grained and relatively unfoliated monzogranite appears to host gold occurrences only where it has been extensively deformed by large faults and zones of intense ductile shearing. For instance, the gold ores extracted from the Excelsior mine came from veins located along the large northeast trending fault zone that separates the monzogranite from paragneisses. Farther south along this same structural zone the monzogranite is quite pervasively altered to variable mixtures of chlorite, clays, and even sericite in some places. These altered areas host gold-bearing vein occurrences that are quite different from most others in that they also carry appreciable amounts of fluorite.

The same northeast trending fault zone that contained the ores at the Excelsior mine broadens to the southwest

into at least three major segments that span a distance of 1000 - 1500 feet in the N/2 of Section 28. Complicating this wide zone of steep faults and shears are a significant number of low-angle, westerly dipping faults. These structures cannot be traced very far in outcrops, usually because they either merge into the high-angle faults, or they are terminated against them. Nonetheless, these low-angle structures are important because they are mineralized at a number of places in the NE/4 of Section 28. From here they project beneath cover into the adjacent Sections 22 and 27.

Another important northeast trending fault zone occurs within Section 16 and adjacent areas. A broad portion of this zone (central portion of Section 16) is defined by sheeted and mylonitized gneissic granodiorite. Injection pegmatites also occur in this area and they appear to be associated with a subtle but pervasive argillic alteration overprinted on the granodiorite. Coincident with this alteration is a strong build-up of carbonate in both the granodiorite and pegmatites.

In the SW/4 of Section 16 the northeast trending fault zone hosts gold-bearing, high-sulfide fissure veins. These veins also carry a strong Fe-carbonate content in addition to a pinkish-colored carbonate that may be Mn-rich. A weak silicification envelopes these vein occurrences within the fault zone, extending approximately 20 to 30 feet outward from them. Locally, there are small stockwork-like developments of quartz-carbonate veinlets.

On the south side of the fault zone in the same location (SW/4 of Section 16), there is a fairly narrow band (200-250 ft. wide) of paragneiss that shows a considerable amount of alteration. Most of the rock has been affected to varying degrees by hydrothermal fluids that probably pervaded outward from the fault zone. The alteration assemblage generally consists of variable mixtures of chlorite-sericite-carbonate$\pm$sulfides. A weak but distinct color anomaly is also associated with these altered rocks indicating an elevated background of probable disseminated sulfides as well as Fe-carbonate. A weak silicification occurs in patchy distribution throughout the same area.

Geochemistry - Preliminary reconnaissance sampling at the Roadrunner property was mainly focused along the northeast trending fault and shear zones, and in areas containing an appreciable amount of altered leucogranite and pegmatite. Detailed sampling traverses across the main structures would be needed to better define the extent of gold-enrichment associated with the many smaller, parallel shears and fracture zones. Mylonitized rocks adjacent to the larger vein structures, especially those along the Malco mine - Excelsior mine trend, should also be sampled in greater detail.

Basically, there are at least two broad zones of metal enrichment associated with the gneissic granodiorite stock at Roadrunner. Altered rocks located along the structurally complex contact zone at the southeast corner of this pluton contain very high gold values, especially where quartz-carbonate-sulfide veins formed within the granodiorite. Base metals (Cu,Pb) are also anomalous in this same area; whereas, anomalously high arsenic values appear to be more sporadically distributed along the same zone.

Random rock-chip sampling across silicified, mylonitic rocks adjacent to the larger quartz-carbonate veins at the Malco mine showed that high gold values (200 - 2300 ppb) are maintained in the altered rocks for distances of more than 20 feet from the vein structures. However, both base metals and arsenic values in these same samples were surprisingly low suggesting that they may not be useful indicator elements for some types of gold mineralization in the region.

A sample (#44188) collected across a 20-foot wide low-angle shear zone in the NE/4 of Section 28 yielded about 5 ppm Au. No other samples were taken from this structure because the amount and intensity of alteration associated with it was not very impressive. On the otherhand, a finely developed network of quartz-carbonate veinlets was noted, and probably corresponds to the gold enriched portions of this low-angle structure. Once again, however, the arsenic (7 ppm) and base metal values for the same sample interval were very low.

The northeast trending fault zone in Section 16 is another gold-enriched structural setting. A couple of samples from the altered paragneiss located on the south side of this structure (SW/4 of Section 16) yielded high gold values (7 ppm) probably associated with the more pervasive quartz-carbonate alteration there. Also worth

noting for these samples are the highly anomalous values for both arsenic and base metals, indicating that the paragneiss probably hosts a different metal signature than the intrusive rocks from the same area. Quite obviously, these rocks need to be mapped and sampled in greater detail in order to delineate the location and extent of possible exploration targets.

Finally, the pegmatite and leucogranite occurrences in the same area of Section 16 have also produced some anomalous gold values. Samples of these rocks contain moderately anomalous values of base metals, but are surprisingly low in arsenic content. Samples of pegmatite containing the highest gold values (235 - 10,000+ ppb) were collected where these rocks are altered (argillic) and overprinted by a considerable amount of iron(?) carbonate (+15 volume percent). Samples from apparently fresher pegmatite yielded much lower values (6 - 30 ppb).

Target Type - Studies of field and geochemical relationships at Roadrunner indicate that gold was most readily deposited along the major fault and shear zones in the area, especially where dilation zones allowed formation of fissure veins. Both metamorphogenic and hydrothermal fluids probably contributed metal to these structural sites. The major northeast trending fault and shear zones formed in response to large-scale, regional tectonic events that began at least back in the Early Proterozoic. Periodic reactivations along these tectonic lineaments allowed channelized fluid-flow to occur at different times, probably through the mid-Tertiary.

Emplacement of the main mass of gneissic granodiorite probably was followed closely by hydrothermal fluid convection around its intrusive contact. Another intrusive event involving the porphyritic monzogranite followed quite closely in time, and probably contributed yet another hydrothermal component to the major structural sites.

Hydrothermal fluids appear to have leached iron, alkali metals, and alkaline earth metals while depositing silica, carbonate, and various sulfide minerals. Gold was probably precipitated along with finely disseminated sulfides (mainly pyrite) where the hydrothermal fluids could move most freely. The largest volumes of fluids may have been accommodated where the high-angle, northeast trending faults and shears intersect with low-angle fault zones.

Probably the most obvious and largest target area at Roadrunner is the gold-enriched portion of the northeast trending tectonic zone extending from the southwest corner of Section 28 to the Excelsior mine area in Section 22. Previous work along this belt was focused on the high-grade fissure veins that had only a limited size potential. Results from the current study, however, indicate a very good probability for more pervasively mineralized zones. Perhaps the optimum target is where this structural zone is intersected by an as yet unknown number of low-angle faults. This appears to occur in an area close to the common corner for Sections 21,22, 27, and 28, and probably extends into Section 22 beneath a thin cover of pediment gravels. I refer to this area as the Roadrunner-South target (see accompanying overlay).

The Roadrunner-South target area is a complex geologic setting where probably at least two or three mineralizing events have taken place. It differs from the target areas in the northern portion of the property in the intensity and types of alteration associated with these multiple events. The widespread presence of this alteration and associated gold-anomalous rocks is strong evidence that a large, bulk-tonnage, low-grade gold deposit was likely to have formed in this vicinity.

The target areas on the northern portion of the property represent smaller areas of anomalous alteration and geochemical signatures. However, they are probably not as well defined, at this point, as the Roadrunner-South target area.

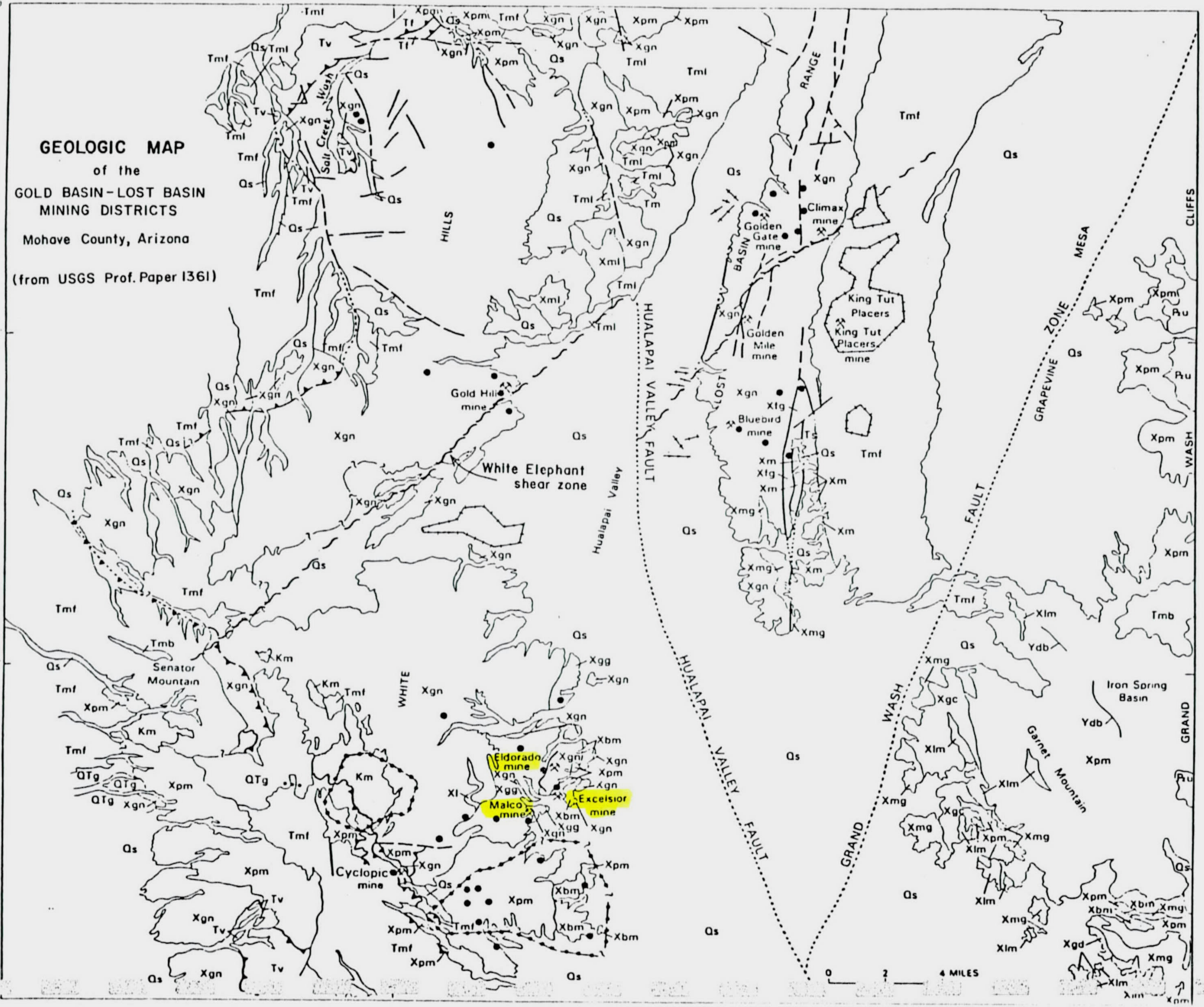
The most readily defined target area in the north is also located along a major northeast trending fault zone. It is similarly associated with high-grade fissure veins that formed at the structural contact between gneissic granodiorite and rocks of the paragneiss sequence. The potential size of the target in this area is enhanced by the possibility of a much broader mineralized (disseminated sulfide) zone occurring along the south side of this structure. This is where a band of altered paragneiss appears as a pendant in the granodiorite intrusive. However, a more thorough sampling of this target area is necessary before any specific parameters can be developed.

Immediately adjacent to the Roadrunner-North target area is an ill-defined zone within the gneissic granodiorite that contains a swarm of pegmatites and leucogranite.

Some of these unusual rocks contain very high gold contents, and, even though their individual sizes are small, there may be a sufficient density of them to warrant their consideration as a target.

These mineralized pegmatites and their intensely sheared and mylonitized wallrocks resemble similar lithologies associated with the Picacho gold mine in southeastern California. At Picacho, though, there is a readily observed zone of intense brecciation believed to represent faulted portions of a large, regional-scale detachment surface. No such features could be seen at the pegmatite bearing areas on the northern Roadrunner property, though the possibility of such a feature in this vicinity is very strong.

A detailed map showing the distribution of pegmatites and altered leucogranite would determine the size of the permissive area for targets. Further, a thorough sampling of these rocks and their associated wallrocks is necessary before specific targets can be delineated.


GEOLOGIC MAP
of the
GOLD BASIN-LOST BASIN
MINING DISTRICTS
Mohave County, Arizona
(from USGS Prof. Paper 1361)
HILLS
White Elephant
shear zone
Hualapai Valley
HUALAPAI VALLEY FAULT
Gold Hill
mine
RANGE
BASIN
LOST
Climax
mine
Golden
Gate
mine
Golden
Mile
mine
Bluebird
mine
King Tut
Placers
King Tut
Placers
mine
MESA
ZONE
GRAPEVINE
FAULT
WASH
CLIFFS
Salt Creek Wash
Senator
Mountain
WHITE
Eldorado
mine
Malco
mine
Excelsior
mine
Cyclopic
mine
GRAND
WASH
Iron Spring
Basin
Garnet Mountain
GRAND
0 2 4 MILES

DESCRIPTION OF MAP UNITS

Qs Sedimentary deposits (Quaternary)—Includes sand and gravel along active stream washes, talus, colluvium, poorly consolidated fanglomerate currently being dissected, and landslide deposits; also may include extensive high-level fanglomeratic deposits, west of Grand Wash Cliffs in general area of Grapevine Mesa, that may be Tertiary and (or) Quaternary in age

QTg Fanglomerate (Quaternary and (or) Tertiary)—Locally derived fanglomerate deposits that include mostly clasts of metamorphic rock south-southeast of Senator Mountain and that do not contain clasts of rapakivi granite or any interbedded tuffs

Muddy Creek Formation (Tertiary)

Tml Hualapai Limestone Member—Includes limestone interbedded with thin beds of limy claystone, mudstone, and siltstone. Weathered limestone beds have a predominantly reddish color and form steep cliffs where they are dissected by Hualapai Wash

Tmb Basalt—As shown, flows at Senator Mountain, near west edge of map area, and at Iron Spring Basin, near east edge. Basalt in these two areas correlates probably with basalt flows (not shown) that conformably underlie the Hualapai Limestone Member and also are interbedded with fanglomerate of the Muddy Creek Formation near northwest corner of map area. Whole-rock K-Ar age determination of basalt from this area yields age of 10.9 Ma (see section by E.H. McKee, this report)

Tmf Fanglomerate—Alluvial fanglomeratic deposits that include conglomerate, sandstone, siltstone, mudstone, and locally abundant gypsum lenses. Locally includes lenses and beds of rhyolitic tuff and, as shown near southwest corner of map area, fanglomerate mapped previously by Blacet (1975) as unit Tf. Unit is also intruded by minor basalt dikes, especially in general area of Senator Mountain. Near northwest corner of map area, unit includes well-exposed flows of basalt

Tv Volcanic rocks (Tertiary)—Includes mostly andesite. Map unit near northwest corner of map area internally is highly broken by numerous faults, and near here, unit also includes air-fall tuff and reddish-brown sandstone interbedded with chaotic sedimentary breccia composed of fragments of Early Proterozoic gneiss. In places, unit also includes massive porphyritic hornblende andesite and basalt flows and breccia and overall minor amounts of tightly cemented volcaniclastic rocks. Flow layering and bedding generally dip at angles of 35° in contrast with shallow dips of about 5° in unconformably overlying basal fanglomerate of the Muddy Creek Formation. Age ranges of 11.8 to 14.6 Ma are reported near type section of the Mount Davis Volcanics (Anderson and others, 1972), whereas K-Ar age determination on sanidine from air-fall tuff near Salt Creek Wash in northwestern part of area yields age of 15.4 Ma. The volcanic rocks may be equivalent of the Mount Davis Volcanics or the Patsy Mine Volcanics (see section by E.H. McKee, this report).

Ts Rhyolitic tuffaceous sedimentary rocks and fanglomerate (Tertiary)—Includes well-bedded mudflows and rhyolitic tuffaceous sedimentary rocks and minor amounts of fanglomerate. Crops out as steeply dipping sequence of rocks, bounded by north-striking faults, near south end of Lost Basin Range. Possibly equivalent to the Mount Davis Volcanics

Tf Fanglomerate (Tertiary)—Coarse fanglomeratic deposits that locally include landslide or mudflow breccia. Overlain unconformably by fanglomeratic deposits of the Muddy Creek Formation, and apparently intercalated with andesite possibly equivalent to the Mount Davis Volcanics

K... Two-mica monzogranite (Cretaceous)—Includes mostly highly leucocratic muscovite-biotite monzogranite and some minor amounts of felsic muscovite granodiorite and episyenitic-altered muscovite-biotite monzogranite. Some facies are fluorite bearing. Porphyritic variants contain as much as 5 percent quartz phenocrysts. In places, contains very weakly defined primary layering of dimensionally oriented potassium feldspar and biotite

Pzu Sedimentary rocks, undivided (Paleozoic)—Includes Cambrian Tapeats Sandstone, Bright Angel Shale, and Muav Limestone

Ydb Diabase (Middle Proterozoic)—Includes normally zoned laths of plagioclase set in very fine grained matrix of granules of opaque mineral(s) and clinopyroxene. Close to chilled margins of some fresh outcrops of undeformed diabase, olivine is found in concentrations of as much as 10 volume percent. Small masses of fine-grained diabase crop out sporadically in Early Proterozoic igneous and metamorphic rocks. Most extensive exposures are about 2 km east of Garnet Mountain. Subophitic textures are dominant. Lower chilled margins of some sills contain sparse hornblende and biotite microveinlets. Presumed to be correlative with the diabase of Sierra Ancha, Ariz., having an emplacement age of 1,150 Ma (Silver, 1963)

Xpm Porphyritic monzogranite of Garnet Mountain (Early Proterozoic)—Includes conspicuous, large potassium feldspar phenocrysts, set in a light-pinkish-gray, coarse-grained hypidiomorphic groundmass. Many exposures show tabular phenocrysts as much as 10 cm long. Some phases are predominantly subporphyritic seriate and show an almost continual gradation in size of their euhedral potassium feldspar phenocrysts. Most widely exposed mass crops out in the general area of Garnet Mountain, in the southeastern part of the area, and extends discontinuously from there to north along the low hills leading to Grand Wash Cliffs. Dated by Wasserburg and Lanphere (1965) as [illegible]

Xgd Granodiorite border facies of porphyritic monzogranite (Early Proterozoic)—Gray granodiorite that includes variable proportions of biotite, hornblende, quartz, plagioclase, and potassium feldspar. Includes less abundant porphyritic granodiorite and porphyritic monzogranite phases. Locally coarse grained and sparsely porphyritic. Porphyritic phases show potassium feldspar phenocrysts set in coarse-grained hornblende-biotite hypidiomorphic granular matrix that is very magnetite rich. Crops out along west and southwest flanks of Garnet Mountain as mafic border facies of porphyritic monzogranite of Garnet Mountain. Found as homogeneous discrete bodies and also in the mixed granodiorite complex (Xgc)

Xbm Biotite monzogranite (Early Proterozoic)—Includes a homogeneous light-gray, fine-grained monzogranite and some porphyritic facies containing potassium-feldspar and quartz phenocrysts. Crops out south-southeast of Garnet Mountain and in the southern part of the Gold Basin mining district. In southern Gold Basin district, forms host rock for numerous fluorite-bearing, quartz-carbonate veins, presumably Late Cretaceous in age, some of which contain visible gold

Xlm Leucocratic monzogranite (Early Proterozoic)—Typically light-yellowish-gray rock and generally nonporphyritic. Partly chloritized biotite makes up less than 5 percent of most outcrops. Crops out as discontinuous, lensoid masses along western front of Garnet Mountain. Where well exposed, contacts with porphyritic monzogranite of Garnet Mountain (Xpm) show irregular dike offshoots of porphyritic monzogranite of Garnet Mountain cutting leucocratic monzogranite

Xgc Mixed granodiorite complex (Early Proterozoic)—Composite unit that includes mainly granodiorite (Xgd), some of which is porphyritic, and porphyritic monzogranite of Garnet Mountain (Xpm). Also includes some leucocratic monzogranite (Xlm)

Xgg Gneissic granodiorite (Early Proterozoic)—Generally, well-foliated, medium-gray-green rock containing highly variable alkali feldspar to plagioclase ratios. Biotite makes up about 20 volume percent of unit. Crops out in elongate body in southern White Hills

Xl Leucogranite (Early Proterozoic)—Includes coarse-grained leucogranite to pegmatitic leucogranite that contains potassium feldspar phenocrysts as much as 8 cm wide. Largest mass is 1-km-long sill cropping out 3 km northeast of Cyclopic mine. Stringers several centimeters wide parallel layering throughout much of the gneiss (Xgn). Fabrics grade from relatively undeformed to intensely mylonitic. Northeast of Gold Hill mine, large sills of pegmatitic leucogranite increase in abundance and eventually grade into complexes of migmatitic leucogranite (Xml). Most facies show modal compositions that plot in the field of granite; some outcrops of gneissic leucogranite contain garnet

Xfg Feldspar gneiss (Early Proterozoic)—Generally, light gray to light pinkish gray; compositionally homogeneous and typified by a strongly lineated fabric. Includes minor amounts of amphibolite, mafic gneiss, highly crenulated quartz tourmaline schist, and tourmalinite. Crops out in a 5-km-long and 0.8-km-wide sliver, bounded by faults in southern Lost Basin Range. Cut by quartz-feldspar veins, some of which contain gold

Xml Migmatitic leucogranite complex (Early Proterozoic)—Composite unit that includes swarms of leucogranite (Xl), aplite, and pegmatite dikes, together with pegmatoid quartz veins all cutting gneiss (Xgn). Complex and highly deformed by a ductile (mylonitic and gneissic) style of deformation

Xgn Gneiss (Early Proterozoic)—Includes variably metamorphosed gneiss and some metaquartzite in northern parts of the Lost Basin Range, and in northern White Hills. Exposed sequence of gneiss in southern parts of the Lost Basin Range includes abundant metabasite and amphibolite consisting partly of metagabbro, metaclinopyroxenite, metawehrlite, metadiabase, and metabasalt. Intruded to varying degrees by porphyritic monzogranite of Garnet Mountain (Xpm), biotite monzogranite (Xbm), leucocratic monzogranite (Xlm), leucogranite (Xl), and diabase (Ydb)

Xmg Migmatitic gneiss (Early Proterozoic)—Composite unit that includes mostly gneiss (Xgn) intruded to varying degrees by porphyritic monzogranite of Garnet Mountain (Xpm), biotite monzogranite (Xbm), and granodiorite (Xgd)

Xm Migmatite (Early Proterozoic)—Composite unit that includes mostly medium-grained, sparsely porphyritic monzogranite of Garnet Mountain (Xpm) complexly intruded into gneiss (Xgn)

———?——— Contact—Queried where location uncertain

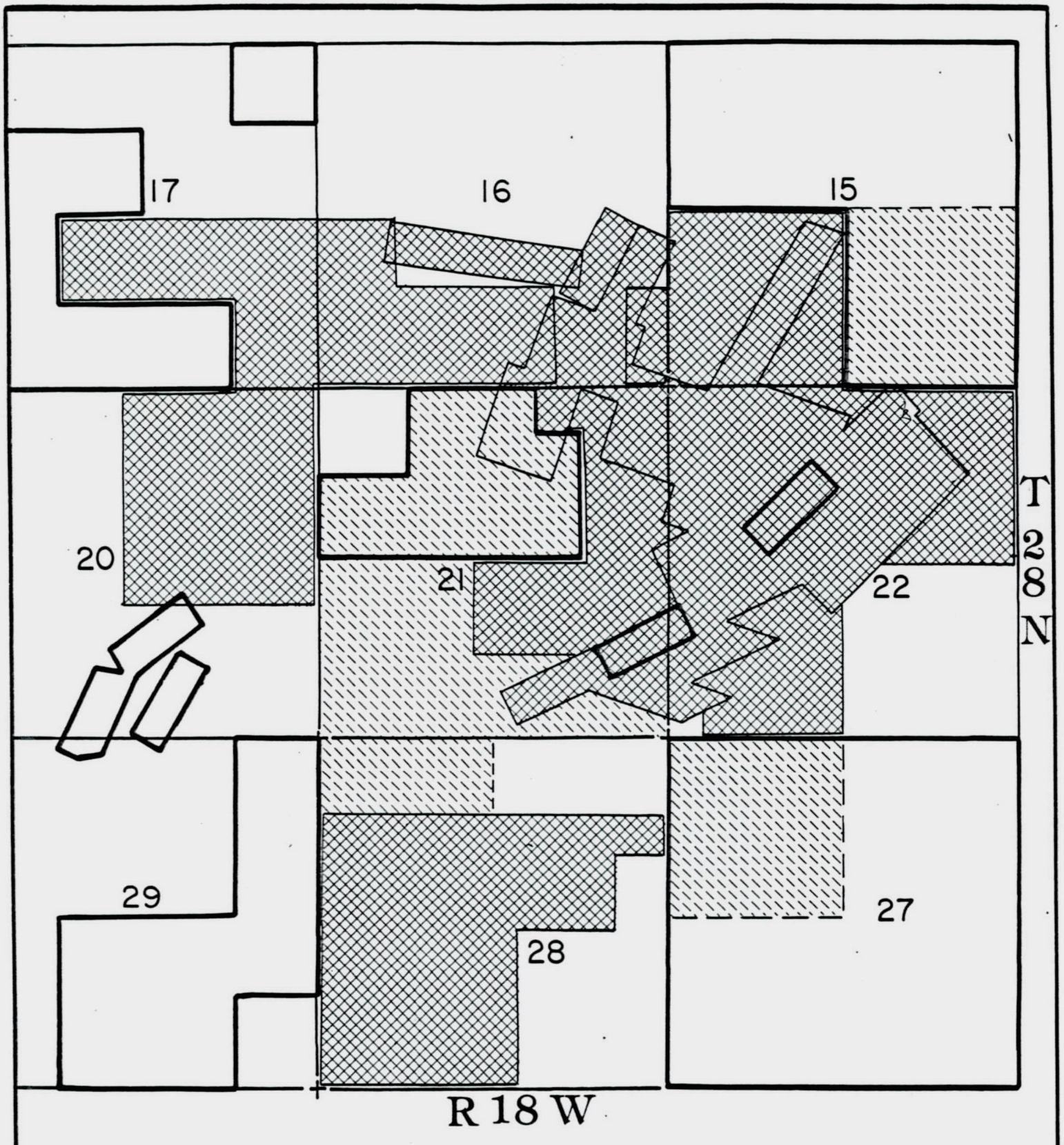
——— Fault—Dashed where approximately located; dotted where concealed

—·—·—?—·—·— Detachment fault—Dashed where approximately located; dotted where concealed; queried where uncertain. Sawteeth on upper plate

● Lode-gold locality—Collected for this report or observed (see Blacet, 1975, and section by J.C. Antweiler and W.L. Campbell, this report)

———?——— Fluorite occurrence—Outer limit observed either in veins or disseminated in the Late Cretaceous two-mica monzogranite; dashed where approximately located, queried where uncertain

Area of placer deposit and (or) mine



ECM Claims and Leased Lands

Lands under negotiations

LAND STATUS

SCALE: 1" = 2000'

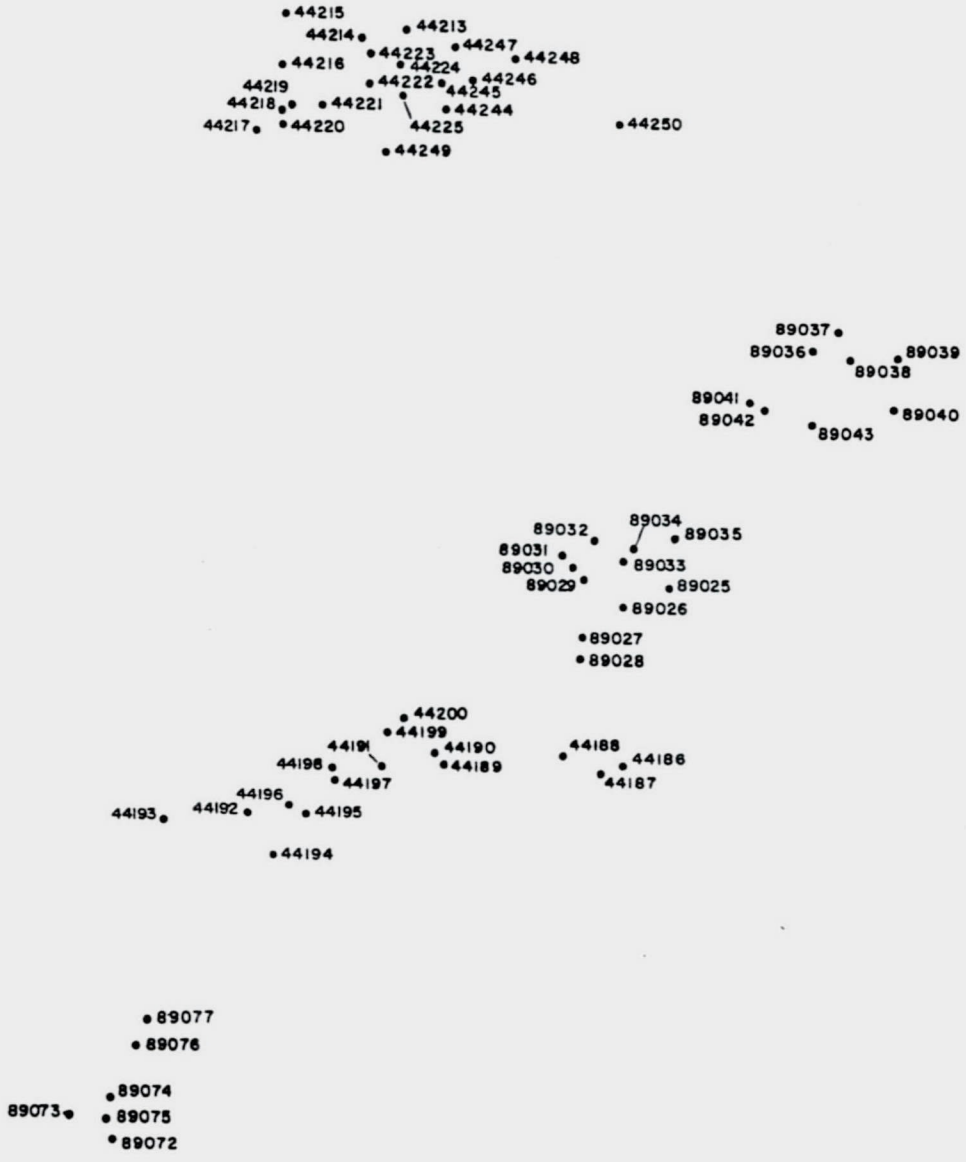
PROPERTY: Roadrunner

LOCATION: Mohave Co., Arizona

DATA BY: GJM

DATE: 10/89 REVISED:

ECM Inc.
P.O. Box 3493
Billings, Montana 59103



• 44195 Rock chip sample location and number

SAMPLE LOCATIONS

SCALE: 1" = 2000'

PROPERTY: Roadrunner

LOCATION: Mohave Co., Arizona

DATA BY: GJH

DATE: 10/89 REVISED:

ECM Inc.
P.O. Box 3493
Billings, Montana 59103

SAMPLE LOCATIONS

SCALE: 1" = 2000'

PROPERTY: White Elephant

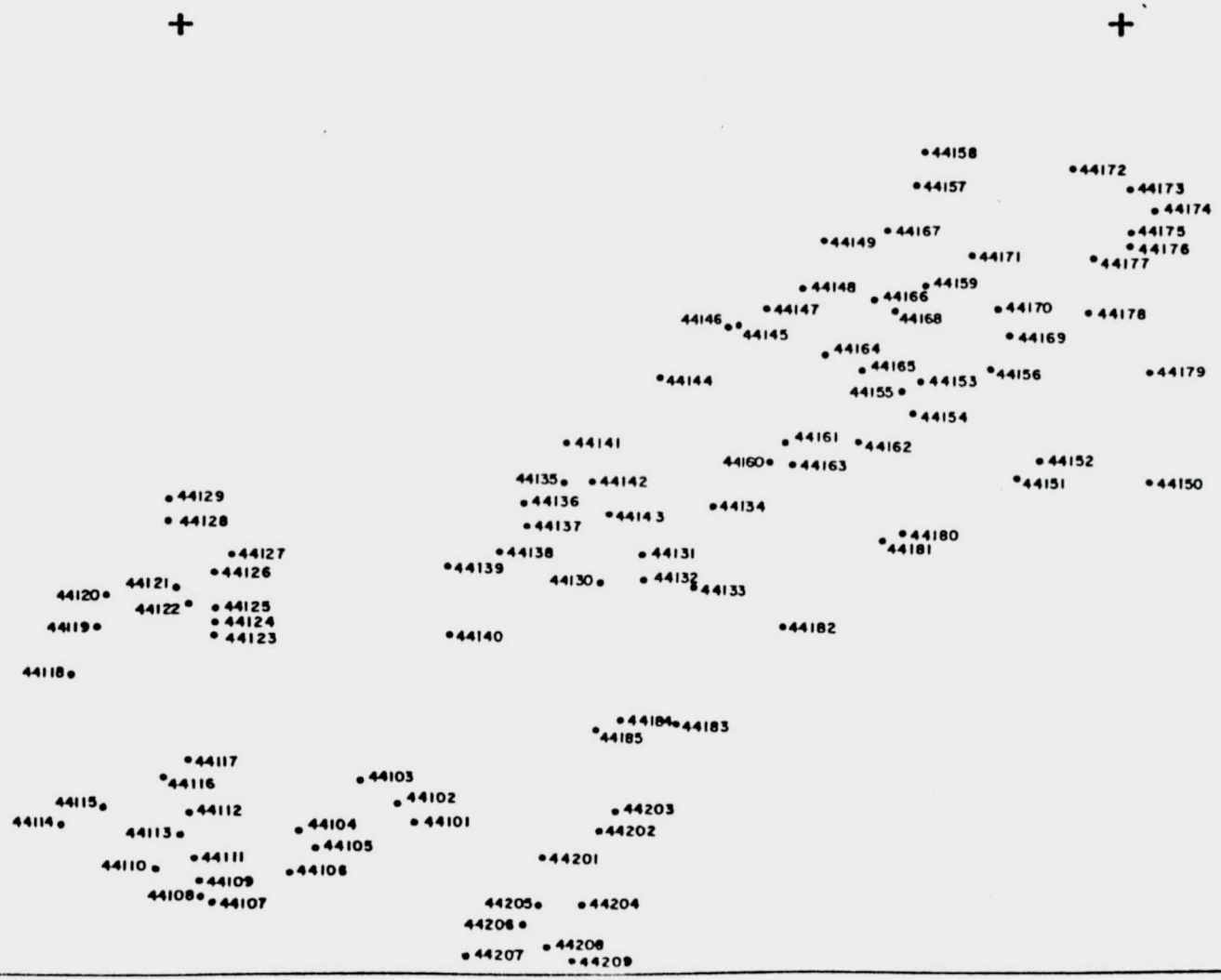
LOCATION: Mohave Co., Arizona

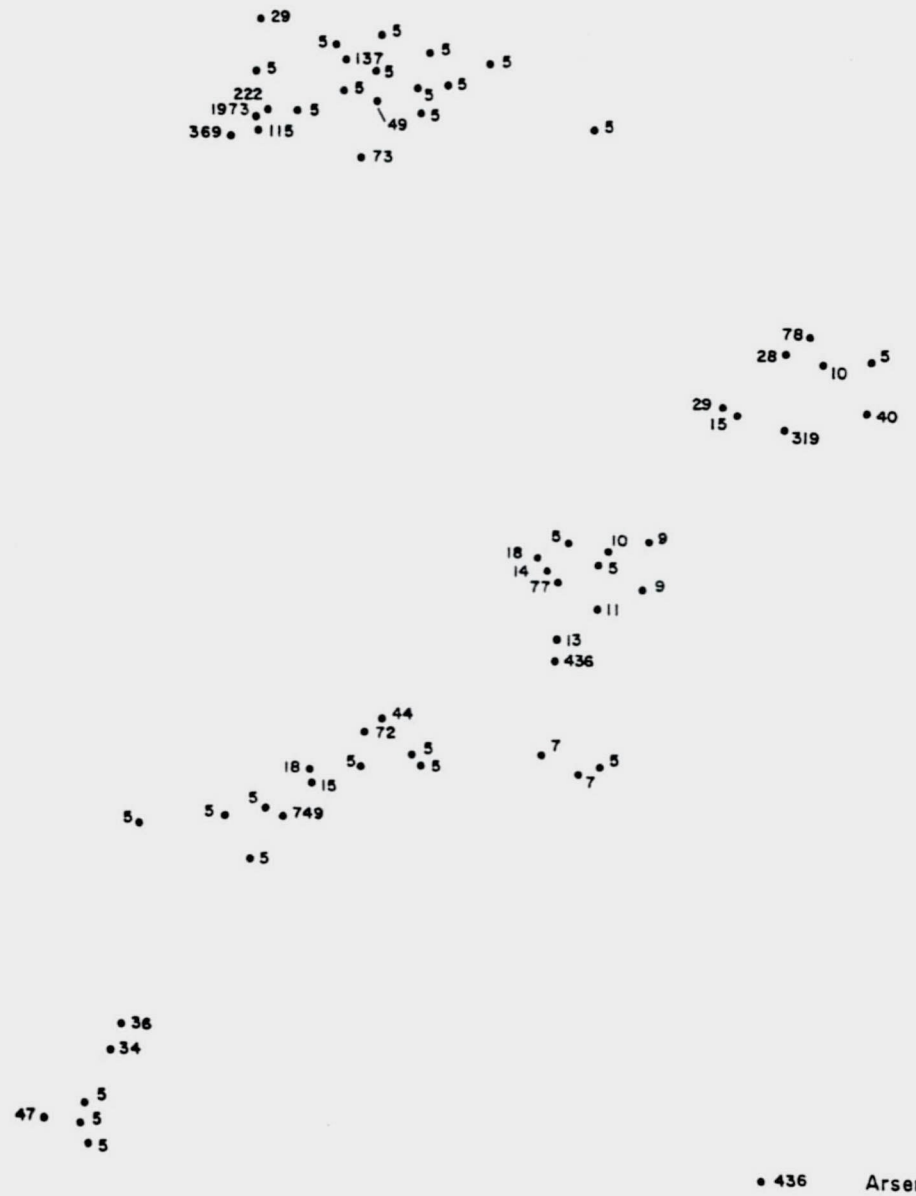
DATA BY: GJH, USGS

DATE: 10/89 REVISED:

ECM Inc.
P.O. Box 3493
Billings, Montana 59103

• 44165 Rock chip sample location and number





As GEOCHEMISTRY

SCALE: 1" = 2000'

PROPERTY: Roadrunner

LOCATION: Mohave Co., Arizona

DATA BY: GJH

DATE: 10/89 REVISED:

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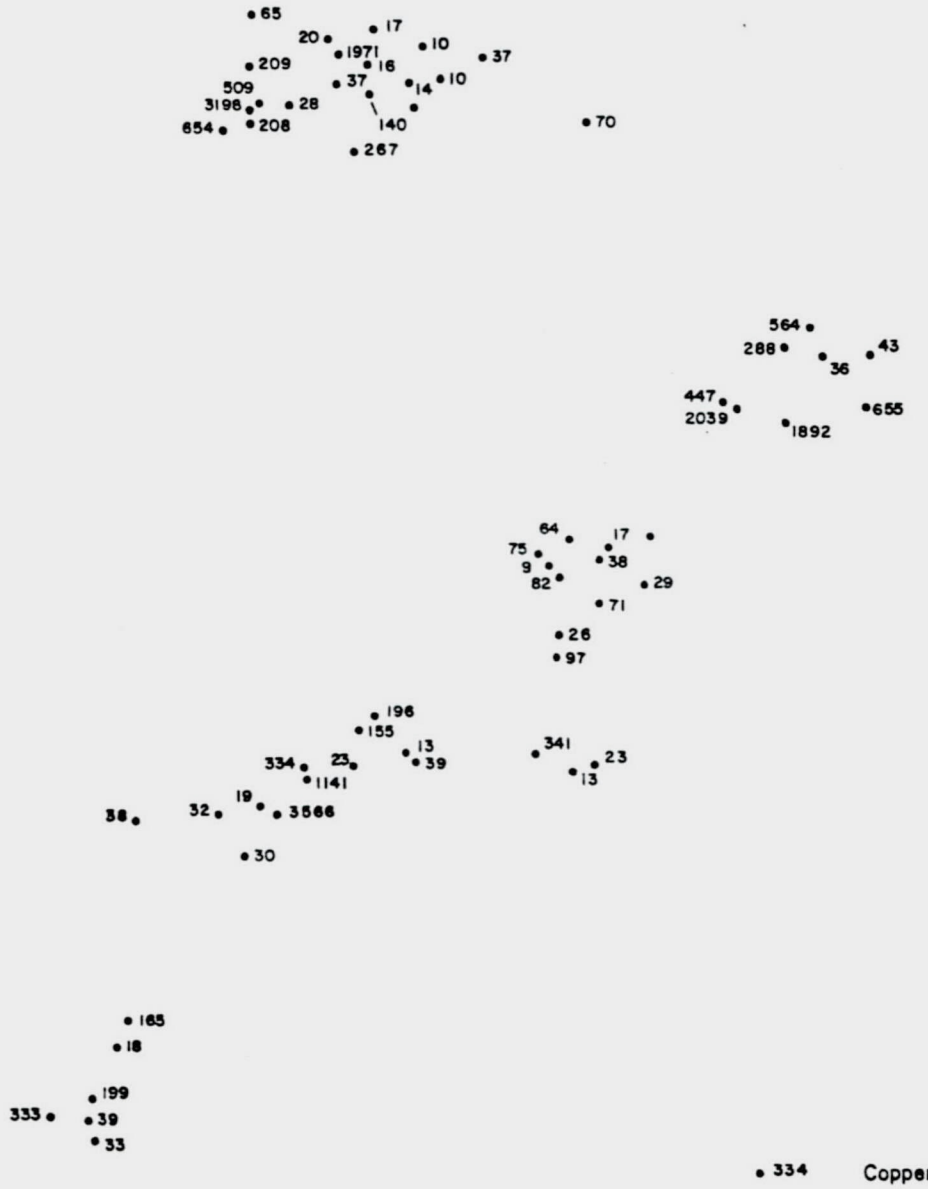
Billings, Montana 59103



Cu GEOCHEMISTRY

SCALE: 1" = 2000'

PROPERTY: Roadrunner

LOCATION: Mohave Co., Arizona

DATA BY: GJH

DATE: 10/89 REVISED:

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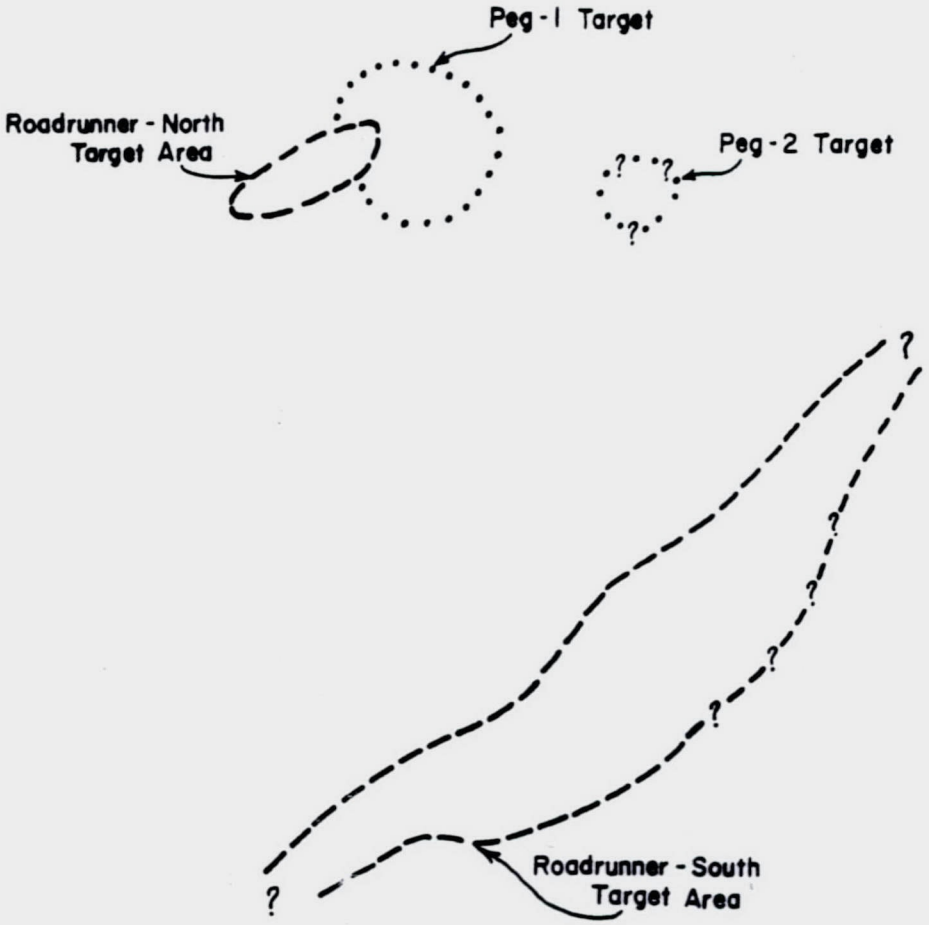

TARGET AREAS

SCALE: 1" = 2000'

PROPERTY: Roadrunner

LOCATION: Mohave Co., Arizona

DATA BY: GJH

DATE: 10/89 REVISED:

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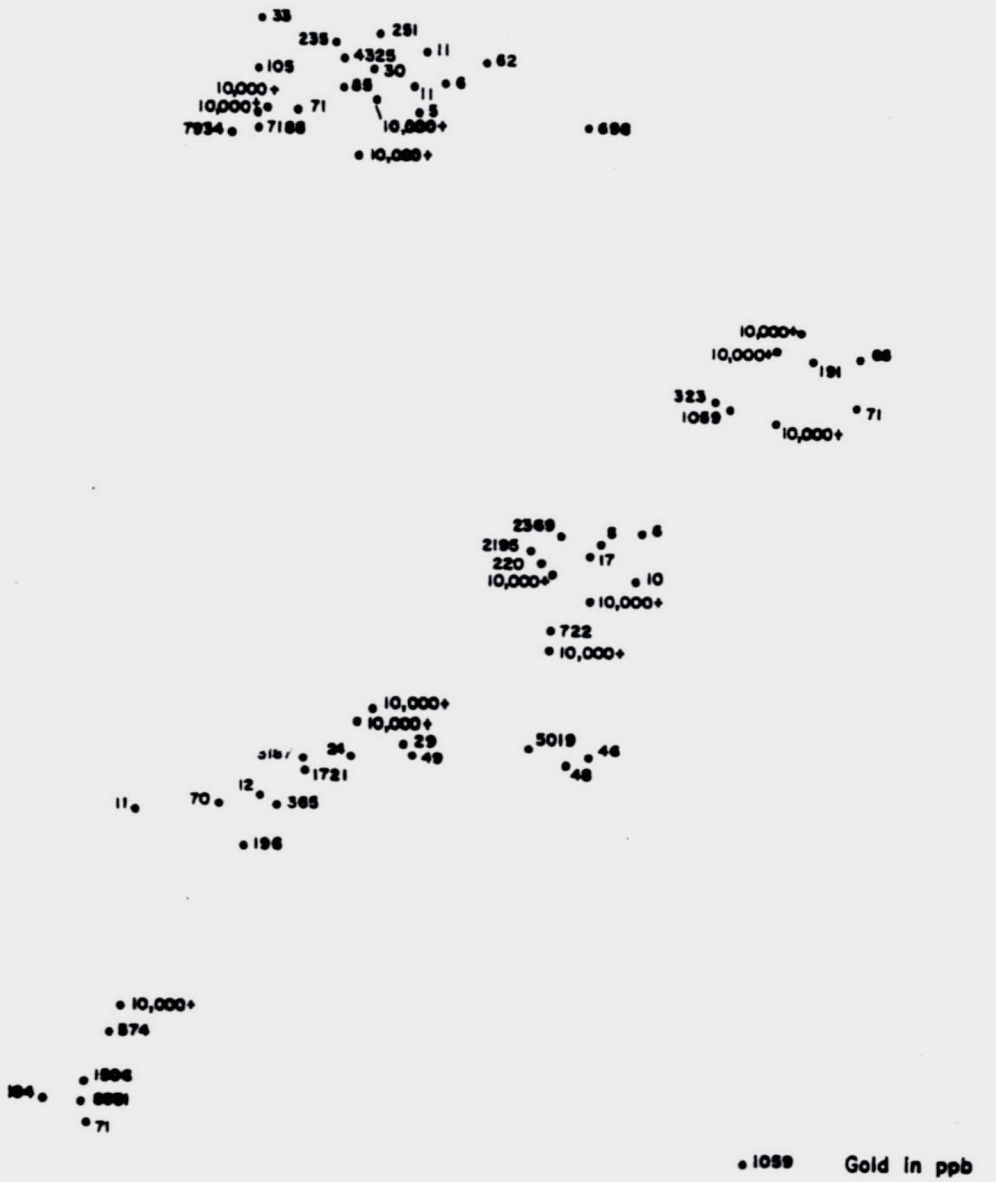

Au GEOCHEMISTRY

SCALE: 1" = 2000'

PROPERTY: Roadrunner

LOCATION: Mohave Co., Arizona

DATA BY: G.J.H

DATE: 10/89 REVISED:

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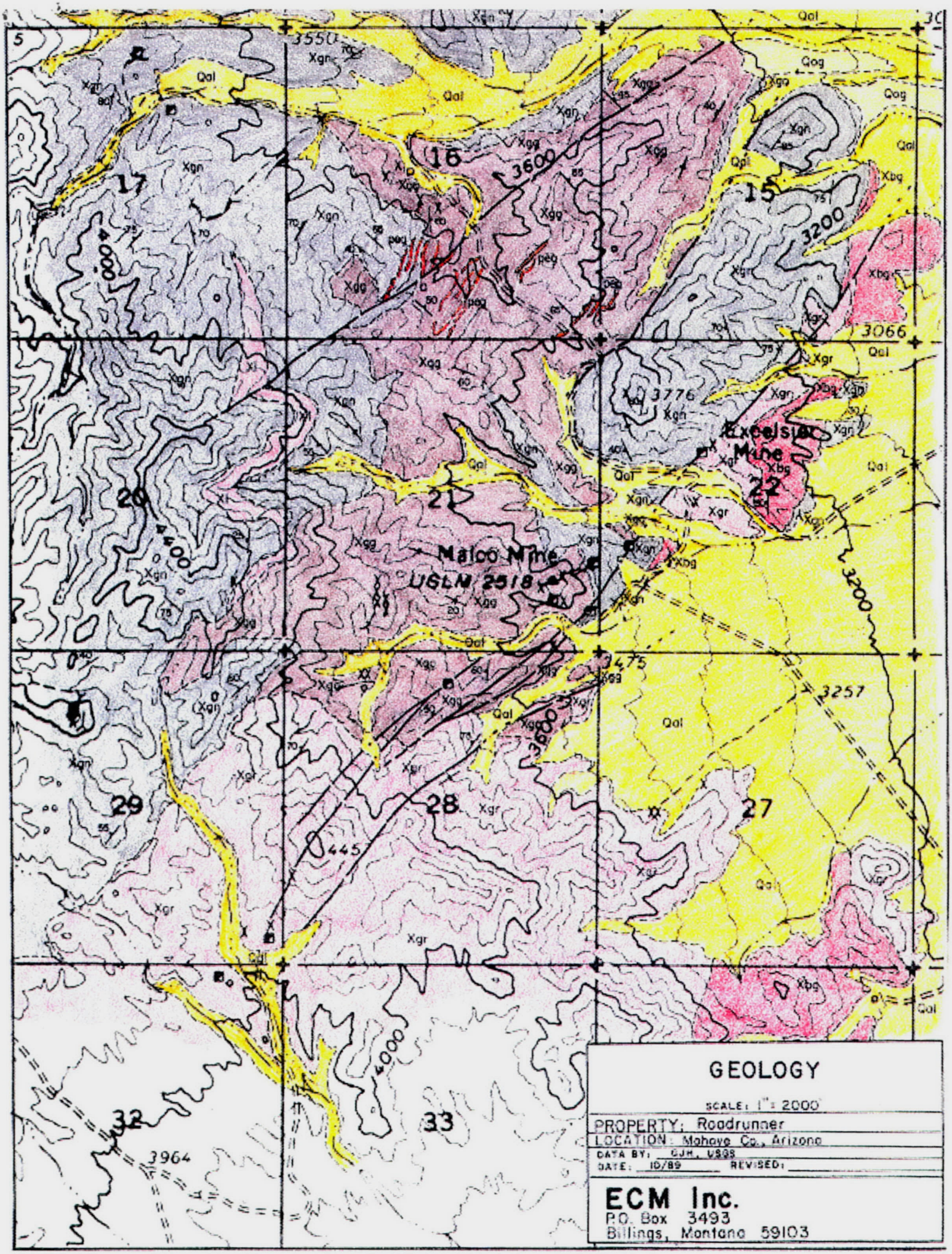
Qal
Qog
Xgn
Xgg
Xgr
Xbg
Excelsior Mine
Malco Mine
UGLN 2518
3550
3600
3200
3066
3776
3251
3964
4000
16
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33
GEOLOGY
SCALE: 1" = 2000'
PROPERTY: Roadrunner
LOCATION: Mohave Co., Arizona
DATA BY: GJH, USGS
DATE: 10/89 REVISED:
ECM Inc.
P.O. Box 3493
Billings, Montana 59103

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