DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PRELIMINARY MINERAL RESOURCE ASSESSMENT OF THE TUCSON AND NOGALES 1^{o} by 2^{o} QUADRANGLES, ARIZONA

Edited by
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PREFACE

This report represents the information collected during a preliminary assessment of the Tucson and Nogales 1° by 2° quadrangles that took place from March through June 1988. The study resulted in an administrative report that outlined the information available for the region at that time for geology, geochemistry, geophysics, and mineral deposits and presented our preliminary ideas concerning the potential for the discovery of new deposits. In addition, recommendations were made to guide program planners in specific topics that need to be addressed such that the preliminary administrative document can be refined and expanded upon to provide a detailed assessment of the area should such a study be desired. This report makes available to the public the scientific information provided in that preliminary administrative document and in no way should be looked upon as a completed assessment of the Tucson and Nogales 1° by 2° quadrangles. It should be used to determine the extent of published studies within the area and as a preliminary indication of the types of deposits, and possible locations of those deposits, that may be present in the area but are as yet undiscovered.

For ease of assembly of this report, accompanying figures and tables are placed at the end of each section in front of the references. Hopefully this will not be too unwieldy for the user.

INTRODUCTION

The Tucson and Nogales 1° by 2° quadrangles in south-central Arizona have made important economic contributions to a mineral-rich state. The area's 1985 mineral production represented 77 percent of molybdenum, 42 percent of boron, 29 percent of zinc, 27 percent of silver, 22 percent of copper, and 10 percent of gold production in Arizona; most of this came from porphyry copper systems. However, the known and possible deposit types within the study area include 22 metallic and 9 nonmetallic types.

This report is an inventory of available data and literature pertinent to a resource assessment of the Tucson and Nogales 1° by 2° quadrangles. It does not address the part of the Nogales quadrangle in Mexico. The study area lies entirely within the Basin and Range physiographic province. Figure 1 shows the locations and names of the mountain ranges and valleys discussed herein. In this report, preliminary tracts were delineated as being permissive for porphyry copper, skarn and replacement, epithermal precious-metal, polymetallic vein, and flat-fault gold deposit types.

Topographic Coverage

The entire study area is covered by 15-minute or 7 1/2-minute topographic quadrangles, and about 80 percent of the study area is covered by both. Figure 2 shows an index to topographic maps available for the study area.

Indian Lands

All or parts of four Indian reservations are within the study area. These include parts of the Tohono O'Odham (formerly Papago), San Carlos, and Maricopa (Ak Chin) Reservations and all of the San Xavier Reservation. The Tohono O'Odham Reservation covers a substantial part of the west side of the study area. In 1978-81 the U.S. Geological Survey (USGS) conducted a comprehensive assessment of the mineral resource potential of the Tohono O'Odham Reservation, which was presented to the tribe in an administrative report through the U.S. Bureau of Indian Affairs. The tribe subsequently asked the USGS to honor the proprietary nature of this data, particularly the geochemical data, during an assessment of the Ajo and Lukeville 1° by 2° quadrangles directly west of the study area, where there are also large tracts of land under Tohono O'Odham administration. These data remain proprietary and will not become available for public use in the forseeable future. Until these data do become available, geochemical information about that part of the study area will be lacking. A similar assessment is underway for the San Carlos Reservation, a small part of which projects into the northeast corner of the study area. Data collected for this study are also proprietary. No similar studies have yet been made on the Maricopa or San Xavier Reservations, in the northwest corner of the study area and south of Tucson, respectively, and it is not known if USGS studies would be allowed in these areas.

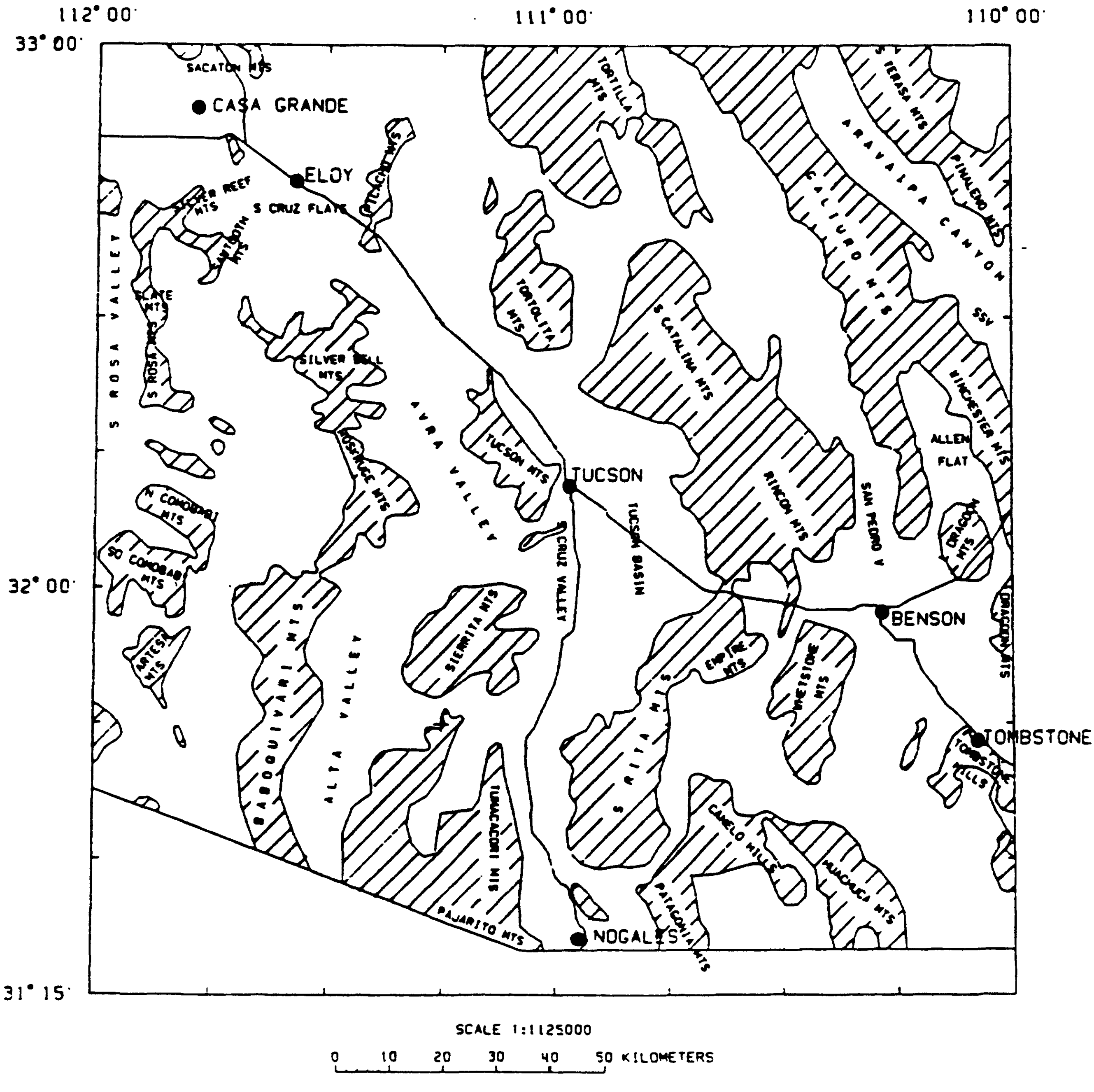

Figure 1. Index map of study area showing geographic locations. Abbreviations: L, Little; MTS, Mountains; N, North; S, Santa; SO, South, SSV, Sulphur Springs Valley; V, Valley.

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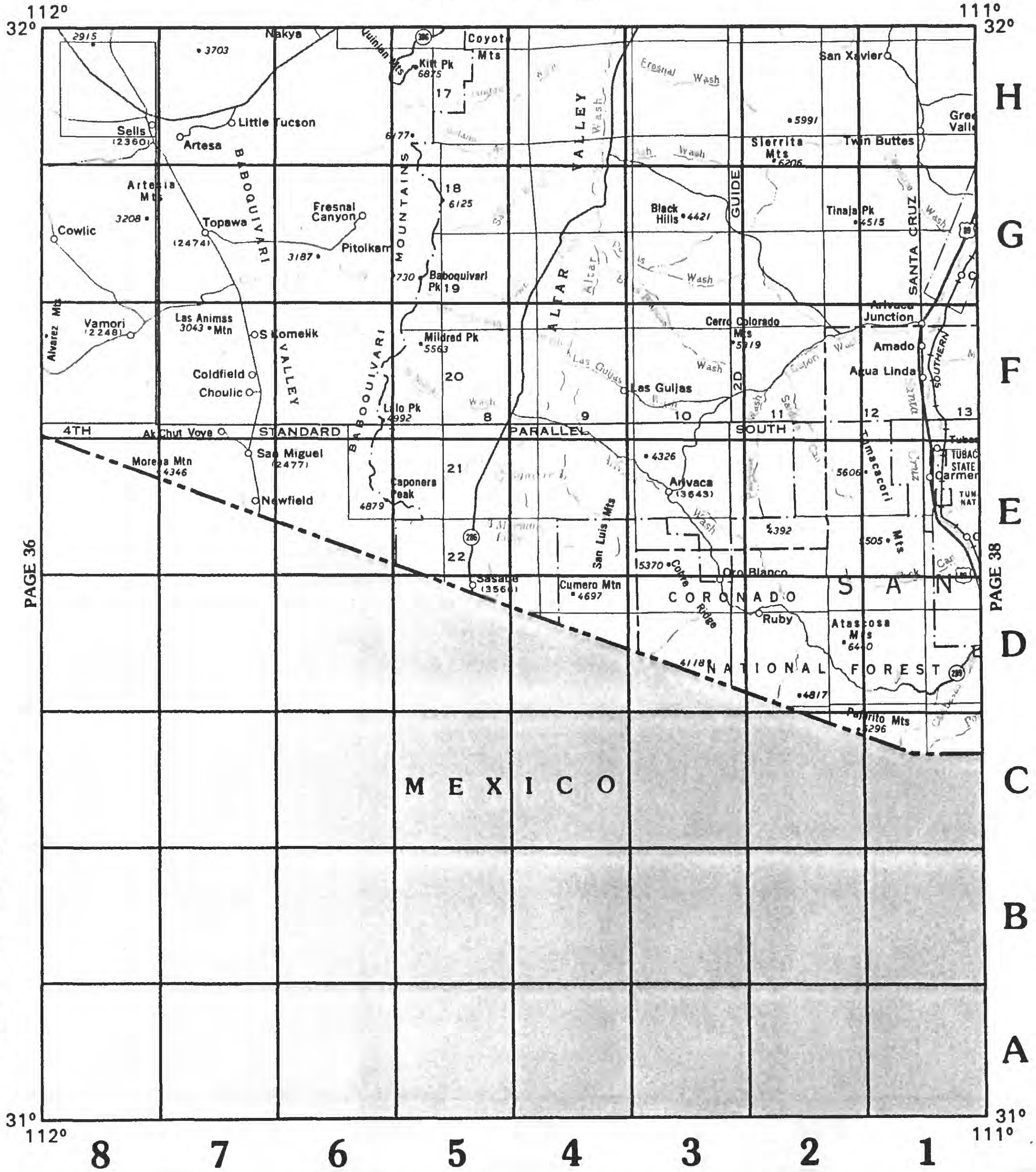

Figure 2. Index to 7.5-minute topographic maps of the Tucson and Nogales 1° by 2° quadrangles.

7.5 MINUTE QUADRANGLE NAMES

A1		E1	Tubac
A2		E2	Murphy Peak
A3		E3	Arivaca
A4		E4	Wilbur Canyon
A5		E5	Presumido Peak
A6		E6	Caponera Peak
A7		E7	San Miguel
A8		E8	San Agustin
B1		F1	Amado
B2		F2	Saucito Mtn.
B3		F3	Cerro Colorado
B4		F4	Las Guijas
B5		F5	Mildred Peak
B6		F6	Aguirre Peak
B7		F7	South Komelik
B8		F8	Vamori
C1	Pajarito Peak	G1	Esperanza Mill
C2	Alamo Spring	G2	Batamote Hills
C3		G3	Penitas Hills
C4		G4	Fresno Wash
C5		G5	Baboquivari Peak
C6		G6	Chiuli Shaik
C7		G7	Topawa
C8		G8	Cowlic
D1	Pena Blanca Lake	H1	Twin Buttes
D2	Ruby	H2	Samaniego Peak
D3	Bartlett Mtn.	H3	Stevens Mtn.
D4	Cumero Mtn.	H4	Palo Alto Ranch
D5	Sasabe	H5	Kitt Peak
D6		H6	San Juan Spring
D7		H7	Sells East
D8		H8	Sells West

7.5-minute maps may not be available for all areas

Certain areas may be covered by 7.5 × 15- or 15-minute maps

See CATALOG OF PUBLISHED MAPS for *available* maps, dates, scales, prices, and Map Order Forms

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7.5 MINUTE QUADRANGLE NAMES

A1
A2
A3
A4
A5
A6
A7
A8
B1
B2
B3
B4
B5
B6
B7
B8
C1 Stark
C2 Bob Thompson Peak
C3 Montezuma Pass
C4 Campini Mesa
C5 Lochiel
C6 Duquesne
C7 Kino Springs
C8 Nogales
D1 Hereford
D2 Nicksville
D3 Miller Peak
D4 Huachuca Peak
D5 Canelo Pass
D6 Harshaw
D7 Cumero Canyon
D8 Rio Rico
E1 Tombstone SE
E2 Lewis Springs
E3 Fort Huachuca
E4 Pyeatt Ranch
E5 O'Donnell Canyon
E6 Mt. Hughes
E7 Patagonia
E8 San Cayetano Mts.
F1 Tombstone
F2 Fairbank
F3 Huachuca City
F4 Mustang Mountains
F5 Elgin
F6 Sonoita
F7 Mt. Wrightson
F8 Mt. Hopkins
G1 Haberstock Hill
G2 Land
G3 McGrew Spring
G4 Apache Peak
G5 Spring Water Canyon
G6 Empire Ranch
G7 Helvetia
G8 Green Valley
H1 Knob Hill
H2 Saint David
H3 Benson
H4 Mescal
H5 The Narrows
H6 Mount Fagan
H7 Corona de Tucson
H8 Sahuarita

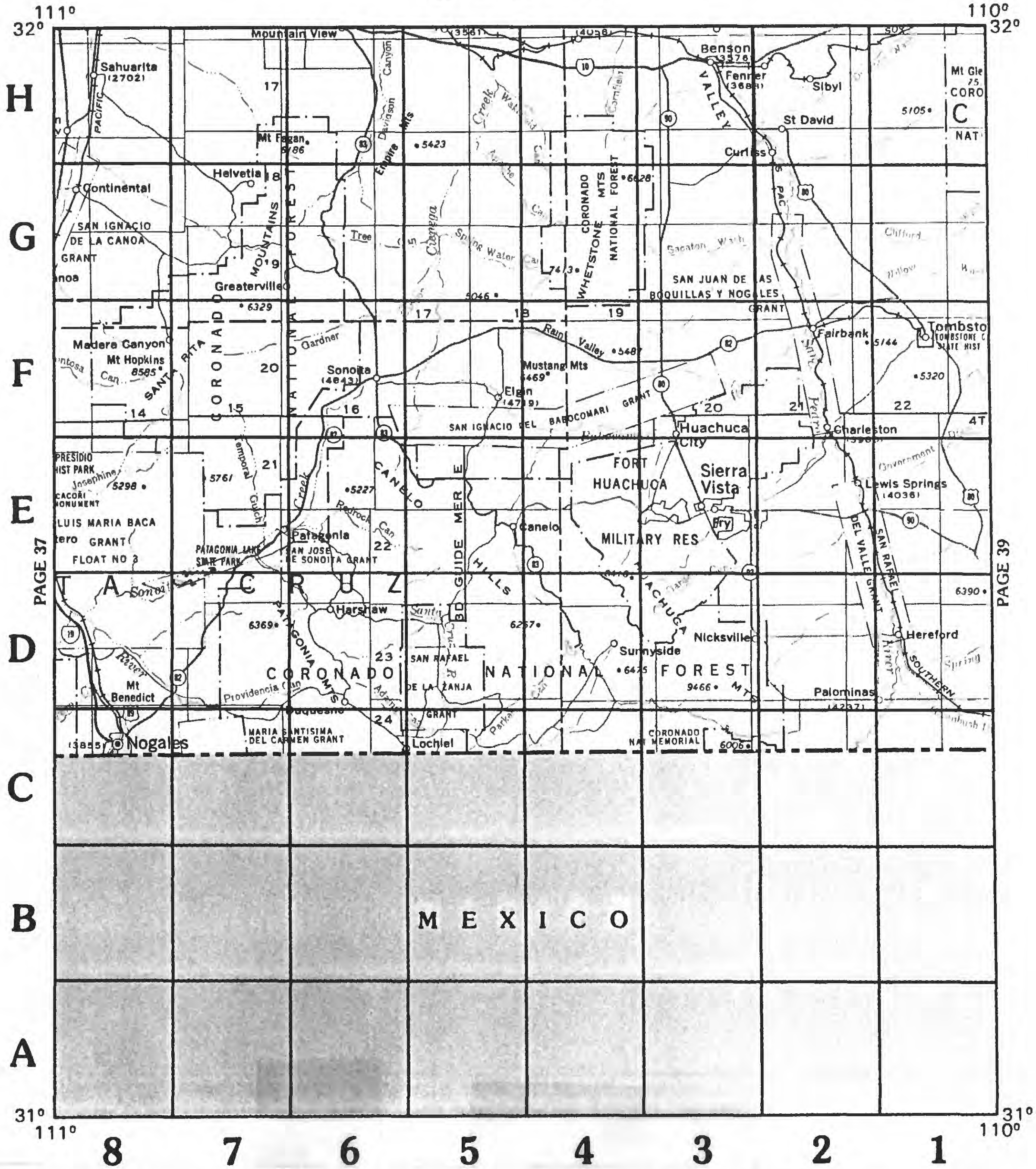

Figure 2. Index to 7.5-minute topographic maps of the Tucson and Nogales 1° by 2° quadrangles--continued

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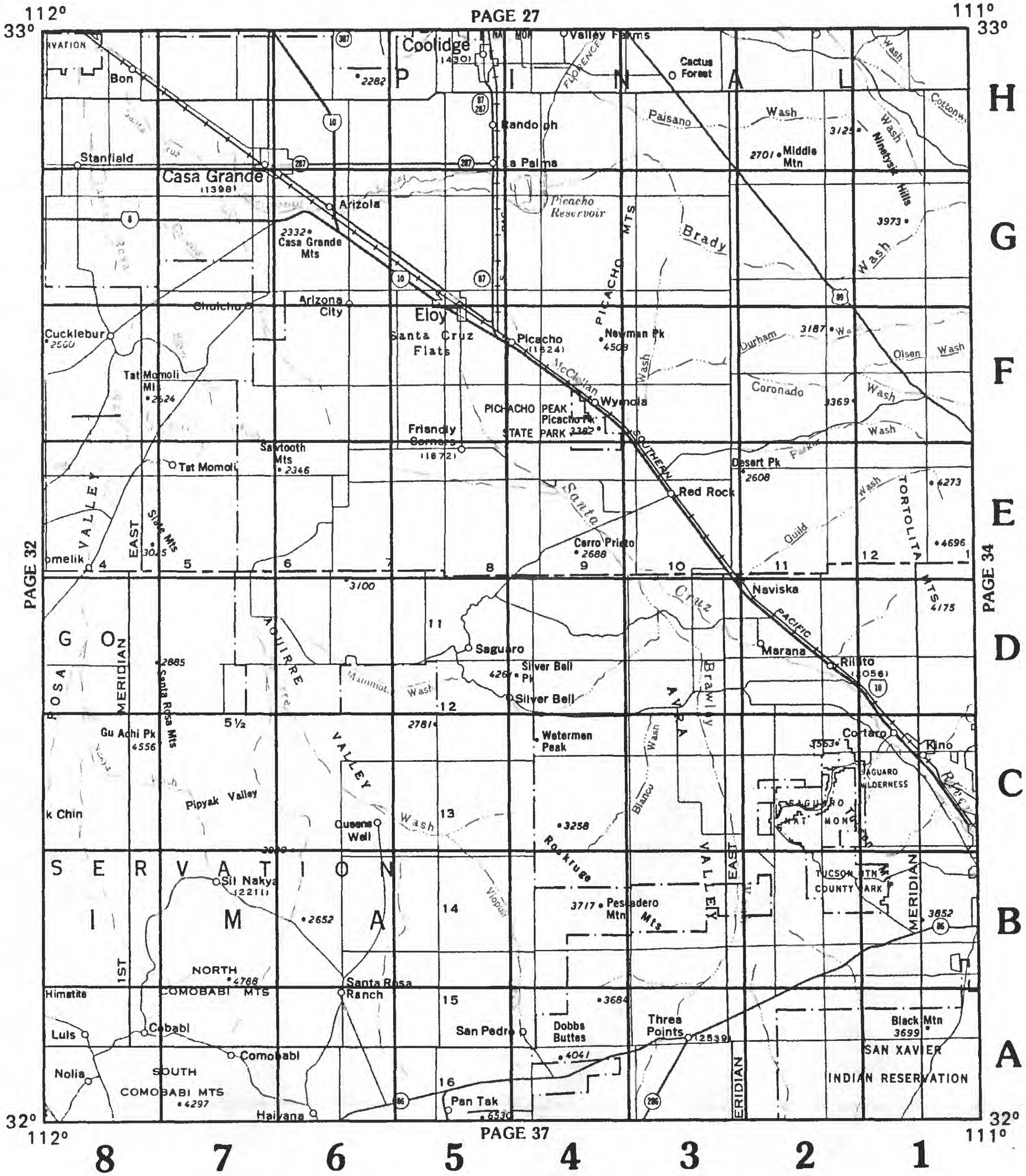

Figure 2. Index to 7.5-minute topographic maps of the Tucson and Nogales 1° by 2° quadrangles--continued.

7.5 MINUTE QUADRANGLE NAMES

A1	San Xavier Mission	E1	Tortolita Mts.
A2	San Xavier Mission SW	E2	Desert Peak
A3	Three Points	E3	Red Rock
A4	San Pedro	E4	Samaniego Hills
A5	Pan Tak	E5	Friendly Corners
A6	Haivana Nakya	E6	Greene Reservoir
A7	Comobabi	E7	Silver Reef Mts. SE
A8	Ko Vaya	E8	North Komelik
B1	Cat Mountain	F1	Chief Butte
B2	Brown Mtn.	F2	Durham Hills
B3	Cocoraque Butte	F3	Picacho Pass
B4	La Tortuga Butte	F4	Newman Peak
B5	San Ignacio Ranch	F5	Eloy South
B6	Black Hills	F6	Arizona City
B7	Sil Nakya	F7	Silver Reef Mts.
B8	Sand Wells	F8	Vaiva Vo
C1	Jaynes	G1	Ninetysix Hills SE
C2	Avra	G2	Ninetysix Hills SW
C3	West of Avra	G3	Picacho Reservoir SE
C4	Waterman Peak	G4	Picacho Reservoir
C5	Koht Kohl Hill	G5	Eloy North
C6	Queens Well	G6	Casa Grande Mtns.
C7	Santa Rosa Mts. SE	G7	Chuichu
C8	Santa Rosa Mts. SW	G8	Double Peak
D1	Ruelas Canyon	H1	Ninetysix Hills NE
D2	Marana	H2	Ninetysix Hills NW
D3	West of Marana	H3	Cactus Forest
D4	Silver Bell East	H4	Valley Farms
D5	Silver Bell West	H5	Coolidge
D6	Gap Tank	H6	Casa Grande East
D7	Santa Rosa Mts. NE	H7	Casa Grande West
D8	Santa Rosa Mts. NW	H8	Stanfield

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Certain areas may be covered by 7.5 x 15- or 15-minute maps

See CATALOG OF PUBLISHED MAPS for *available* maps, dates, scales, prices, and Map Order Forms

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7.5 MINUTE QUADRANGLE NAMES

A1	Dragoon	E1	Sierra Bonita Ranch
A2	San Pedro Ranch	E2	Harrison Canyon
A3	Galleta Flat East	E3	Bassett Peak
A4	Galleta Flat West	E4	Kielberg Canyon
A5	Rincon Peak	E5	Peppersauce Wash
A6	Vail	E6	Campo Bonito
A7	Tucson SE	E7	Oracle
A8	Tucson SW	E8	Oracle Junction
B1	Steele Hills	F1	Blue Jay Peak
B2	Deepwell Ranch	F2	Eureka Ranch
B3	Wildhorse Mtn.	F3	Kennedy Peak
B4	Happy Valley	F4	Rhodes Peak
B5	Mica Mountain	F5	Clark Ranch
B6	Tanque Verde Peak	F6	Mammoth
B7	Tucson East	F7	North of Oracle
B8	Tucson	F8	Fortified Mtn.
C1	Muskhog Mtn.	G1	Tripp Canyon
C2	Hookers Hot Springs	G2	Buford Hill
C3	Soza Mesa	G3	Klondyke
C4	Soza Canyon	G4	Oak Grove Canyon
C5	Piety Hill	G5	Holy Joe Peak
C6	Agua Caliente Hill	G6	Lookout Mtn.
C7	Sabino Canyon	G7	Putnam Wash
C8	Tucson North	G8	Black Mountain
D1	Reiley Peak	H1	Telegraph Wash
D2	The Mesas	H2	Jackson Mtn.
D3	Cherry Spring Peak	H3	Cobre Grande Mtn.
D4	Redington	H4	Booger Canyon
D5	Buehman Canyon	H5	Brandenburg Mtn.
D6	Mount Bigelow	H6	Dudleyville
D7	Mt. Lemmon	H7	Winkelman
D8	Oro Valley	H8	Grozier Peak

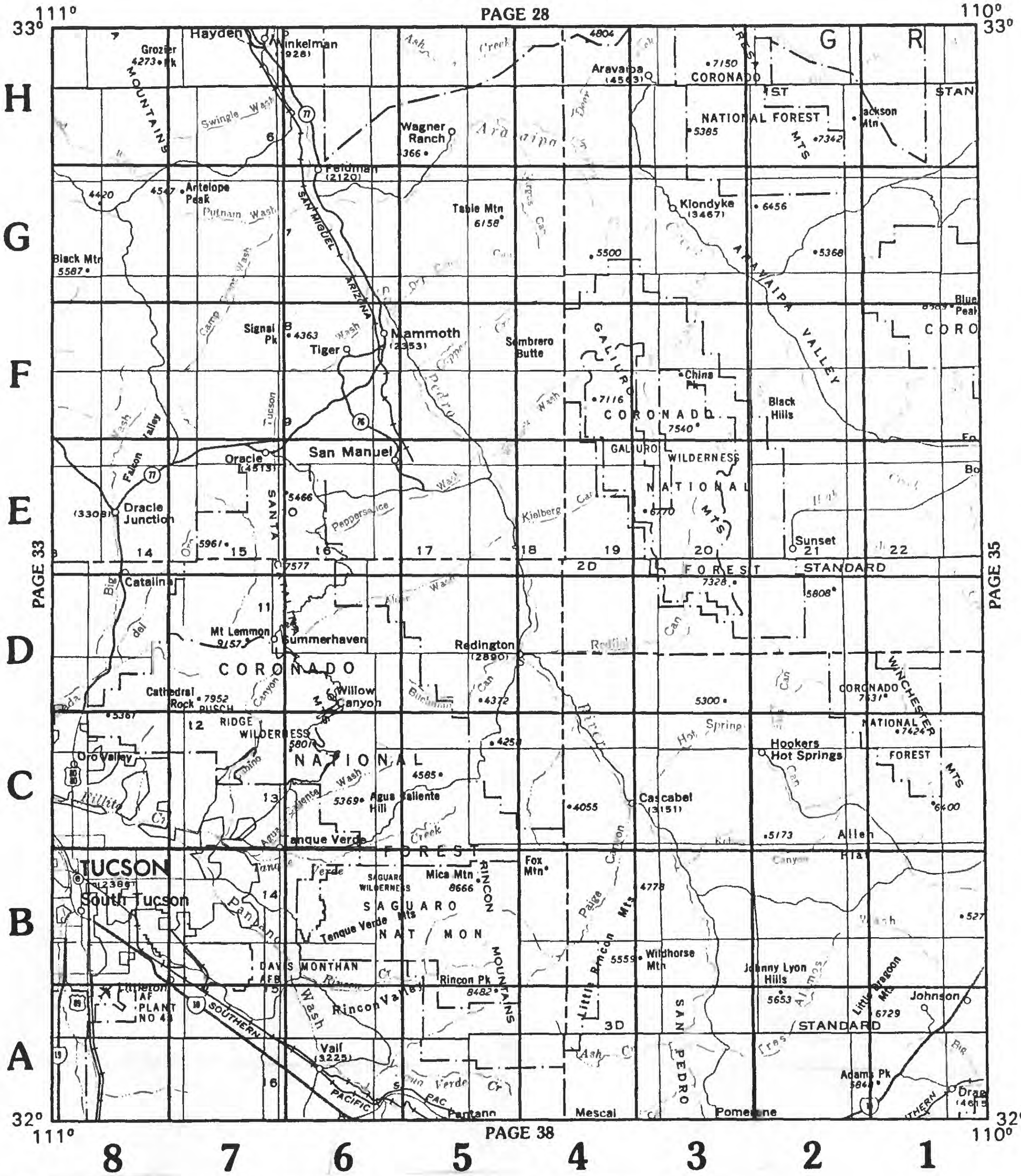

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Figure 2. Index to 7.5-minute topographic maps of the Tucson and Nogales 1° by 2° quadrangles--continued.

GEOLOGY

By Jocelyn A. Peterson, Joel R. Bergquist, Stephen J. Reynolds, and

Susan S. Page-Nedell

Data coverage and map compilation

Many 7 1/2- and 15-minute quadrangles within the Tucson and Nogales 1° by 2° quadrangles have been mapped at scales greater than or equal to 1:62,500 by the USGS (table 1), and students have produced thesis maps of local areas at a variety of scales (table 2). In addition, the tectonic map of southeastern Arizona (Drewes, 1980) includes about one-third of the study area at a scale of 1:125,000. Those areas not covered by large-scale mapping were compiled on a new Arizona state geologic map (Reynolds, 1988).

The geology of much of the study area is relatively well known because the area has undergone extensive exploration for several major types of mineral deposits, most notably for porphyry copper deposits associated with Laramide (Late Cretaceous and early Tertiary) plutons and for numerous skarn and replacement deposits in Paleozoic calcareous sedimentary rocks. In addition, because the region is geologically complex and interesting, the USGS and the University of Arizona in Tucson, have produced many maps and reports for this area that date back nearly 100 years. Thesis studies within the area date from the 1920's and cover topics such as stratigraphic and structural characteristics, aspects of mineral deposits, groundwater, and more recently, metamorphic core complexes and detachment faults. Geologic aspects of the study area that are not yet well known are the detailed Quaternary geology of the basins and the location of the structural boundaries between these basins and the mountain ranges. Because geologic studies in the region are ongoing, the geologic understanding of the region will continue to evolve.

The accompanying geologic map (pl. 1) was compiled from several sources. The Tucson 1° by 2° quadrangle has been compiled by Reynolds and others (in press) of the USGS and the Arizona Geological Survey and is currently being prepared for publication. Because a similar compilation does not exist for the Nogales 1° by 2° quadrangle, its geology was compiled from existing quadrangle maps, the tectonic map of southeastern Arizona (Drewes, 1980), and the new Arizona state map (Reynolds, 1988). Because new age data have become available since some of the quadrangle maps were published, the ages of rock units are those shown on the new state map. To provide continuity at the common boundary and to aid in interpreting the geology and making mineral assessments, the Nogales compilation largely follows the unit designations used for the Tucson compilation. It was necessary, however, to add four new unit designations to the Nogales quadrangle, and because we could not distinguish the various basin-fill units as designated on the Tucson quadrangle, all basin-fill sediments were combined into a single unit.

Geologic Summary

This geologic summary is largely a modification of the text provided with the compiled Tucson quadrangle (Reynolds and others, in press), augmented by information relating the geologic units to mineral deposits in the region. Generalization was necessary to show regional geology at the 1:250,000 map scale, which is suitable for a preliminary resource assessment.

The study area has a complex geologic history that began prior to 1.7 Ga. The oldest exposed rocks in the quadrangle are lower Proterozoic metasedimentary and metavolcanic rocks that accumulated in an ocean basin along the southern margin of what was then the edge of the North American craton (Silver, 1978). The protoliths were metamorphosed to greenschist- and lower amphibolite-grade rocks in Early Proterozoic time and are now referred to as the Pinal Schist. The Pinal Schist crops out in many of the major mountain ranges of the study area, usually associated with more extensive Proterozoic granitic rocks. The schist is generally considered unfavorable for hosting mineral deposits, although small base-metal and gold-silver-quartz veins are present locally. These veins are termed gash or reef veins in the Ajo 1° by 2° quadrangle to the west (Peterson and other, 1987) and are believed to have formed during metamorphism. They are of little economic significance.

The Pinal Schist was twice intruded by granitic rocks, at 1.65 and 1.45-1.40 Ga. The older plutons are composed of granodiorite, granite, and quartz diorite that are undeformed to foliated. Except for extensive exposures in the northeast corner of the study area in the Pinaleno and Santa Teresa Mountains, these plutons are limited to relatively small exposures. Much more extensive are the younger granitic rocks that are commonly correlated with the Oracle Granite of Peterson (1938), one of the major batholiths of this age. These younger plutons are readily identified by their distinctive potassium-feldspar megacrysts and medium- to coarse-grained texture. Compositionally they are mostly granite and granodiorite and commonly contain pegmatite, alaskite, and aplite dikes. The pegmatites are usually small and simple but some have been prospected for quartz, feldspar, and mica. The complex zoned pegmatites that contain rare elements, which are found farther north in Arizona, have not been seen in these plutons. These plutons are also suitable host rocks for porphyry copper mineralization when appropriate rocks have intruded them, as at the Vekol Hills deposit, about 9 km west of the quadrangle, and at San Manuel.

After intrusion of the younger granitic rocks and accompanying regional uplift, they were 200 to 300 million years of widespread erosion to a low-relief landscape. Thus, around 1.2 Ga the sedimentary rocks of the Apache Group were deposited in the region. Toward the end of deposition of the Apache Group around 1.1 Ga, large diabase sills and dikes intruded this sequence and the underlying basement rocks. Although Apache Group rocks probably were present in much of the northern part of the study area, only scattered remnants remain. These crop out mostly along flanks of the mountain ranges in the Tucson quadrangle; they are apparently absent in the Nogales quadrangle. Rocks of the Apache Group are nearly undeformed, commonly distinctive sedimentary units, which include quartzite, siltstone, mudstone, limestone, and conglomerate. Apache Group rocks and associated diabase are mineralized at the Lakeshore deposit; and farther north in Gila County they host asbestos and uranium deposits that have been mined. The uranium mineralization was of diagenetic origin and was further concentrated during intrusion of the diabase (Nutt, 1982).

Following deposition of the Apache Group, there was no further sedimentation for 500 million years until Cambrian time. Paleozoic rocks in the region are 1- to 2-km thick and represent siliciclastic and carbonate rocks of cratonic origin deposited concordantly on the Apache Group. They are Cambrian and Late Devonian through Permian age (Pierce, 1976). The Paleozoic sequence is characterized by numerous beds of limestone, dolomite, quartzite, sandstone, shale, and conglomerate, some of which have undergone low-grade metamorphism. Minor tectonism during Late Pennsylvanian and Early Permian time caused a local influx of clastic rocks and formed the Pedregosa basin east of the study area. Paleozoic strata are common in mountain ranges of the east half of the study area but are of very restricted extent in the west half because of erosion following Mesozoic and Cenozoic tectonism and uplift. The Paleozoic strata in the Tucson and Nogales quadrangles are very important as known and potential host rocks for numerous types of ore deposits including porphyry copper-related deposits, several kinds of skarns, and replacement deposits, which can include resources of base and precious metals, tungsten, and manganese. Such mineralization occurs mostly in the reactive calcareous strata rather than in siliciclastic rocks.

During the Mesozoic, the previously stable craton became a region of magmatism, deformation, and metamorphism (Reynolds and others, 1988). The oldest Mesozoic units are Early and Middle Jurassic sedimentary and volcanic rocks exposed primarily in the western and southern parts of the study area. The widely varied stratigraphy of these rocks throughout the region probably reflects complex lateral facies patterns developed in a tectonically active depositional area. Jurassic granitic rocks have intruded these rocks but are absent elsewhere. In Late Jurassic and Early Cretaceous time, magmatism decreased markedly and the region underwent local block faulting and widespread deposition of nonmarine clastic rocks, primarily of the Bisbee Group, which is most prevalent in the southern two-thirds of the study area. In the Late Cretaceous, a marine transgression from the area of the present Gulf of Mexico and another from the northeast invaded the southeastern and northeastern parts of the study area, depositing marine clastic rocks such as the Pinkard Formation found in the area of the northeastern transgression. Pre-Laramide Mesozoic rocks are generally not mineralized, although minor veins and pegmatites are found in some plutons, and Jurassic intrusons at Bisbee, east of the study area, are associated with a porphyry copper deposit. Some deposits in the Patagonia Mountains are hosted by Laramide volcanic rocks. Mesozoic sedimentary rocks host minor skarn and replacement deposits and some veins.

In Laramide time (late Cretaceous through Paleocene) the region was tectonically active (Drewes, 1981; Haxel and others, 1984; Keith and Wilt, 1986). Extensive volcanism, plutonism, compressional deformation, and deep-level metamorphism occurred. Volcanism between 75 and 65 Ma formed large andesitic stratovolcanoes and collapse calderas resulting from the eruption of rhyolitic ash. Unusual breccias such as the Tucson Mountains chaos accumulated within the calderas. These breccias contain andesitic megabreccia blocks in a rhyolitic tuff matrix (Lipman and Sawyer, 1985). The extensive volcanism was accompanied by intermediate-composition (generally granodioritic) intrusions and their associated porphyry copper deposits (Titley, 1982). These plutons were also the sources for ore fluids that formed skarn and replacement deposits in the calcareous Paleozoic strata and they are permissive rocks for low-fluorine porphyry molybdenum deposits, although none have been found in the study area. Younger peraluminous granites of crustal derivation that commonly contain muscovite and garnet were emplaced between 50 and 60 Ma in association with regional metamorphism (Haxel and others, 1984). They are extensive in the Santa Catalina, Rincon, and Baboquivari Mountains and are present locally elsewhere. These granites are not as likely to be mineralized as are the granodioritic intrusions and generally are not considered favorable for lithophile-element mineralization (Coney and Reynolds, 1980). Cretaceous and older rock units were repeated along both brittle and ductile thrust faults (Drewes, 1981); locally, metamorphism was accompanied by ductile attenuation of complete stratigraphic sequences, such that contacts between originally adjacent units are overprinted by an intense ductile fabric not necessarily representing thrust faults or other discrete shear zones.

The Eocene was a time of erosion, which was followed by renewed tectonism in the Oligocene that continued into the middle Miocene. Rhyolitic ash-flow tuffs and rhyolitic to basaltic flows covered much of the region (Shafiqullah and others, 1980) while granodioritic to granitic intrusions were emplaced at depth. Crustal extension at this time formed detachment faults, gently dipping, normal-displacement shear zones of regional extent that penetrated into the middle of the crust (Rehrig and Reynolds, 1980; Davis, G.H., 1983; Reynolds and others, 1988). Displacement along these shear zones formed mylonitic rocks that have been uplifted and are exposed in the Santa Catalina, Rincon, Tortolita, and Picacho Mountains. Upper-plate rocks along these zones formed tilted fault blocks, which are associated with syntectonic sedimentary units such as large megabreccia landslide blocks that were deposited in some half grabens. Similar tectonic settings in western Arizona and southeastern California are being examined for flat-fault-related gold that may be genetically tied to the tectonism. Such gold deposits have not been found in the study area, but some detachment-related Cu-Ag and Cu-U mineral deposits are locally present (Welty and others, 1985). The volcanic rocks from this period are present in nearly every mountain range and comprise a substantial part of the Galiuro and Winchester Mountains in the northeastern part of the study area. Rocks of this age contain various types of hydrothermal vein deposits. The associated intrusions are more restricted and crop out mainly in the Santa Catalina, Tortolita, and Picacho Mountains.

A younger episode of block faulting in the late Miocene formed basin-range structures. Subsequently, some of the larger grabens received as much as 3 km of nonmarine clastic sediments and evaporite deposits (Eberly and Stanley, 1978; Scarborough and Pierce, 1978). Pedimentation of the ranges was followed by deposition of a thin sequence of Pliocene and younger gravels. Basin-fill deposits in the topographically higher valleys in the east half of the study area were deeply incised and covered by multiple generations of Pleistocene and Holocene alluvial-fan and river-terrace gravels. The lower valleys on the west side of the study area are not incised and are covered by early Pleistocene to Holocene alluvium. Except for possible diatomite, zeolite, and evaporite deposits containing halite, gypsum, or anhydrite deep within the basin-fill sediments and for placer gold deposits at and close to the surface, these rocks are not likely to be mineralized.

Table 1.--Published maps by the U.S. Geological Survey that cover parts of the Tucson and Nogales 1° by 2° quadrangles. See selected references for complete citation

Quadrangle	Scale	Author and date of publication
Arivaca	1:63,360	Keith and Theodore, 1975
Baboquivari Peak	1:62,500	Haxel and others, 1980
Bellota Ranch	1:62,500	Creasey and Theodore, 1975
Benson	1:62,500	Creasey, 1967b
Black Mountain	1:24,000	Krieger, 1974a
Blue Jay Peak	1:24,000	Bergquist, 1979
Brandenburg Mountain	1:24,000	Krieger, 1968a
Casa Grande Mountains	1:24,000	Bergquist and Blacet, 1978
Cocoraque Butte	1:62,500	Keith, 1976
Comobabi	1:62,500	Haxel and others, 1978
Crozier Peak	1:24,000	Krieger, 1974b
Dragoon	1:31,680	Cooper and Silver, 1964
Eloy	1:62,500	Bergquist and others, 1978a
Empire Mountains	1:48,000	Finnell, 1971
Happy Valley	1:48,000	Drewes, 1974
Hereford (part)	1:48,000	Hayes and Landis, 1964
Holy Joe Peak	1:24,000	Krieger, 1968b
Jackson Mountain	1:62,500	Blacet and Miller, 1978
Klondyke	1:62,500	Simons, 1964
Lochiel	1:48,000	Simons, 1974
Lookout Mountain	1:24,000	Krieger, 1968c
Mammoth	1:62,500	Creasey, 1967a
Mount Lemmon	1:62,500	Banks, 1976
Mount Wrightson	1:48,000	Drewes, 1971a
Ninetysix Hills NE	1:62,500	Yeend and others, 1977
Ninetysix Hills NW	1:62,500	Yeend and others, 1977
Ninetysix Hills SE	1:62,500	Yeend and others, 1977
Ninetysix Hills SW	1:62,500	Yeend and others, 1977
Nogales	1:48,000	Simons, 1974
Palo Alto Ranch (part)	1:24,000	Drewes and Cooper, 1973
Presumido Peak	1:62,500	Haxel and others, 1982
Putman Wash	1:24,000	Krieger, 1974c
Rincon Valley	1:48,000	Drewes, 1977
Saddle Mountain	1:24,000	Krieger, 1968d
Sahuarita	1:48,000	Drewes, 1971b
San Vicente	1:62,500	Keith, 1976
Santa Rosa Mountains	1:62,500	Bergquist and others, 1978b
Sells	1:62,500	May and Haxel, 1980
Silver Reef Mountains	1:62,500	Blacet and others, 1978
Tortolita Mountains	1:62,500	Banks and others, 1977
Twin Buttes	1:48,000	Cooper, 1973
Vaca Hills	1:62,500	Banks and Dockter, 1976
Winkelman	1:24,000	Krieger, 1974d

Table 2.-- Thesis mapping used in the compilation of the Tucson 1^{o} by 2^{o} quadrangle. See selected references for complete citation

Area studied	Scale	Author and thesis completion date
Central Arizona	1:125,000	Balla, 1972
Tortolita-Santa Catalina Mts.	1:62,500	Budden,1975
Buehman Canyon, Santa Catalina Mts.	1:6,000	Bykerk-Kauffman, 1983
Black Hills	1:62,500	Hansen, 1983
Safford Peak, Tucson Mts.	1:9,600	Imswiler, 1959
Geesaman Wash, Santa Catalina Mts.	1:12,000	Janeke, 1986
Picacho Mts.	1:6,000	Johnson, 1981
Northern Tucson Mts.	1:6,000	Knight, 1967
Northern Rincon Mts.	1:24,000	Lingrey, 1982
Waterman Mts.	1:6,000	McClymonds, 1957
Silver Bell Mts.	1:100,000	Sawyer, 1987
Northern Santa Catalina Mts.	1:24,000	Wallace, 1954

Selected References

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GEOCHEMISTRY

By Maurice A. Chaffee

Data Coverage

For this report, all available analyses from the NURE hydrogeochemical and stream-sediment reconnaissance (HSSR) data bases (National Uranium Resource Evaluation Program, 1982a, b, c) and the USGS RASS and PLUTO data bases were retrieved and examined. The information contained in these data bases is summarized in tables 3 and 4. The locations of sample sites for each medium for which analytical data exist are shown on figures 3 to 12 for the Tucson and Nogales 1° by 2° quadrangles. For this geochemical evaluation, only the three data bases mentioned above were examined. No exhaustive search was made for additional geochemical data, although such data probably exist. Also, none of the Indian reservations within the study area have been evaluated because of the proprietary nature of the geochemical data (see Introduction).

Except for soil samples, the NURE data bases do not have adequate sample coverage for regional evaluations (tables 3, 4; figs. 3-7). The soil samples adequately cover the study area, but they were rejected for this evaluation because (1) soil samples usually represent restricted source material and are thus not suitable for a regional reconnaissance evaluation, (2) there is no way to determine whether the material collected was, in fact, soil and whether it was derived from residual or transported material or even from a reasonably consistent soil horizon, and (3) the fine size of the material collected (<0.149 mm or <100 mesh) suggests that eolian contamination and dilution may have biased the analyses, a suspicion that is confirmed by the distributions of selected elements, which show anomalies along major highways and downwind from major mines and smelters.

The PLUTO data base contains data for numerous rock samples (tables 3, 4) but has little else of use for a regional assessment. Because rock samples generally represent point sources of data, they are not generally useful in regional reconnaissance evaluations. They are most useful for defining normal abundances of elements in selected rock types and for identifying elements associated with the types of mineralization that may be present in a study area. Much of the PLUTO data are for samples collected prior to 1980. Consequently, the elements analyzed for these samples commonly were not the same suite as has been routinely used in RASS, and the detection limits for PLUTO samples differed from those commonly found in RASS data.

For this investigation, the chemical data for the stream-sediment samples in the RASS data base were deemed the most useful, even though the coverage is not uniform (fig. 9). The distributions of anomalies for samples in this medium are discussed below.

Evaluation of USGS Stream-sediment Data

Information concerning the complete stream-sediment data set is summarized in table 5. All samples were analyzed by a semiquantitative emission spectroscopic method (Grimes and Marranzino, 1968), although not every sample was run for all of the commonly determined 31 elements. Also, several elements (As, Au, Sb, Th) that are usually determined spectrographically were not found in detectable concentrations in any of the samples. Many samples from the Nogales quadrangle were also analyzed by various nonspectroscopic methods for As, Au, Cd, Hg, Sb, Te, U, and (or) Zn (tables 5, 6). In contrast, with the exception of AA-Zn, samples from the Tucson quadrangle were not analyzed for any elements by nonspectroscopic methods. Evaluation of the geochemical data is, therefore, further hampered by a lack of data on many common ore-related elements. Thus, the lack of anomalies for a given ore-related element in a given area may result from a lack of analyses rather than from analyses that were within the background range.

The ore-related elements Ag, As, Au, Bi, Cu, Hg, Mo, Pb, Sb, Sn, Te, U, W, and Zn were selected from the original data set for this evaluation. Information about these elements is summarized in table 6. For the discussion below, each 1° by 2° quadrangle was divided into areas that generally represent a single mountain range or part of a range (pl. 2). Those ranges for which there are geochemical data are delineated by a letter, which also has been added in parentheses after each range name in the text. Plate 2 also shows the approximate limits of outcrop of pre-middle Miocene age rocks, which are considered to have been deposited after major mineralization. These outlines are useful for planning future sampling programs. They also emphasize that only about 50 percent of the study area is composed of outcrops and, thus, is suitable for reconnaissance geochemical sampling.

Element maps were made for evaluating the study area (pls. 3 to 17). Anomalies shown on these maps have been integrated into the discussion that follows. Several symbols identify anomalous samples on the geochemical maps. The classificiation of sample analyses is somewhat arbitrary and is based on past experience in evaluating tracts for their mineral potential. In general, a square represents approximately the upper 2 percent (98th percentile) of all of the analyses for a given element and a circle represents the next 3 percent (95th percentile). Other symbols further classify the element abundances in decreasing concentration ranges. A plus (+) is used for analyses considered to be clearly in the background range for a given element.

Actual anomalous areas are delineated, to some extent, arbitrarily on the basis of past experience but also on a knowledge of mineralized areas in the two quadrangles. In general, anomalies based on clusters of anomalous samples are more significant than single-site anomalies, particularly for concentrations near the threshold (uppermost background) value. Outlines of anomalous areas in some cases are based on the extents of drainage basins, which represent the restricted sources of the stream alluvium sampled; in other cases the outlines simply enclose clusters of anomalous samples. The latter is especially true where the sample density is low.

Two maps are included for Au because samples were analyzed by two methods that are so different that the analyses for the two methods could not be merged. The anomalies on the two maps may or may not overlap, even where analyses of both types are available for the same general area. This lack of agreement is partly related to the particulate nature, and therefore the commonly erratic distribution, of gold in stream alluvium. This erratic distribution of gold tends to hinder sample reproducibility. Other differences in anomaly distributions result from the spatial distributions of anomalous samples and from the concentrations of gold in specific samples relative to concentrations in other samples in the same data set.

Tucson Quadrangle

Santa Catalina Mountains (area A)--The Pusch Ridge part of this range, which has been evaluated for a wilderness mineral resource assessment report (Hinkle and Ryan, 1982), is composed mostly of Proterozoic and Tertiary plutonic rocks of intermediate composition. A few prospects containing quartz veins with associated traces of base metals or Au were identified (Hinkle and Ryan, 1982).

Stream-sediment samples from this range show scattered Cu, Mo, and Sn anomalies (pls. 8, 10, 13), some of which are relatively strong when compared to concentrations elsewhere in the study area. These anomalies in the Pusch Ridge area are associated with quartz veins in Tertiary and Proterozoic host rocks, an environment similar to that found at the San Manuel-Kalamazoo porphyry copper-molybdenum deposit about 25 km to the northeast. The chemistry of the Pusch Ridge area suggests a possibility of porphyry copper-molybdenum mineralization at depth.

Rincon Mountains (area B)--Part of this range has also been described in a wilderness mineral resource assessment report (Thorman and others, 1981). Rocks in the wilderness study area consist mostly of Proterozoic schist and of Proterozoic and Tertiary intrusions generally of intermediate composition. Paleozoic, Cretaceous, and Tertiary sedimentary units and Paleozoic and Cretaceous metasedimentary units are also present. Pods containing minor amounts of base and precious metals were found in both skarns and unaltered, carbonate-rich, Paleozoic sedimentary rocks and in sheared Proterozoic gneisses. Uranium mineralization is present in Paleozoic and Cretaceous metasedimentary rocks, granitic rocks, and Tertiary "basin fill" clastic rocks (Thorman and others, 1981).

The samples of stream sediment collected from the Rincon Mountains contain scattered, generally weak anomalies for Ag, Cu, Mo, and Pb (pls. 3, 8, 10, and 11), with most of the anomalies, including some that are strongly anomalous for Mo, confined to the northern part of the range between the Redington Pass road and Mineta Ridge. The anomalous elements corroborate known mineralization, which may represent leakage from a deep-seated porphyry copper and (or) molybdenum system or from some other, as yet undefined, type of mineralization.

Aravaipa Canyon (area C)--Most of the area is covered by a thick sequence of mid-Tertiary rhyolitic to andesitic volcanic rocks, but Proterozoic diabase, quartzite, and granitic rocks and Paleozoic sedimentary rocks are exposed on the west side. Part of this area was studied for the Aravaipa Canyon Instant Study Area by Krieger and others (1979) who identified no metallic-mineral resources; however, zeolite resources were identified. Silver, Au, Cu, Mo, Pb, and Zn have been produced from mining districts a few miles north of this study area (Krieger and others, 1979).

Samples collected from the Aravaipa Canyon study area are locally anomalous for Ag, Cu, Mo, and (or) Pb (pls. 3, 8, 10, and 11). These anomalies may have resulted from contamination from mining upstream to the north or may represent leakage from possible porphyry copper and (or) molybdenum mineralization that may be present in the study area at depth under the Tertiary volcanic cover.

Galiuro Mountains (area D)--A large part of this area was sampled for the Galiuro Wilderness Area mineral resource assessment (Creasey and others, 1981). Outcrops are dominated by mid-Tertiary volcanic rocks, which vary in composition from rhyolite to andesite. Locally exposed older rocks include Proterozoic schists, granites, and quartzites; Paleozoic quartzites; and Late Cretaceous or early Tertiary volcanic and plutonic rocks of generally intermediate composition. Area D contains base- and precious-metal vein deposits that are present near faults in the Tertiary volcanic rocks in or near Cretaceous granodiorite plutons. At least one porphyry copper-molybdenum system, with associated Ag and Pb, has been identified in the Copper Creek district at the north end of the area. This system is associated with Cretaceous granodiorite. Pyritic-argillic alteration that is locally present in the Galiuro Volcanics may have resulted from remobilization of blind porphyry copper mineralization during deposition of the volcanic rocks (Creasey and others, 1981).

Evaluation of analyses of stream-sediment samples indicate that two significant clusters of sites with anomalous Cu are present in the northern part of this range (pl. 8). These anomalies, locally accompanied by Mo and Pb (pls. 10 and 11), reflect the known porphyry copper-molybdenum mineralization in that area. Scattered anomalies for Ag and Cu (pls. 3 and 8) are present farther south in the range. These anomalies may represent leakage upward into the overlying volcanic rocks from blind porphyry copper-molybdenum mineralization. Scattered, locally strong, Sn anomalies (pl. 13) may reflect felsic volcanic rock units similar to those that are known to be Sn-rich in some localities in Arizona and New Mexico.

Santa Teresa Mountains (area E)--Part of this range was studied for the mineral resource assessment of the Black Rock Wilderness Study Area (Simons and others, 1987). Rocks in the Black Rock area include Proterozoic schist, gneiss, diabase, and quartz monzonite; Tertiary granite; and Tertiary volcanic rocks of rhyolitic to basaltic composition. Simons and others (1987) noted anomalous Ag, Au, Ba, Be, Bi, Cd, Co, Cu, Pb, Sn, V, W, and Zn associated with quartz veins in volcanic rocks, granite, and granitic gneiss. They also described high concentrations of rare-earth and associated elements, such as La, Th, Y, and Zr, which may indicate potential for rare-earth-element resources in the area, and they suggested that contact-metasomatic vein tungsten deposits may occur in metamorphic rocks.

On the basis of stream-sediment data, the eastern part of this range is strongly anomalous for Cu, Pb, and Sn (pls. 8, 11, and 13) and weakly to moderately anomalous for Ag and Mo (pls. 3 and 10). These elements suggest a favorable environment for base- and precious-metal vein mineralization. Porphyry copper and (or) molybdenum mineralization at depth is also possible.

As has been suggested for the Galiuro area, the high Sn concentrations here may be related to a Sn-rich, felsic volcanic or plutonic rock unit.

Winchester Mountains (area F)--Samples from this area were collected for the Winchester Roadless Area mineral resource assessment study (Chaffee, 1985). Outcrops are composed of the same Tertiary volcanic units found in the Galiuro Mountains to the northwest. No mines or prospects were identified in the roadless area and the range does not contain any anomalies that can be related to mineralization.

Little Dragoon Mountains (area G)--This area contains outcrops of Proterozoic metamorphic rocks, Paleozoic sedimentary rocks, and Laramide plutonic rocks of intermediate composition. The area contains base- and precious-metal skarn mineralization in Paleozoic rocks associated with the porphyry copper deposit at Johnson Camp. Strongly anomalous Ag, Cu, and Mo (pls. 3, 8, and 10) and moderately anomalous Sn (pl. 13) are present in samples collected from the eastern part of the range. These anomalies reflect the porphyry copper-molybdenum deposit and surrounding mineralization at Johnson Camp.

Nogales Quadrangle

Baboquivari Mountains (east side) (area H)--Outcrops in this area consist largely of Jurassic sedimentary and volcanic rocks and Jurassic and Cretaceous felsic to intermediate plutonic rocks. Much of the area contains weakly to moderately anomalous Au (pls. 5 and 6). Strongly anomalous Te (pl. 14) occurs in the center of the range from near Mildred Peak northward. The Mildred Peak area also locally exhibits anomalous Ag, As, Pb, Sb, and W (pls. 3, 4, 11, 12, and 16) as well as scattered anomalies for Mo, Sn, and W (pls. 10, 13, and 16). The Ag, As, Au, Sb, and Te suite suggests epithermal precious-metal vein mineralization. Tin and W anomalies suggest that veins rich in these two elements or Sn-rich felsic igneous rocks may be present. Areas containing anomalous Mo, Sn, and W may indicate porphyry molybdenum mineralization.

Sierrita Mountains (area I)--Rocks in this complex mountain range include Jurassic and Laramide felsic to intermediate plutonic rocks, Paleozoic sedimentary rocks, Mesozoic sedimentary and volcanic rocks, and Tertiary volcanic rocks. Numerous major porphyry copper-molybdenum deposits are present along the east side of the range.

Stream-sediment samples collected from the west side of this range contain strong anomalies for Ag, Hg, Pb, Sb, Te, and Zn (pls. 3, 9, 11, 12, 14, and 17). Most of these anomalies are in or near the Ash Creek drainage below known mineralized localities. This suite suggests that Ag-Pb-Zn vein-type mineralization is the most common. One sample was anomalous for Au (pl. 6). The southern and eastern parts of the range contain scattered sites with strongly anomalous Cu, Mo, and Te (pls. 8, 10, and 14) and locally anomalous Ag and As (pls. 3 and 4). These anomalies correlate with the known porphyry copper-molybdenum and associated skarn deposits in this area.

Cerro Colorado Mountains area (area J)--This area is composed almost entirely of Cretaceous and Tertiary volcanic rocks. Samples from the area are strongly anomalous for Ag, Hg, and Sb (pls. 3, 9, and 12), and are locally weakly to moderately anomalous for Au, Mo, Pb, and Te (pls. 6, 10, 11, and 14). These elements correlate with known epithermal Ag-Hg base-metal veins in the area.

Las Guijas Mountains (area K)--This range contains Jurassic and Cretaceous volcanic and sedimentary rocks and Jurassic granitic rocks. Complex vein tungsten ores have been mined in the northern part of the range and epithermal base- and precious-metal veins have been mined along the south side. Samples collected from this range are strongly anomalous for Sb, Sn, and W (pls. 12, 13, and 16) and moderately to weakly anomalous for Ag, Au, and Mo (pls. 3, 5, 6, and 10). These elements are consistent with the two known types of mineralization in the area.

San Luis Mountains-Cobre Ridge area (area L)--This area contains exposures of Jurassic and Cretaceous sedimentary and volcanic rocks and Laramide felsic plutonic rocks. Small-scale base- and precious-metal mining has occurred in the past. Samples from this area contain strongly anomalous Au, Te, and W (pls. 5, 6, 14, and 16) as well as moderately to weakly anomalous Ag, Bi, Cu, Hg, Mo, Pb, Sb, Sn, and Zn (pls. 3, 7-13, and 17). The anomalies for Ag, Au, Hg, Pb, Sb, Te, and Zn corroborate known epithermal Ag-Au vein mineralization. The anomalies for Bi, Mo, Sn, and W may locate vein tungsten associated with the felsic plutonic rocks.

Ruby-Bartlett Mountain area (area M)--The main rock types in this area include Jurassic and Tertiary felsic to intermediate volcanic rocks and Jurassic felsic plutonic rocks. Base- and precious-metal vein deposits are found at the Ruby mine and numerous other smaller mines and prospects. This area is strongly anomalous for many elements, including Ag, Au, Bi, Cu, Hg, Mo, Pb, Sb, Sn, W, and Zn (pls. 3, 5-13, 16, and 17). The strong anomalies for Bi, Cu, Mo, Sn, and W (as well as for some of the other elements) suggests that, in addition to vein deposits, porphyry copper and (or) molybdenum mineralization could be present at depth, especially near Bartlett Mountain.

Pajarito Mountains (area N)--Jurassic and Tertiary volcanic rocks predominate; small amounts of Mesozoic sedimentary rocks are present in the western part of the area. Samples from this area are strongly anomalous for Ag, As, Au, Pb, Sb, Sn, and Zn (pls. 3-6, 11-13, and 17) and are weakly to strongly anomalous for Bi, Hg, Mo, Te, and U (pls. 7, 9, 10, 14, and 15). Small epithermal base- and precious-metal vein deposits are known in the area and uranium mineralization has also been identified. The anomalous elements corroborate these deposits and also suggest that some of these small veins may be the upper manifestations of one or more deep-seated porphyry copper-molybdenum systems.

Tumacacori Mountains (area O)--The north end of this range contains a Jurassic granitoid pluton and small exposures of altered Paleozoic sedimentary rocks. Nearly all of the rest of the range is composed of Tertiary volcanic rocks. Samples from this range contain scattered strong anomalies for As, Au, Sb, and Sn (pls. 4, 6, 12, and 13) and local moderate to weak anomalies for Ag, Au, Bi, Hg, Mo, and Te (pls. 3, 5, 7, 9, 10, and 14). The strongest anomaly, which contains As, Au, Hg, Sb, Sn, and Te, is near the north end of the range. This anomaly is near the contact between the granitic pluton and Tertiary volcanic rocks and suggests that epithermal-vein gold mineralization may be present.

Mount Benedict area (area P)--This small area consists of outcrops of a Jurassic granite. The area contains weakly anomalous Au, Bi, Hg, Sb, and Sn (pls. 5, 7, 9, 12, and 13). This suite suggests that weak vein-associated gold mineralization may be present locally.

Patagonia Mountains (area Q)--This range contains a complex assemblage of Proterozoic plutonic rocks; Paleozoic sedimentary rocks; Mesozoic sedimentary, volcanic, and plutonic rocks; and Tertiary volcanic and intrusive rocks. Skarn deposits occur at the south end of the range; base- and precious-metal-vein deposits are found in the middle and northern parts of the range; and porphyry copper-molybdenum mineralization is found at Red Mountain in the northern part of the range. Porphyry-type mineralization is also present at other localities in the range.

On the basis of the available geochemical data, the Patagonia Mountains are probably the most highly mineralized part of the study area. Much of the range is moderately to strongly anomalous for all 14 selected ore-related elements (Ag, As, Au, Bi, Cu, Hg, Mo, Pb, Sb, Sn, Te, U, W, and Zn) (pls. 3-17). This suite is consistent with known porphyry copper-molybdenum mineralization at Red Mountain, base- and precious-metal mineralization that is associated with at least one major mineralized fault, and skarn mineralization at the south end of the range. The intensity and extent of the geochemical anomalies in the range as a whole suggest that additional porphyry- and vein-type mineralization may be present at depth in various parts of the range (Chaffee and others, 1981).

San Cayatano Mountains (area R)--This small range contains Cretaceous sedimentary rocks that were intruded by a small pluton. Samples collected in the area contain moderately to strongly anomalous Hg (pl. 9), as well as moderately to weakly anomalous Ag, Au, Cu, Mo, Pb, Sb, Te, U, and Zn (pls. 3, 5, 8, 10-12, 14, 15, and 17). This suite probably represents epithermal base- and precious-metal vein mineralization but may also represent the upper manifestations of a deep-seated porphyry copper-molybdenum system.

Santa Rita Mountains (area S)--Rocks in this area range from Proterozoic to Quaternary and include felsic to intermediate plutonic rocks, felsic to mafic volcanic rocks, and clastic and nonclastic sedimentary sequences. The most significant types of mineralization in the range include precious-metal veins, base- and precious-metal skarn deposits, and porphyry copper-molybdenum deposits.

The range has not as yet been adequately sampled, but the available stream-sediment analyses indicate that the area is strongly mineralized. Stream-sediment samples from the area are strongly anomalous for Ag, As, Au, Cu, Pb, Sn, U, and Zn (pls. 3, 4, 6, 8, 11, 13, 15, and 17) and weakly to moderately anomalous for Bi, Hg, Mo, Sb, Te, and W (pls. 7, 9, 10, 12, 14, and 16). These anomalies are associated with known mineralization (1) north of Mt. Fagan at the north end of the range, (2) in the Helvetia-Rosemont district, (3) in the Greaterville district (Drewes, 1970), (4) in the Cottonwood Canyon (Glove mine) area, and (5) in the Squaw Peak-Temporal Gulch area at the south end of the range (Drewes, 1967). Many of the stream-sediment anomalies present in the Patagonia Mountains (area Q) continue northwestward into the south end of the Santa Rita Mountains, suggesting that similar mineralized areas, particularly for porphyry copper-molybdenum deposits, may be present in the Santa Rita Mountains. Locally high concentrations of Mo, Sn, and (or) W may indicate occurrences of vein or skarn tungsten deposits or deep-seated porphyry copper and (or) molybdenum systems.

Empire Mountains (area T)--This range, northeast of the Santa Rita Mountains, contains similar geology. Base- and precious-metal mineralization is present locally. This area has not, as yet, been adequately sampled. Available data show stream-sediment samples with strongly anomalous Mo, and Te (pls. 10 and 14) as well as weakly to moderately anomalous Ag, As, Bi, Cu, Pb, Sb, and Zn (pls. 3, 4, 7, 8, 11, 12, and 17). This suite corroborates known Ag-rich base-metal mineralization. It is possible that this mineralization may be associated with a deep-seated porphyry copper-molybdenum system.

Whetstone Mountains (area U)--This range contains Proterozoic granite and gneiss, Paleozoic sedimentary rocks, and Mesozoic and Tertiary sedimentary, volcanic, and plutonic rocks. Part of the area was sampled for a mineral resource assessment of the Whetstone Roadless Area (Wrucke and others, 1983). Samples collected in this range show scattered anomalies for Ag, As, Bi, Cu, Mo, Sb, Sn, U, and W (pls. 3, 4, 7, 8, 10, 12, 13, 15 and 16), and a widespread weak to moderate anomaly for Au (pl. 5). The most significant anomaly (As, Au, Bi, Cu, and Mo) is in Mescal Creek on the southeast side of the range, where porphyry copper-molybdenum mineralization and base- and precious-metal mineralization are known (Wrucke and others, 1983). Bismuth, Sn, and W anomalies may be associated with tungsten-vein mineralization. Other deposits identified in this range by Wrucke and others (1983) contain F, Hg, and U.

Mustang Mountains (area V)--Outcrops in this small range are predominantly Paleozoic sedimentary and Jurassic volcanic rocks. The few stream-sediment samples from the area contain scattered anomalies for Au, Pb, and Te (pls. 6, 11, and 14), suggesting that epithermal precious-metal vein mineralization may be present locally.

Canelo Hills (area W)--This area contains a predominance of Paleozoic sedimentary rocks and Jurassic and Cretaceous volcanic rocks. Local anomalies of Au, Pb, Sb, Sn, Te, and Zn (pls. 5, 6, 11-14, and 17) are found in the area. The source or sources of most of these anomalies are not known. Only the Sn anomalies are particularly strong; they are probably related to Sn-bearing felsic volcanic rocks.

Huachuca Mountains (area X)--Proterozoic granite, Paleozoic and Mesozoic sedimentary rocks, and Jurassic and Cretaceous felsic to intermediate intrusions predominate in this area. Stream-sediment samples are moderately to strongly anomalous for Hg, Pb, Sn, Te, W, and Zn (pls. 9, 11, 13, 14, 16, and 17) on the east side and for Ag, Cu, Hg, Pb, Sn, Te, and Zn (pls. 3, 8, 9, 11, 13, 14, and 17) on the west side. Anomalies for Au, Bi, and (or) Sb (pls. 5-7 and 12) are present in scattered localities. The Bi, Sn, and W anomalies are related to known tungsten-vein mineralization along the east front of the range. The other elements reflect known polymetallic base- and precious-metal vein-type and skarn mineralization, primarily in the western part of the range.

Tombstone Hills (area Y)--This area contains outcrops of Paleozoic and Mesozoic sedimentary rocks, Mesozoic volcanic rocks, and Laramide intrusions. Past mining has been of carbonate-hosted base- and precious-metal ores. Stream-sediment samples are moderately to strongly anomalous for Ag, As, Au, Cu, Hg, Pb, Sb, Te, and Zn (pls. 3-6, 8, 9, 11, 12, 14, and 17) and also contain weakly to moderately anomalous Mo (pl. 10). These anomalous elements reflect the known mineralization but also suggest that a porphyry copper-molybdenum system may be present at depth.

Mule Mountains (area Z)--Only a small part of this range, which includes the Bisbee porphyry copper district, is in the study area. The exposures are mostly Paleozoic sedimentary rocks but include Proterozoic metamorphic rocks and Laramide intrusions. Samples from this area contain strongly anomalous Te (pl. 14) and weakly to moderately anomalous Au, Pb, and Sn (pls. 5, 11, and 13). The Au and Te may reflect the outer effects of a chemical halo surrounding the Bisbee district or might represent leakage from a deep, as yet unknown, porphyry copper-molybdenum system.

Dragoon Mountains (area AA)--About one-third of this range is within the study area. The entire range was studied for the Dragoon Mountains Roadless Area assessment (Drewes and others, 1983). The part of the range in the study area contains mostly Proterozoic granodiorite and metamorphic rocks, Paleozoic and Mesozoic sedimentary rocks, and Tertiary granitic rocks. The roadless area study identified localities west of 110°00' west longitude that might contain silver- and base-metal-rich skarn deposits, porphyry molybdenum deposits, and replacement or vein deposits of tungsten (Drewes and others, 1983).

Based on available geochemical data, this range is one of the most intensely mineralized in the study area. Strong to moderate anomalies for Ag, As, Au, Bi, Cu, Mo, Pb, Sb, Sn, Te, W, and Zn (pls. 3-5, 7, 8, 10-14, 16, and 17) all overlap in the northern part of the range. This suite of elements agrees with those that might be expected in the types of mineralization mentioned above.

Table 3.--Summary of analytical information from the RASS, PLUTO, and NURE data bases for the Tucson 1° by 2° quadrangle, Arizona

[Elements not determined by semiquantitative emission spectroscopy (SQS) were determined by various chemical methods, mainly neutron activation analysis, atomic absorption analysis, and inductively coupled plasma spectroscopy; CX, cold extractable method; HM, heavy metals; --, no analyses]

Sample type	Number of samples	Number of sites	Elements determined: On most samples	Elements determined: On some samples
RASS DATA BASE				
<60- or <80-mesh stream sediment	957	954	30-element SQS[1], Zn	CX-HM, CX-Cu, S, Th
Nonmagnetic heavy-mineral concentrate	322	314	31-element SQS[2]	--
Magnetic heavy-mineral concentrate	80	80	30-element SQS[1]	--
Mineralized/unmineralized rock	206	153	do.	CX-HM, CX-Cu, Au, Zn
Well water	133	122	As, Ca, Cu, Fe, K, Mg, Mn, Mo, Na, $SO_4^=$, Zn, alkalinity	Ag, Al, Cd, Cl, Co, Cr, F, Li, Ni, NO_3^-, Pb, SiO_2,
PLUTO DATA BASE				
<80-mesh stream sediment	15	15	30-element SQS[1]	--
Mineralized/unmineralized rock	90	90	do.	--
NURE DATA BASE				
<100-mesh stream sediment	377	377	Ag, Al, B, Ba, Be, Ca, Ce, Co, Cr, Cu, Fe, Hf, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, Pb, Sc, Sr, Th, Ti, V, Y, Zn, Zr	--
<100-mesh soil	1,350	1,350	do.	--
Well water	296	296	Ag, Al, As, B, Ba, Ca, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Sc, Si, Sr, Ti, V, Y, Zn, Zr, pH, alkalinity	Be, Br, Ce, Cl, Dy, F
Stream water	51	51	do.	do.
Spring water	28	28	do.	do.

[1]Includes Ag, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, La, Mg, Mn, Mo, Nb, Ni, Pb, Sb, Sc, Sn, Sr, Ti, V, W, Y, Zn, and Zr.
[2]Includes all of the elements in the 30-element SQS plus Th.

Table 4.--Summary of analytical information from the RASS, PLUTO, and NURE data bases for the Tucson 1° by 2° quadrangle, Arizona

[Elements not determined by emission spectroscopy (SQS) were determined by various chemical methods, mainly neutron activation analysis, atomic absorption analysis, and ICP; CM, colorimetric analysis; --, no analyses]

Sample type	Number of samples	Number of sites	Elements determined: On most samples	Elements determined: On some samples
			RASS DATA BASE	
<60- or <80-mesh stream sediment	1,618	1,493	30-element SQS[1], As, Au, Hg, Sb, Te, Zn	CM-As, Cd, U
Nonmagnetic heavy-mineral concentrate	382	380	31-element SQS[2]	--
Mineralized/unmineralized rock	693	531	31-element SQS[2], Au, Hg, Sb, Te, Zn	As, Bi, Cd, K, Na, Tl, U
Well water	335	159	As, Ca, Cl, Cu, F, Fe, K, Mg, Mn, Mo, Na, NO_3^-, SiO_2, specific conductance	Ag, Al, Cd, Co, Cr, Li, Ni, Pb, Sr
			PLUTO DATA BASE	
<80-mesh stream sediment	16	16	30-element SQS[1]	--
Mineralized/unmineralized rock	138	138	do.	--
			NURE DATA BASE	
<100-mesh stream sediment	228	228	Ag, Al, B, Ba, Be, Ca, Ce, Co, Cr, Cu, Fe, Hf, K, La, Li, Mg, Mn, Na, Nb, Ni, Pb, Sc, Sr, Th, Ti, V, Y, Zn, Zr	--
<100-mesh soil	943	943	do.	--
Well water	200	200	Ag, Al, As, B, Ba, Ca, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Sc, Si, Sr, Ti, V, Y, Zn, Zr, pH, alkalinity	Be, Br, Ce, Cl, Dy, F
Stream water	13	13	do.	do.
Spring water	27	27	do.	do.

[1]Includes Ag, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, La, Mg, Mn, Mo, Nb, Ni, Pb, Sb, Sc, Sn, Sr, Ti, V, W, Y, Zn, and Zr.
[2]Includes all of the elements in the 30-element SQS plus Th.

Table 5.--Summary of analytical data for combined stream-sediment data sets, Tucson and Nogales 1^{o} by 2^{o} quadrangles, Arizona

[All values are in parts per million except those for Fe, Mg, Ca, and Ti, which are in percent. Letters preceding element symbol indicate analytical method; S, emission spectroscopic analysis; AA, atomic absorption analysis; INST, instrumental method; CM, colorimetric analysis. B, not analyzed; L, less than lower limit of determination shown in minimum value column; N, not detected at lower limit of determination shown in minimum value column; G, greater than upper limit of determination as shown in maximum value column, except S-Pb (20,000), S-Zn (10,000), S-Zr (2,000), AA-As (2,000), and INST-Hg (10)]

Variable	Minimum value	Maximum value	Geometric mean value[1]	Unqualified analyses	Numbers of Qualified analyses B	L	N	G
S-Fe%	0.5	20	3.6	2,561	0	0	0	16
S-Mg%	.05	10	.64	2,577	0	0	0	0
S-Ca%	.05	20	.74	2,573	0	4	0	0
S-Ti%	.005	1.5	.39	2,521	0	0	0	56
S-Mn	70	5,000	850	2,551	0	0	0	26
S-Ag	.5	500	1.4	385	0	215	1,977	0
S-B	10	1,500	31	1,961	0	581	35	0
S-Ba	20	5,000	620	2,572	0	2	0	3
S-Be	1	100	1.8	2,224	0	290	63	0
S-Bi	10	1,000	21	42	959	31	1,545	0
S-Cd	20	500	81	18	959	10	1,587	3
S-Co	5	70	12	2,377	0	124	76	0
S-Cr	10	700	37	2,428	0	111	38	0
S-Cu	5	10,000	33	2,569	0	8	0	0
S-La	20	1,000	56	2,462	0	62	47	6
S-Mo	5	300	7.6	541	0	280	1,756	0
S-Nb	20	300	25	400	0	1,445	732	0
S-Ni	5	200	16	2,393	0	144	40	0
S-Pb	10	7,000	48	2,570	0	3	0	4
S-Sc	5	70	9.7	2,402	108	54	13	0
S-Sn	10	1,000	18	95	3	80	2,399	0
S-Sr	100	1,000	240	2,362	0	111	104	0
S-V	10	1,000	83	2,572	0	5	0	0
S-W	50	100	55	14	959	60	1,544	0
S-Y	10	1,500	32	2,572	0	5	0	0
S-Zn	200	7,000	360	265	0	214	2,089	9
S-Zr	10	1,500	220	2,467	62	0	1	47
AA-As	10	1,500	28	284	1,479	109	703	2
AA-Cd	.10	2.4	.22	60	2,421	0	96	0
AA-Sb	2	1,500	4.4	736	1,043	186	612	0
AA-Zn	10	150,000	56	1,722	853	0	2	0
AA-Au-P	.05	10	.13	147	1,242	347	841	0
AA-Au-T	.002	1.	.011	121	2,351	16	89	0
AA-Te	.01	120	.07	925	1,498	65	89	0
INST-Hg	.02	1.2	.05	1,211	1,122	70	173	1
INST-U	.25	21	1.2	130	2,447	0	0	0
CM-As	1.0	100	18	98	2,116	113	250	0

[1]Based on unqualified analyses only.

Table 6.--Summary of analytical data for ore-related elements in 2,527 stream-sediment samples, Tucson and Nogales 1° x 2° quadrangles, Arizona

[All values are in parts per million. Letters preceding element symbol indicate analytical method; S, emission spectrographic analysis; AA, atomic absorption analysis; INST, intrumental method. N, not detected at lower limit of determination shown in parentheses; L, detected but in a concentration less than value shown in parentheses; G, detected but in a concentration greater than value shown in parentheses. P following Au indicates partial digestion method; T, total digestion method]

Element	Concentration range		50th percentile value	Number of unanalyzed samples
	Background	Anomalous		
S-Ag	N(.5)-L(.5)	0.5-500	N(.5)	0
AA-As	N(10)-10	20-G(2,000)	N(10)[1]	1,479
AA-Au-P	N(.05)	L(.05)-10	N(.05)[1]	1,242
AA-Au-T	N(.002)-0.003	0.004-1.00	0.002[1]	2,351
S-Bi	N(10)	L(10)-1,000	N(10)[1]	959
S-Cu	L(5)-70	100-10,000	30	0
INST-Hg	N(.02)-0.11	0.12-G(10)	0.04[1]	1,122
S-Mo	N(5)-5	7-300	N(5)	0
S-Pb	L(10)-70	100-G(20,000)	50	0
AA-Sb	N(2)-2	3-1,500	L(2)[1]	1,043
S-Sn	N(10)	L(10)-100	N(10)	0
AA-Te	N(.01)-0.048	0.05-120	0.035[1]	1,498
INST-U	0.25-0.69	0.70-21	0.97[1]	2,447
S-W	N(50)	L(50)-100	N(50)[1]	959
AA-Zn	N(10)-95	100-150,000	50[1]	853

[1]Unanalyzed samples excluded for calculation.

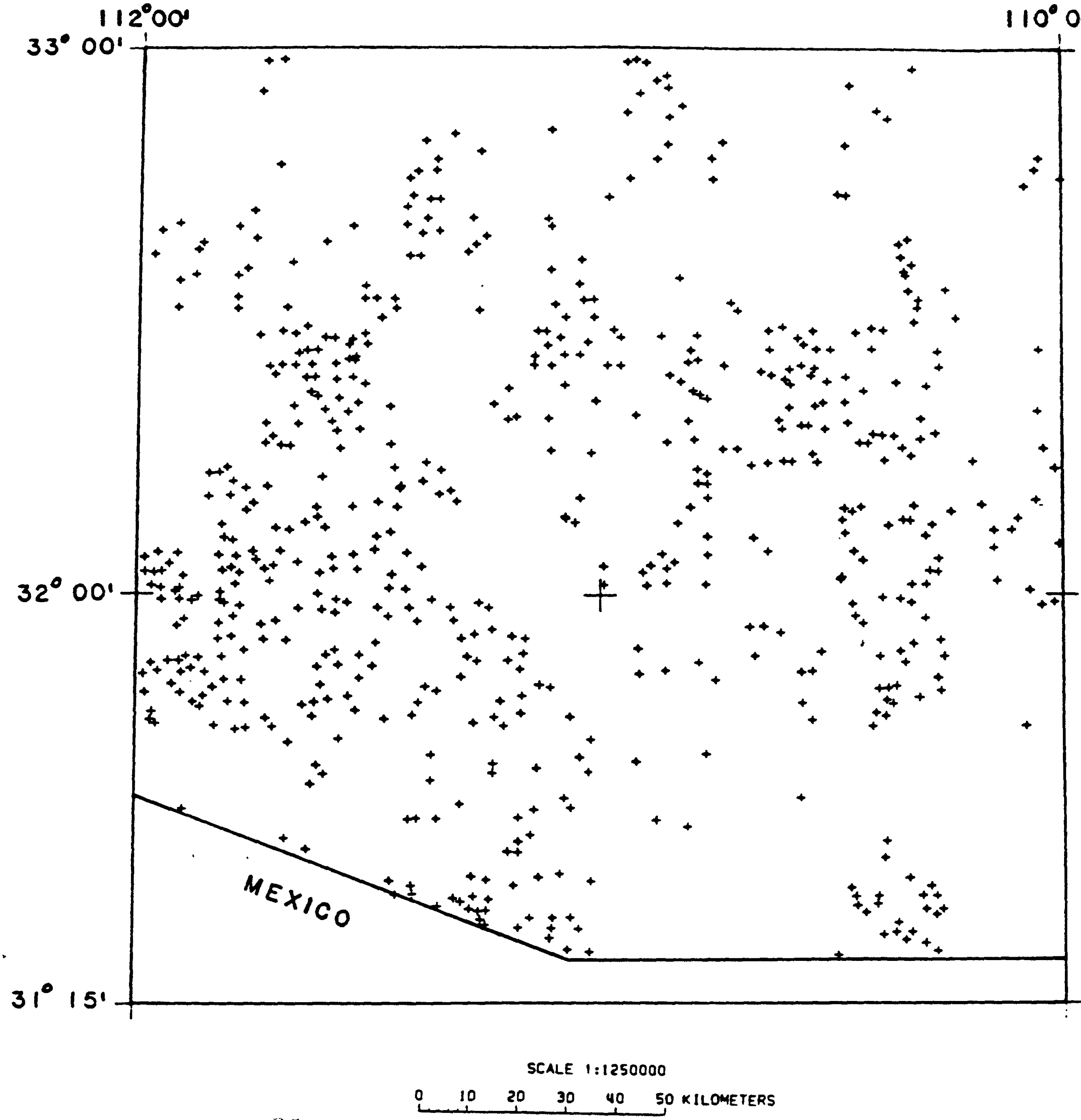

Figure 3. Distribution of sample sites for <100-mesh stream sediment, NURE data base.

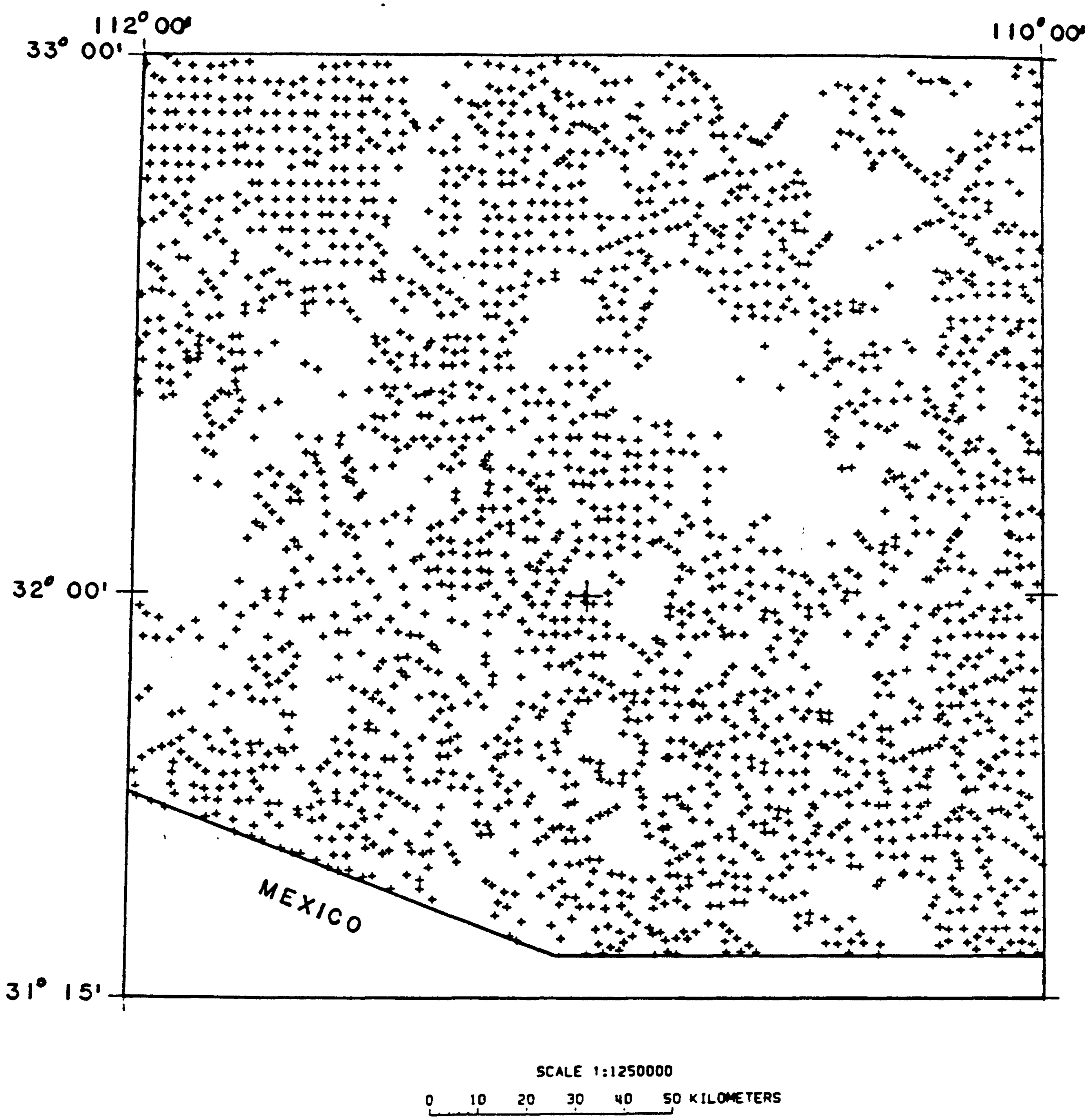

Figure 4. Distribution of sample sites for <100-mesh soil, NURE data base.

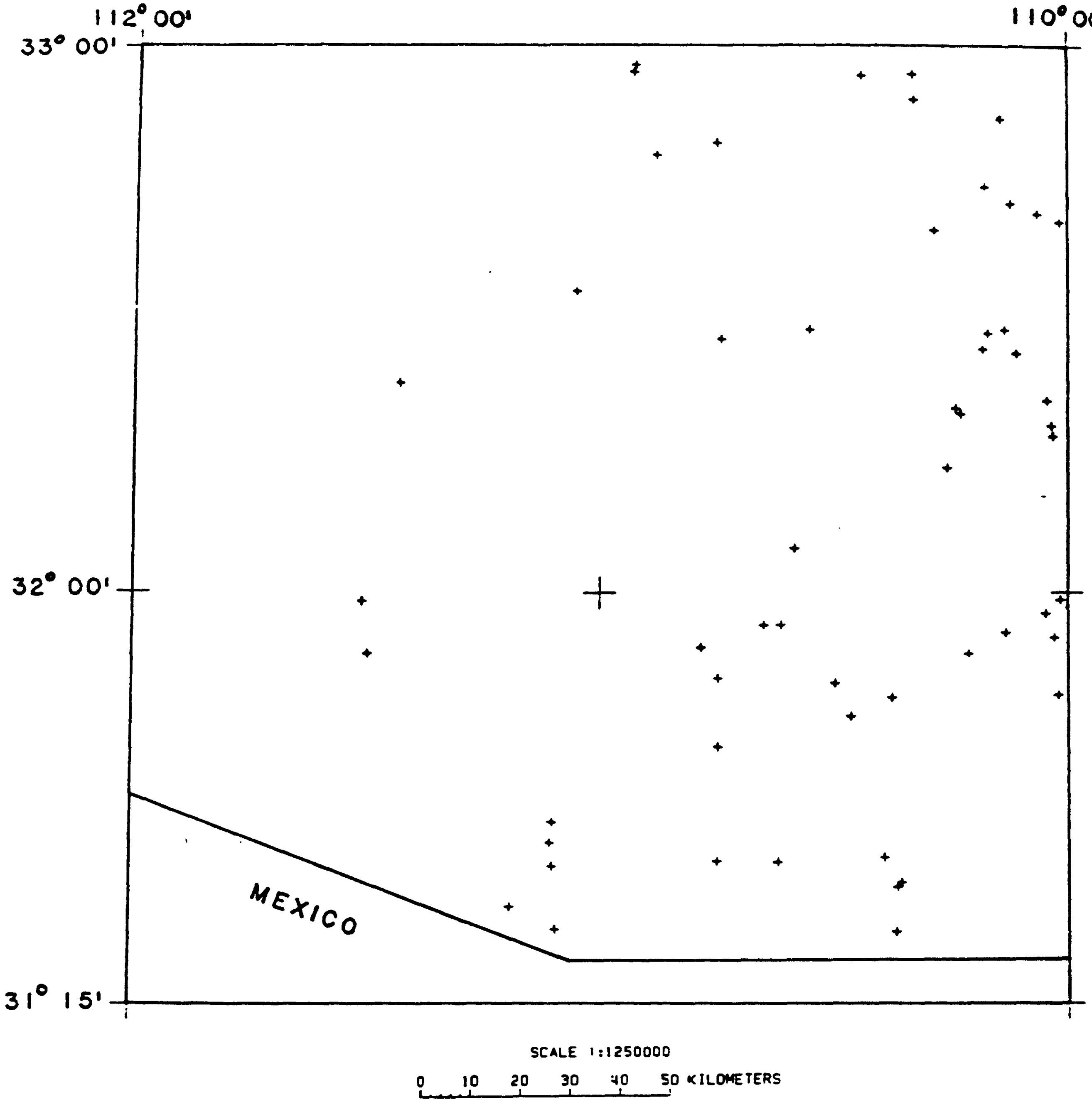

Figure 5. Distribution of sample sites for spring water, NURE data base.

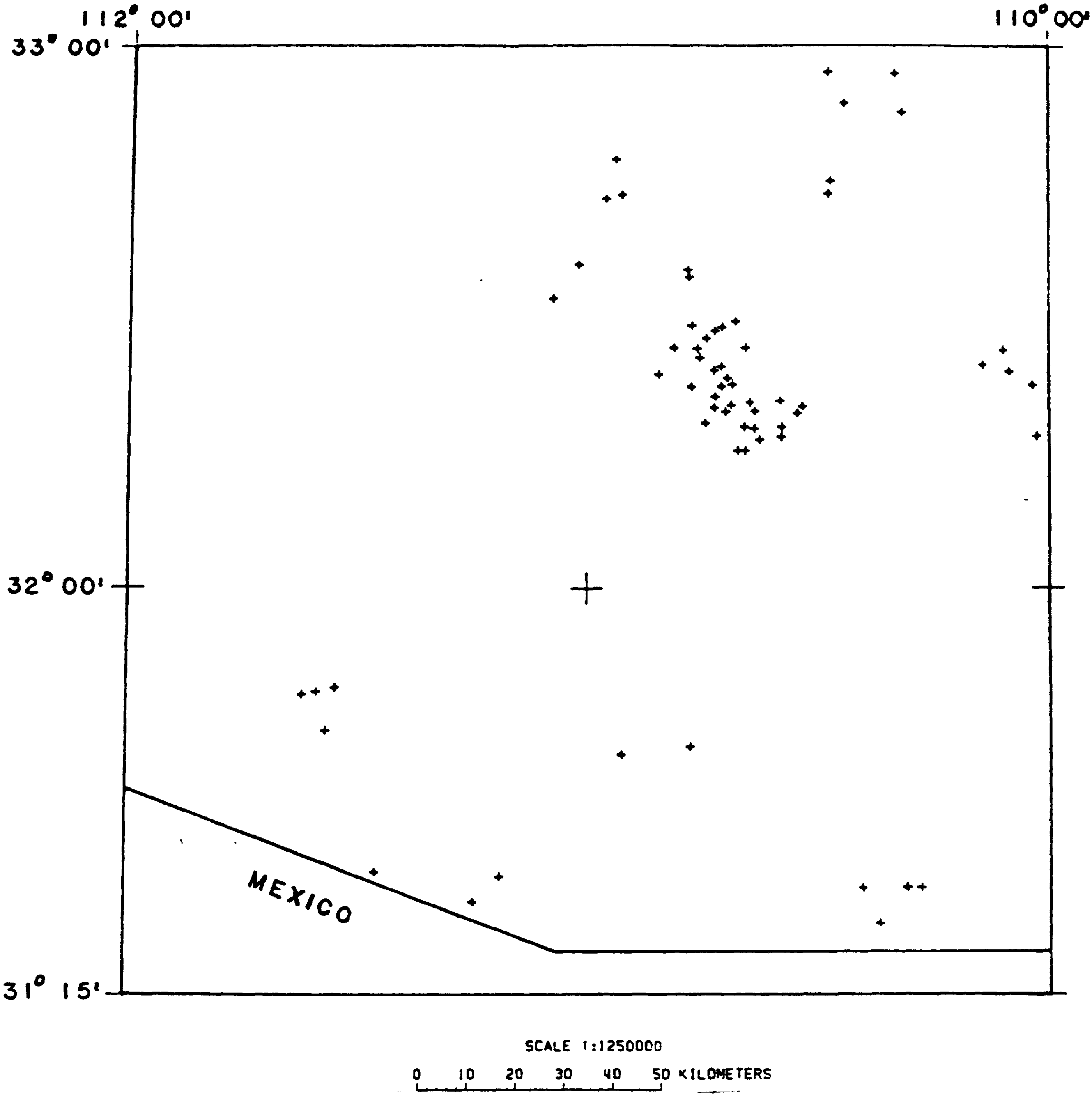

Figure 6. Distribution of sample sites for stream water, NURE data base.

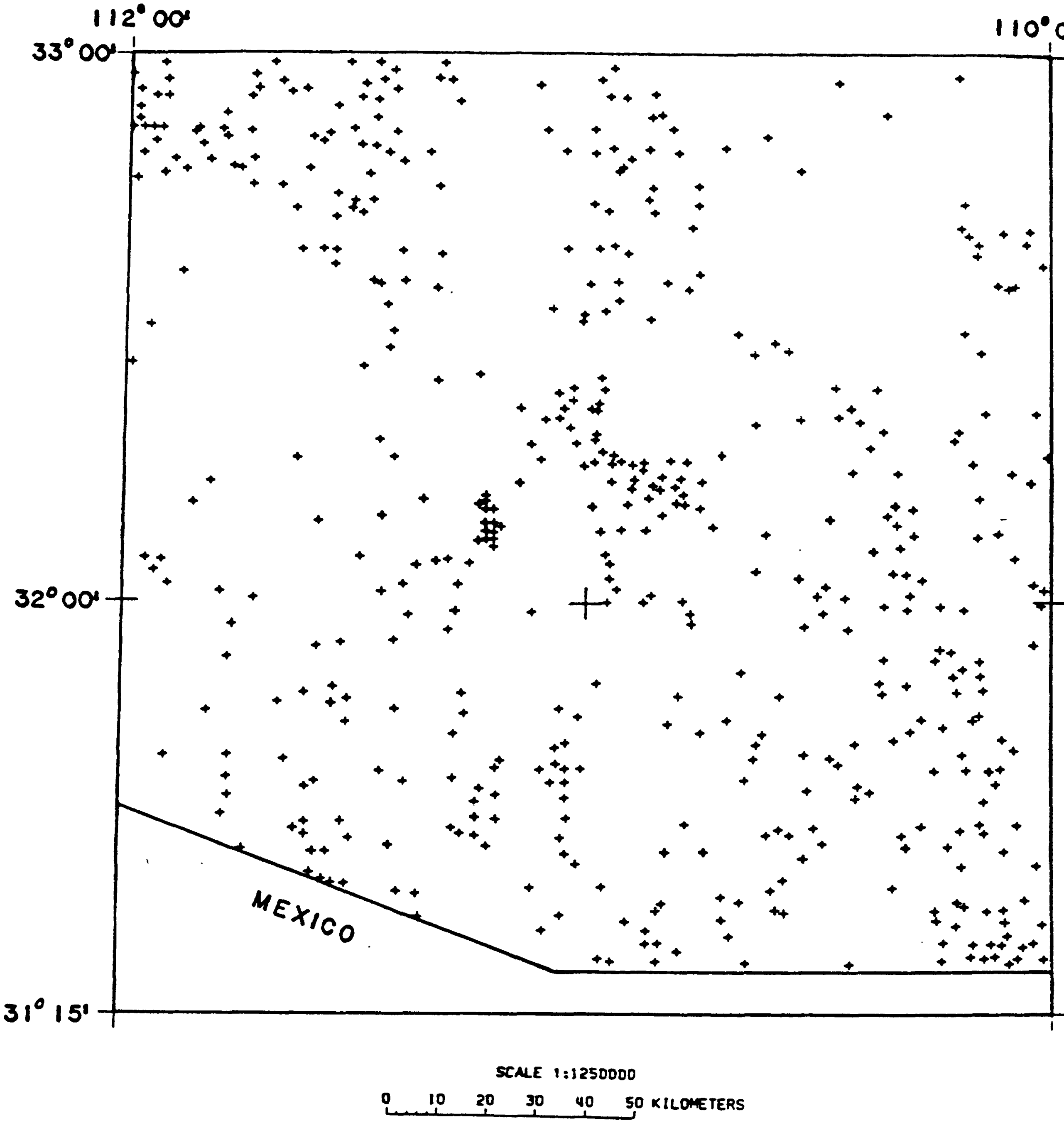

Figure 7. Distribution of sample sites for well water, NURE data base.

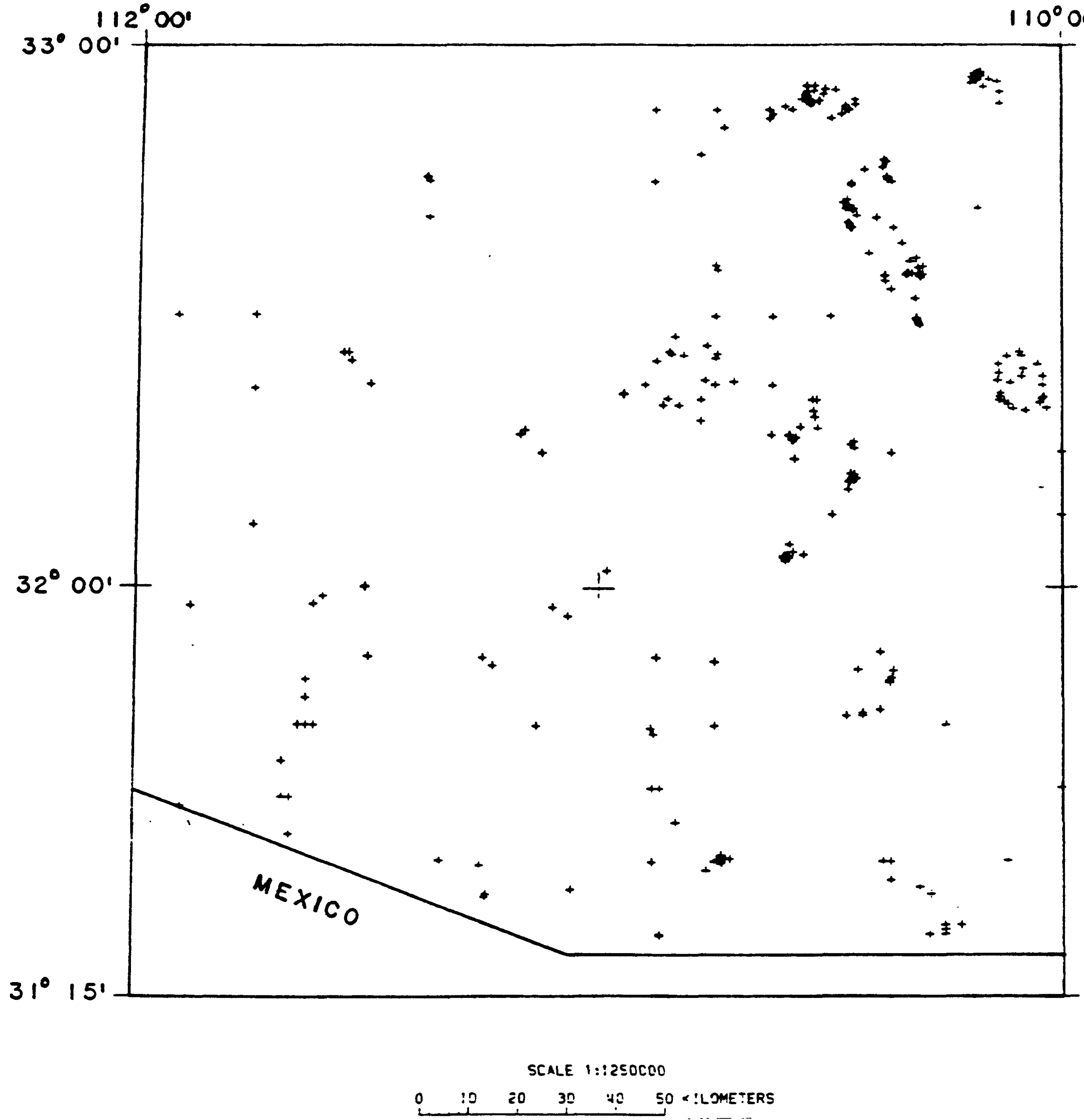

Figure 8. Distribution of sample sites for rock, RASS and PLUTO data bases.

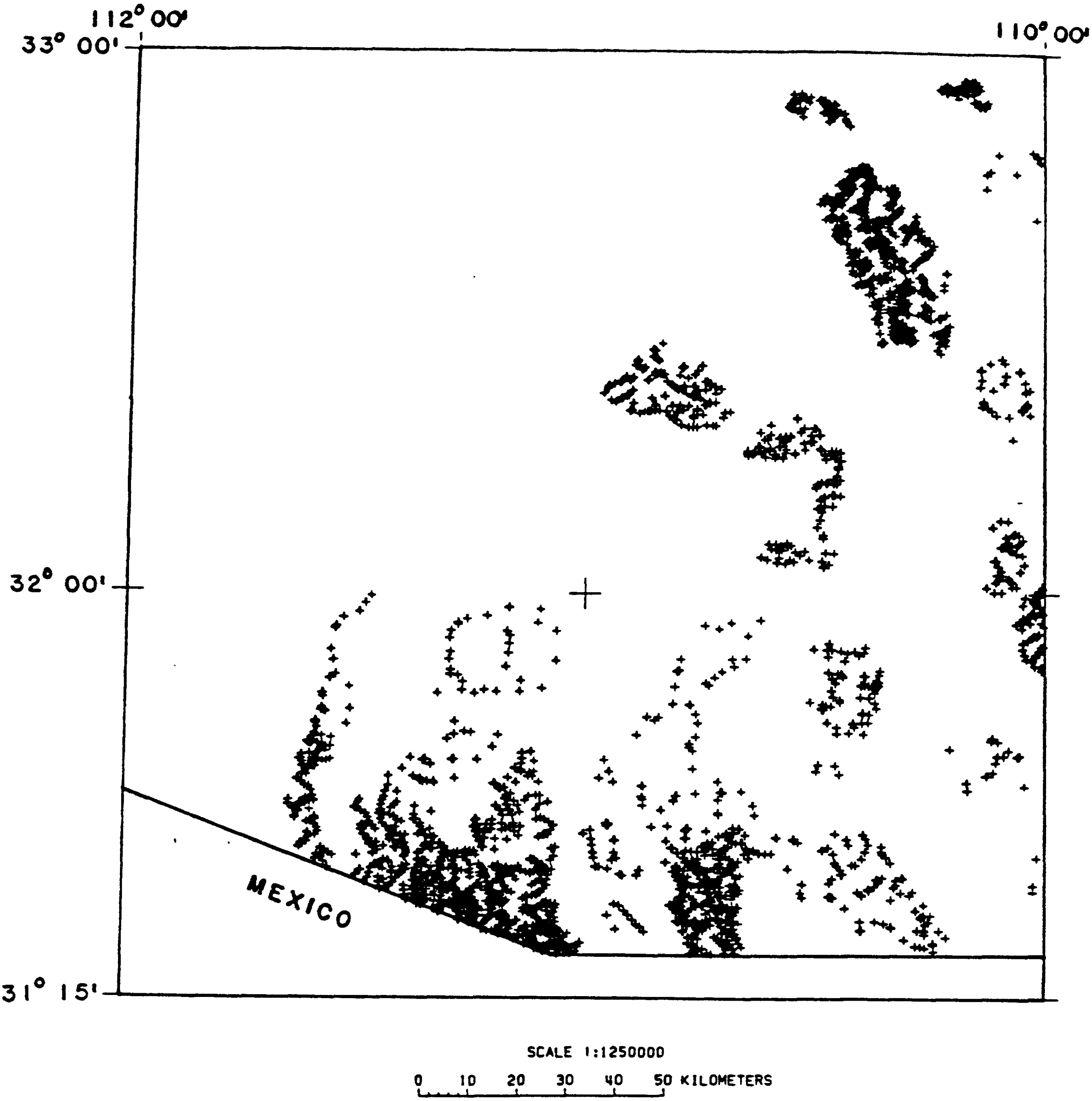

Figure 9. Distribution of sample sites for stream sediment, RASS data base.

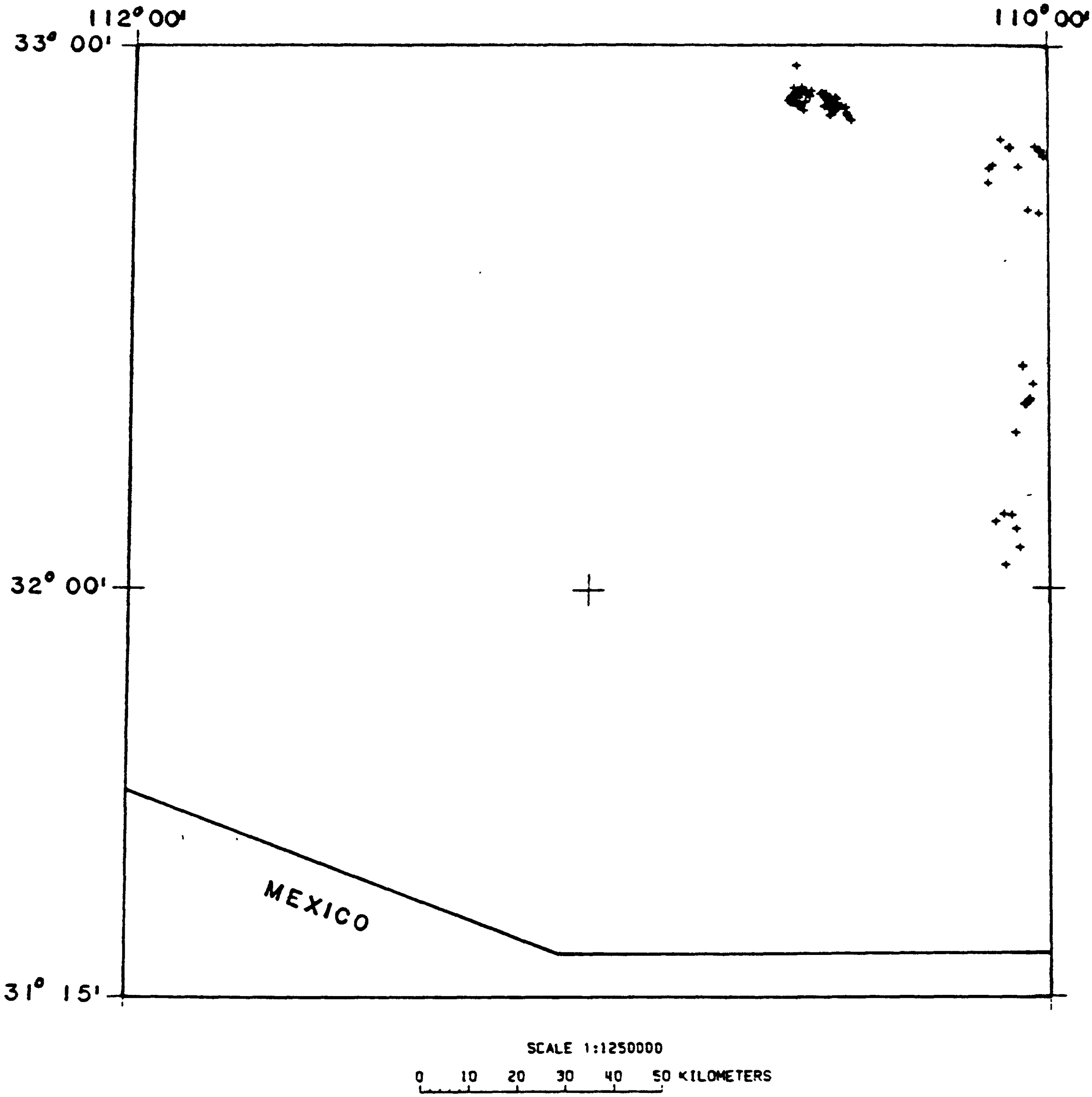

Figure 10. Distribution of sample sites for magnetic heavy-mineral concentrate, RASS data base.

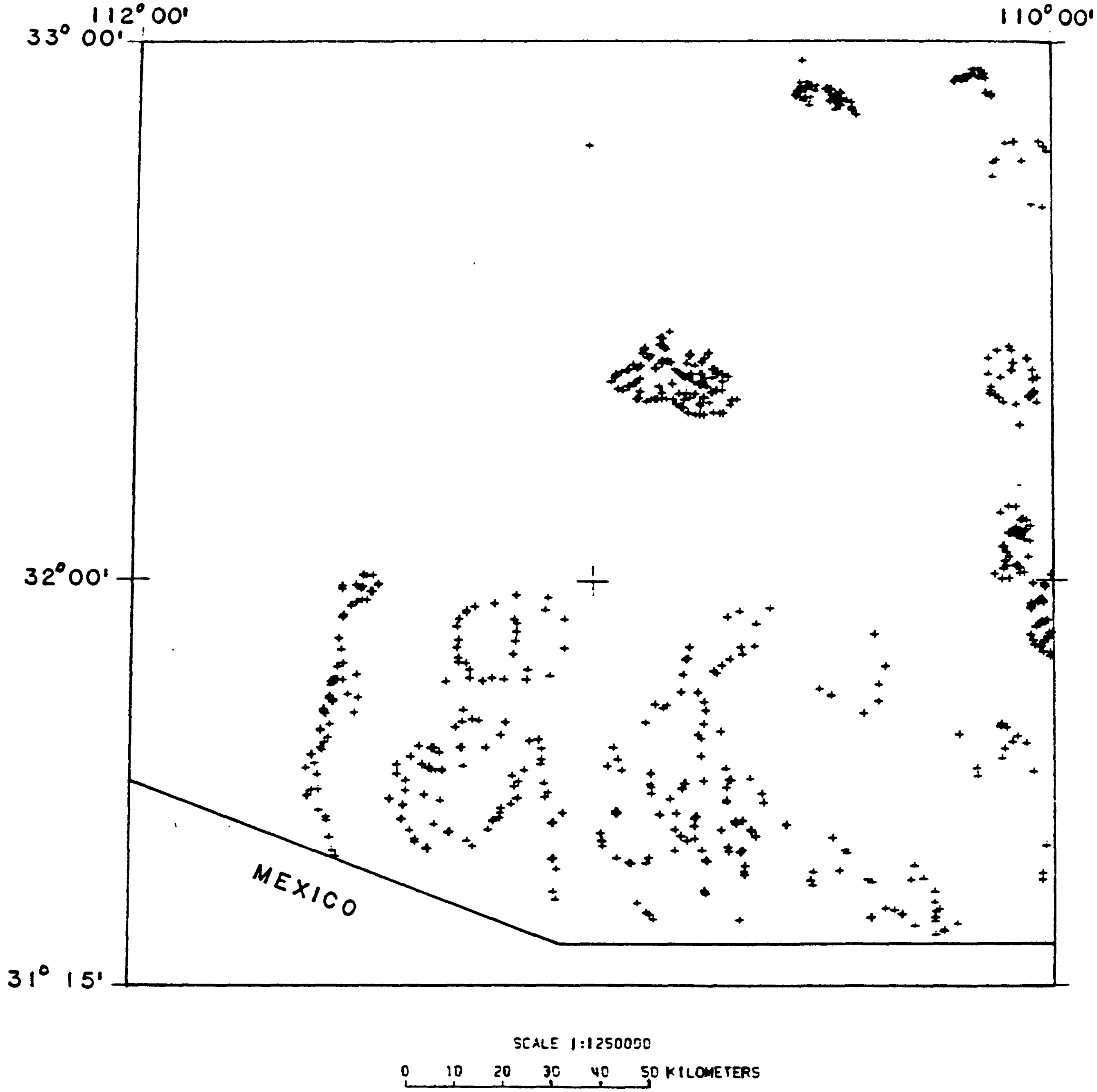

Figure 11. Distribution of sample sites for nonmagnetic heavy-mineral concentrate, RASS data base.

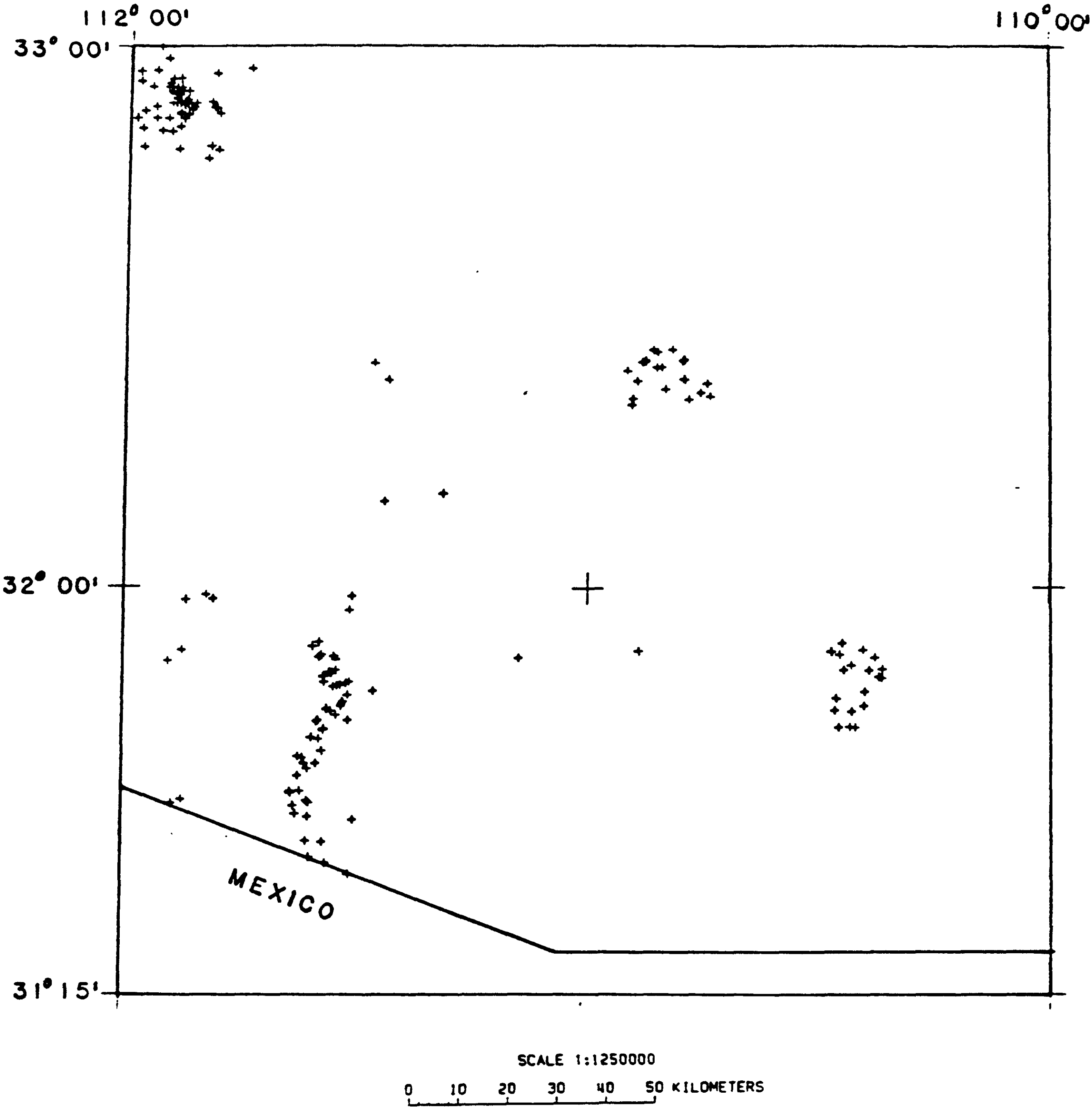

Figure 12. Distribution of sample sites for well and spring water, RASS data base.

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GEOPHYSICS - GRAVITY AND MAGNETIC METHODS

By David A. Ponce

Gravity Methods

Data Coverages

There are approximately 4,100 and 3,100 gravity stations in the Tucson and Nogales quadrangles, respectively (fig. 13). These data were compiled from the U.S. Department of Defense gravity files (available from National Geophysical Data Center, National Oceanic and Atmospheric Administration, Mail Code E/Gcx2, 325 Broadway, Boulder, CO, 80303). Sources for these data are listed in table 7.

Gravity coverage of the Tucson and Nogales quadrangles is poor to fair, averaging about one to two stations per 25 km^2 (fig. 14). Excluding Mexico, there are 357 5 x 5 km cells that have no stations, 269 cells that have one station, 111 cells that have two stations, and 645 cells that have three or more stations.

Density Data

Density data are listed in table 8. Proterozoic metamorphic rocks are generally denser than intrusive rocks. Proterozoic gneissic rocks have average densities of about 2.59 to 2.73 g/cm^3. Eighty-one samples of plutonic rocks from the Basin and Range province of Arizona average 2.62 g/cm^3 and range from 2.27 to 2.79 g/cm^3. Paleozoic carbonate rocks generally have high densities of about 2.64 to 2.77 g/cm^3. Tertiary volcanic rocks have a wide range in density from about 2.15 to 2.75 g/cm^3 and 40 volcanic samples from the Basin and Range provice of Arizona have an average of 2.45 g/cm^3 (Oppenheimer, 1980). Davis (1971) reported that drill-core data indicate a density of about 2.27 g/cm^3 for the upper part of unconsolidated mid-Tertiary formations and that interpretation of velocity logs shows a density of at least 2.5 g/cm^3 for these sediments at depth.

Interpretation

A complete Bouguer gravity anomaly map of the Tucson and Nogales quadrangles is shown on figure 15 and plate 18. Complete Bouguer anomalies were reduced for a density of 2.67 g/cm^3 and terrain corrected from the station to a radial distance of 167 km. An isostatic gravity anomaly map is shown on figure 16 and plate 19 and was reduced with an assumed upper-crust density of 2.67 g/cm^3, a crustal thickness of 25 km, and a density contrast between the upper crust and lower mantle of 0.4 g/cm^3. These maps were compiled from publicly available data. An analysis of individual gravity sources has not been made, but stations with obvious errors, usually greater than about 5 mGal, have been removed from the data sets. Several published gravity maps that cover all of the Tucson or Nogales quadrangles are available including a Bouguer gravity anomaly map of Arizona at a scale of 1:500,000 (West and Sumner, 1973), a residual Bouguer gravity anomaly map of Arizona at a scale of 1:1,000,000 (Aiken, 1975), a complete residual Bouguer gravity anomaly map of the Tucson quadrangle at a scale of 1:250,000 (Lysonski and others, 1981), and a complete residual Bouguer gravity anomaly map of the Nogales quadrangle at a scale of 1:250,000 (Lysonski and others, 1981).

Bouguer gravity anomaly values range from about -190 to about -60 mGal. The lowest values are found over thick alluvium in the Tucson basin about 15 mi south of Tucson, in Aravaipa

Canyon in the northeastern part of the study area, and in the Sonoita basin southwest of the Whetstone Mountains. The highest Bouguer gravity values are found in the northwestern part of the study area in the Silver Reef and Slate Mountains. Isostatic gravity anomaly values range from about -35 to 15 mGal. The lowest of these values are in alluvial basins, whereas the highest values are over the Picacho Mountains and southeast of the Santa Catalina Mountains over the Tucson basin.

There are two major regions of differing gravity trends in the study area. In the northeastern part, gravity trends are northwest, whereas in the southwestern part trends are predominantly north and northeast. These two regions are separated by a gravity lineament that extends from Bisbee to approximately 80 km due west of Phoenix and probably continues to the northwest. Near Tucson, on the isostatic gravity anomaly map, this lineament is marked by one of the more conspicuous features, a northwest-trending high that overlies the eastern part of the Tucson basin and the western part of the Santa Catalina and Rincon Mountains. The source is probably at intermediate depth and is denser than the gneissic rocks that comprise most of the Santa Catalina Mountains. This gravity anomaly also correlates with a major magnetic anomaly discussed below.

All the major valleys in the study area are characterized by high-amplitude gravity lows that generally indicate intermediate to deep alluvial basins. A gravity anomaly with an amplitude of about 25 mGal is south of Tucson in the Santa Cruz Valley. There, an assumed density contrast of about 0.3 g/cm^3 yields a thickness of about 2.5 km, whereas a density contrast of about 0.2 g/cm^3 yields a thickness of about 3.8 km. The latter depth correlates well with drill-hole data that indicate a depth to quartz monzonite basement of 3.9 km (Aiken and Sumner, 1974). A more detailed analysis of the Tucson basin was made by Davis (1971) and other basins were discussed by Aiken and Sumner (1974) and Oppenheimer and Sumner (1981).

Magnetic Methods

Data Coverage

There are approximately 16 aeromagnetic surveys that are all or partly within the study area (see Hill, 1986). Figure 17 shows the boundaries of the aeromagnetic surveys and table 9 lists them in chronological order by year flown, provides survey specifications, gives the reference for each survey, and indicates those surveys that are available in digital form.

Susceptibility Data

Magnetic susceptibility data are listed in table 10. These data are predominantly from the northern part of the Tucson basin and susceptibility values for these rocks may not be representative of other areas. Rock units in the study area are weakly to strongly magnetic based on limited magnetic susceptibility data and on the relation between lithology and magnetic anomalies. In general, granitic rocks are moderately to strongly magnetic except for weakly magnetic Cretaceous to Tertiary peraluminous granitic rocks and some weakly magnetic Tertiary granitic and Proterozoic gneissic rocks. The metamorphic core complexes of the Tortilla, Santa Catalina, and Rincon Mountains that appear to be almost devoid of magnetite (Sumner, 1985) are weakly magnetic and are associated with broad magnetic lows. Volcanic rocks have a wide range of magnetic susceptibility and Paleozoic carbonate rocks are essentially nonmagnetic.

Interpretation

A total intensity aeromagnetic map of the Tucson and Nogales quadrangles is shown on figure 18 and plate 20. This map was compiled from two surveys that are available in digital form, an aeromagnetic survey of Arizona flown at 9,000 ft (2,700 m) barometric elevation with north-south flightlines spaced at 3-mi (4.8-km) intervals (Sauck and Sumner, 1970) and an aeromagnetic survey of Tombstone and vicinity flown at 9,000 ft (2,700 m) barometric elevation with north-south flightlines spaced at 1-mi (1.6-km) intervals (Andreasen and others, 1965).

A very conspicuous feature of the aeromagnetic map is a magnetic high trending N. 50° W. along the Tucson basin. The anomaly is about 15 mi (24 km) wide and at least 140 mi (220 km) long. This magnetic anomaly may be related to a similar magnetic feature near Ajo; Klein (1982) suggested that these magnetic anomalies are offset from one another. The inferred offset would be about 80 mi (130 km). Gneissic rocks exposed northeast of the anomaly have a very low susceptibility of about 0.065 x 10^{-3} cgs units and are probably not the cause of the anomaly. Rather, this anomaly is probably caused by a dense magnetic intrusion. Sauck and others (1971) and Sumner (1985) suggested that this positive magnetic feature may indicate a deep-seated intrusive belt.

In the northeastern part of the study area, an interpretation by Davis (1981) of an aeromagnetic map of part of the Galiuro Mountains has shown that most of the main anomalies are caused by volcanic rocks. Anomalies in the northwestern part of the Galiuro Mountains are probably related to a quartz-monzonite pluton that hosts copper deposits in the Copper Creek mining district. Some low magnetic gradients and magnetic lows may represent altered zones southeast of Mescal Peak, west and northwest of Kielberg Peak, near Rhodes Peak, near China Peak, and in an area north of Sunset Peak. A magnetic high near Basset Peak in the southeastern part of the Galiuro Mountains covers a north-trending dike swarm (see Davis, 1981).

Several of Arizona's porphyry copper deposits are associated with arcuate magnetic lows. One of these, the Twin Buttes low, is north of the Sierrita Mountains, about 20 mi (30 km) southwest of Tucson. In contrast, the Silver Bell and Lakeshore deposits in the northwestern part of the study area are on or near magnetic highs (see Sumner, 1985).

A geophysical study of the Whetstone Mountains was done as part of a wilderness mineral resource evaluation (Bankey and Kleinkopf, 1985). The most prominent anomaly in the area is a circular magnetic high over an outcrop of Cretaceous granodiorite (pl. 20), which indicates that the granitic intrusion probably extends to the east under alluvium. Although the magnetic susceptibility of a single surface sample of the granodiorite was 1.7 x 10^{-3} cgs units, a simple magnetic model suggests that it must have a susceptibility greater than about 6.0 x 10^{-3} cgs units. A second major anomaly in the northern part of the Whetstone Mountains covers a large outcrop of Proterozoic quartz monzonite. (See Bankey and Kleinkopf, 1985). This anomaly trends northwest and may, in part, be related to the structural trend of the Tucson-basin anomaly discussed above.

Another gravity and magnetic study done as part of a wilderness mineral resource assessment was made in the Dragoon Mountains on the east-central edge of the study area (Klein, 1983). One of the most prominent anomalies there is over alluvium near the southern tip of the Dragoon Mountains (pl. 20). A gradient on the north side of the anomaly crosses, with little interruption, a large Tertiary granite stock, suggesting that the stock is weakly magnetic and probably not the cause of the anomaly. Magnetic data and a coincident gravity high suggest that this anomaly is probably caused by an uplift of Proterozoic basement or possibly by an unexposed intrusion (see Klein, 1983).

Table 7.--Sources for U.S. Department of Defense (DOD) gravity data

[na, not available; DMAH/TC, Defense Mapping Agency Hydrographic/Topographic Command]

DOD source code	Number of stations	Year	Source and comments
1083	29	na	National Oceanic and Atmospheric Administration
2051	39	na	Woollard, G.P., University of Wisconsin
2250	1,101	na	USGS; Tucson gravity data
2270	659	na	USGS, Peterson, D.L.
2381	4	1963	DMAH/TC; deleted[1]
2506	96	na	DMAH/TC
2514	61	na	USGS, Peterson, D.L.
2555	69	1966	USGS, Eaton, J.P., and Timmons, C.E.
2662	202	1965	USGS; Tombstone gravity data
3035	3	1968	DMAH/TC, deleted[1]
3097	190	1967	University of Arizona
3277	672	1969	DMAH/TC
3507	2	1954	Mack, J., and Iverson, R.M., University of Wisconsin; deleted[1]
3598	6	1952	Ostenso, N.A., University of Wisconsin; deleted[1]
4099	13	1967	DMAH/TC
4679	21	1974	Powers, H.W.; Maricopa-Casa Grande area
5790	569	1978	USGS, Hassemer, J.H., and Dansereau, D.; Maricopa and Pinal Counties
5887	35	1981	USGS, Wynn, J.C.; Silver City quadrangle
5918	3,254	na	University of Arizona
6048	22	na	USGS, Boler, F.M., and Brickey, M.
6206	2	na	Hawaii Institute of Geophysics; deleted[1]
6323	112	1981	USGS, Bankey, V.; Whetstone Mts. area
6357	39	1981	USGS, Martin, R.A., Sherrard, M.S., and Abrahms, G.A.; Winchester Mts. area
TOTAL:	7,200		

[1] Not used in present compilation (figs. 13, 14) because of the small number of stations or quality of data

Table 8.--Density data for southeastern Arizona

[na, not available; B and R, Basin and Range province]

Lithology	Number of samples	Average density (g/cm^3)	Range of density (g/cm^3)	Comments	References
Alaskite	1	2.56	na	Whetstone Mts.	Bankey and Kleinkopf (1985)
Alluvium	na	2.0	na	Sulphur Springs Valley	Aiken (1978)
Alluvial fill	29	2.25	1.81-2.58	Tertiary	Oppenheimer (1980)
Alluvial fill	323	2.12	1.81-2.58	Cenozoic	Oppenheimer (1980)
Andesite	na	2.6	na	Sulphur Springs Valley	Aiken (1978)
Andesite porphry	4-5	2.52	na	Pantano Formation	Davis (1971)
Andesite porphyry	4-5	2.63	na	--	Davis (1971)
Aplite dike	4-5	2.58	na	--	Davis (1971)
Basalt, vesicular	4-5	2.68	na	Tertiary	Davis (1971)
Breccia (?)	4-5	2.62	na	Tucson Mtn.	Davis (1971)
Diorite	4-5	2.86	na	Leatherwood Diorite	Davis (1971)
Gneiss	4-5	2.59	na	Catalina Gneiss	Davis (1971)
Gneiss	4-5	2.73	na	Catalina Gneiss	Davis (1971)
Gneiss	4-5	2.65	na	Catalina Gneiss	Davis (1971)
Gneiss	4-5	2.60	na	Rincon Gneiss	Davis (1971)
Gneiss	4-5	2.70	na	Rincon Gneiss	Davis (1971)
Granitic rock	4-5	2.62	na	--	Davis (1971)
Granitic rock	4-5	2.56	na	--	Davis (1971)
Granitic rock	4-5	2.62	na	--	Davis (1971)
Granodiorite	1	2.68	na	Whetstone Mts.	Bankey and Kleinkopf (1985)
Limestone	4-5	2.77	na	Escabrosa Limestone	Davis (1971)
Limestone	4-5	2.70	na	Naco Group	Davis (1971)
Limestone	4	2.70	2.64-2.77	Escabrosa Limestone	Bankey and Kleinkopf (1985)
Limestone	2	2.68	2.67-2.70	Horquilla Limestone	Bankey and Kleinkopf (1985)
Limestone	1	2.70	na	Whetstone Mts., Colina Limestone	Bankey and Kleinkopf (1985)
Limestone	1	2.69	na	Whetstone Mts., Concha Limestone	Bankey and Kleinkopf (1985)
Metamorphic and sedimentary rocks	78	2.67	2.57-2.99	B and R, Arizona	Oppenheimer (1980)
Metasiltstone	4-5	2.77	na	Amole Formation (?)	Davis (1971)
Mudstone	4-5	2.76	na	Recreation Redbeds, Cretaceous	Davis (1971)
Mudstone and conglomerate	na	2.4	na	Sulphur Springs Valley	Aiken (1978)
Phyllite	4-5	2.82	na	Apache Group	Davis (1971)
Plutonic rocks	81	2.62	2.27-2.79	B and R, Arizona	Oppenheimer (1980)
Quartz monzonite	4-5	2.58	na	Catalina Granite	Davis (1971)
Quartz monzonite	4-5	2.69	na	Rincon Granite	Davis (1971)
Quartzite	4-5	2.69	na	Bolsa Quartzite	Davis (1971)
Rhyodacite	3	2.43	2.35-2.52	Whetstone Mts.	Bankey and Kleinkopf (1985)
Quartzite	2	2.62	2.60-2.63	Bolsa Quartzite	Bankey and Kleinkopf (1985)
Sandstone, silty	4-5	2.40	na	Pantano Formation, Cienega Gap	Davis (1971)
Schist	2	2.66	2.65-2.66	Whetstone Mts., Pinal Schist	Bankey and Kleinkopf (1985)
Sedimentary rocks	5	2.65	2.50-2.79	Whetstone Mts., Bisbee Group	Bankey and Kleinkopf (1985)
Sediments	na	na	2.34-2.51	Catalina foothills	Abuajamieh (1966)
Tuff, Welded	4-5	2.35	na	Tertiary	--
Volcanic rocks	40	2.45	2.15-2.75	Tertiary	Oppenheimer (1980)

Table 9.--Aeromagnetic surveys in the Tucson and Nogales quadrangles

[b, barometric; d, drape]

Area	Name	Spacing (mi)	Direction	Altitude (ft)	Year flown	Contractor	Digital (Y/N)	References
1	Dragoon	1/2	E-W	500d	1947	USGS	N	Dempsey and others (1963)
2	Mammoth	1/2	N-S	1,000d	1947	USGS	N	Dempsey and Hill (1963)
3	Cortaro	1/4-1	E-W	500d	1952	USGS	N	U.S. Geological Survey (1952)
4	Twin Buttes A	1/4-1/2	N-S	500d	1959	USGS	N	Andreasen and Pitkin (1963)
	Twin Buttes B	1	N-S	4,000b	1959	(1)	N	Andreasen and Pitkin (1963)
	Twin Buttes C	1	N-S	6,000b	1959	(1)	N	Andreasen and Pitkin (1963)
5	Safford	1	E-W	1,500d	1962	(1)	N	U.S. Geological Survey (1966)
6	Casa Grande	1	N-S	2,400b	1963	USGS	N	Mitchell and Zandle (1963)
7	Tombstone	1	N-S	9,000b	1964	USGS	Y	Andreasen and others (1965)
8	Arizona	3	N-S	9,000b	1968	(1)	Y	Sauck and Sumner (1970)
9	Tucson basin	1/2-1	E-W	6,000b	1968	(1)	Y	Sauck and others (1971)
10	Galiuro	1	N-S	8,000b	1972	USGS	N	Davis (1981)
11	Papago	1	E-W	4,000b	1976	Aerial Surveys	N	U.S. Geological Survey (1980c)
12	NURE	3	N-S	400d	1979	Texas Instruments, Inc.	Y	Texas Instruments, Inc. (1978a, 1979b)
13	Ajo	1	E-W	4,000b	1979	Airmag Surveys, Inc.	N	U.S. Geological Survey (1980b)
14	Dragoon area	1/2	E-W	1,000d	1980	Airmag Surveys, Inc.	Y	U.S. Geological Survey (1980a)
15	Whetstone	1/2	E-W	1,000d	1980	Airmag Surveys, Inc.	Y	U.S. Geological Survey (1980d)
16	Winchester	1/2	N-S	1,000d	1981	High Life Helicopters--QEB, Inc.	Y	U.S. Geological Survey (1982)

[1]Contractor not shown on aeromagnetic map

Table 10.--Magnetic susceptibility data for southeastern Arizona

[na, not available]

Lithology or geologic unit name	Number of samples	Susceptability (10^{-3} cgs units) Average	Range	Location	References
Alaskite	1	0.008	na	Whetstone Mts.	Bankey and Kleinkopf (1985)
Andesite	na	4.500	na	Sulphur Springs Valley, drill-hole sample	Aiken (1978)
Bisbee Group	5	.0104	.003-.018	Whetstone Mts.	Bankey and Kleinkopf (1985)
Catalina Gneiss	8	.065	na	--	Sauck and others (1971)
Granodiorite	1	1.742	na	Whetstone Mts.	Bankey and Kleinkopf (1985)
Escabrosa Limestone	4	.0046	.003-.006	Whetstone Mts.	Bankey and Kleinkopf (1985)
Horquilla Limestone	2	.005	.004-.006	Whetstone Mts.	Bankey and Kleinkopf (1985)
Colina Limestone	1	.006	na	Whetstone Mts.	Bankey and Kleinkopf (1985)
Concha Limestone	1	.003	na	Whetstone Mts.	Bankey and Kleinkopf (1985)
Bolsa Quartzite	2	.045	.003-.006	Whetstone Mts.	Bankey and Kleinkopf (1985)
Rhyodacite	3	.0093	.007-.013	Whetstone Mts.	Bankey and Kleinkopf (1985)
Rillito beds, Sandstone and mudstone	9	.300	na		Sauck and others (1971)
Pinal Schist (?)	2	1.305	.850-1.760	--	Sauck and others (1971)

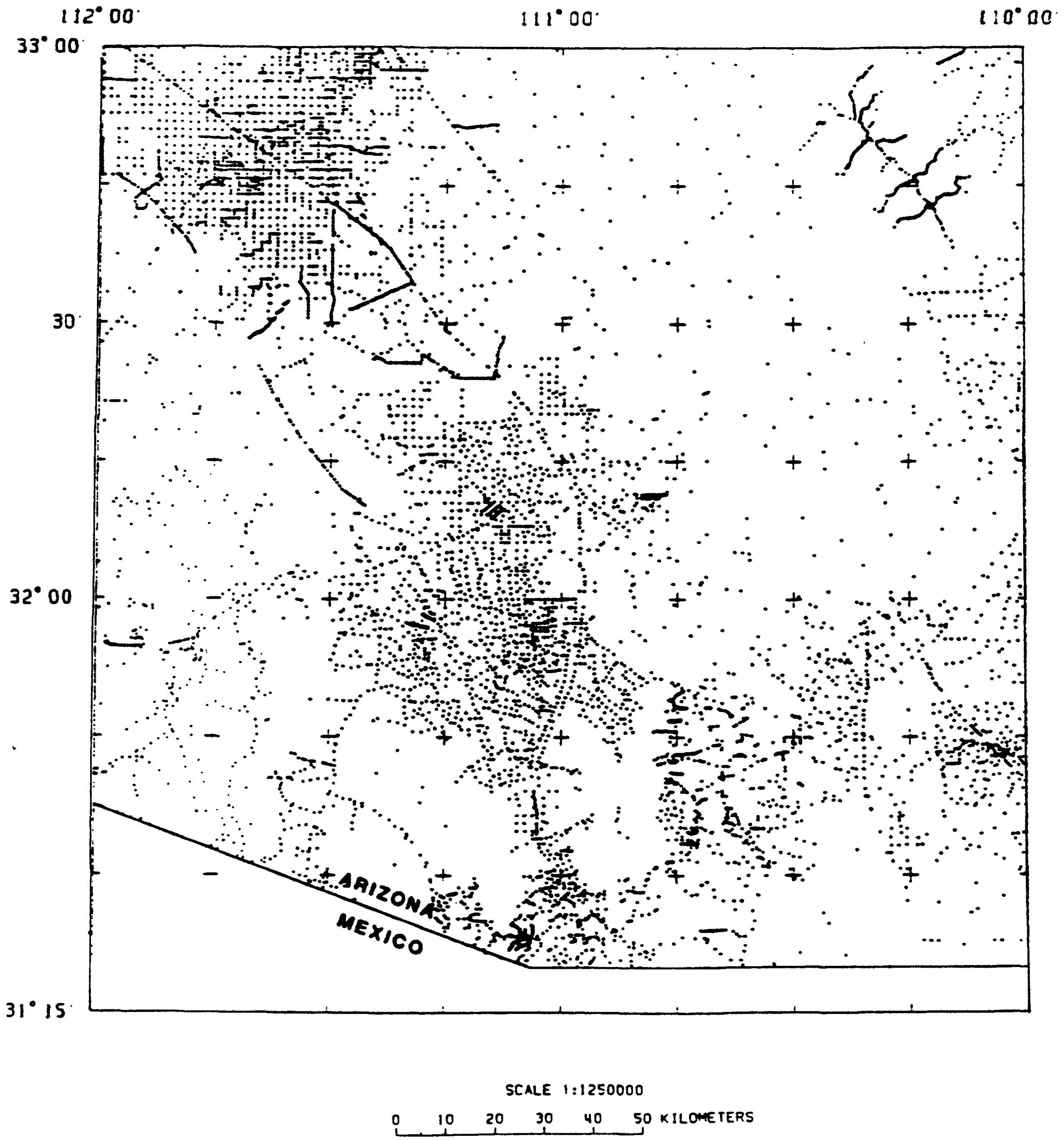

Figure 13. Index showing gravity station locations.

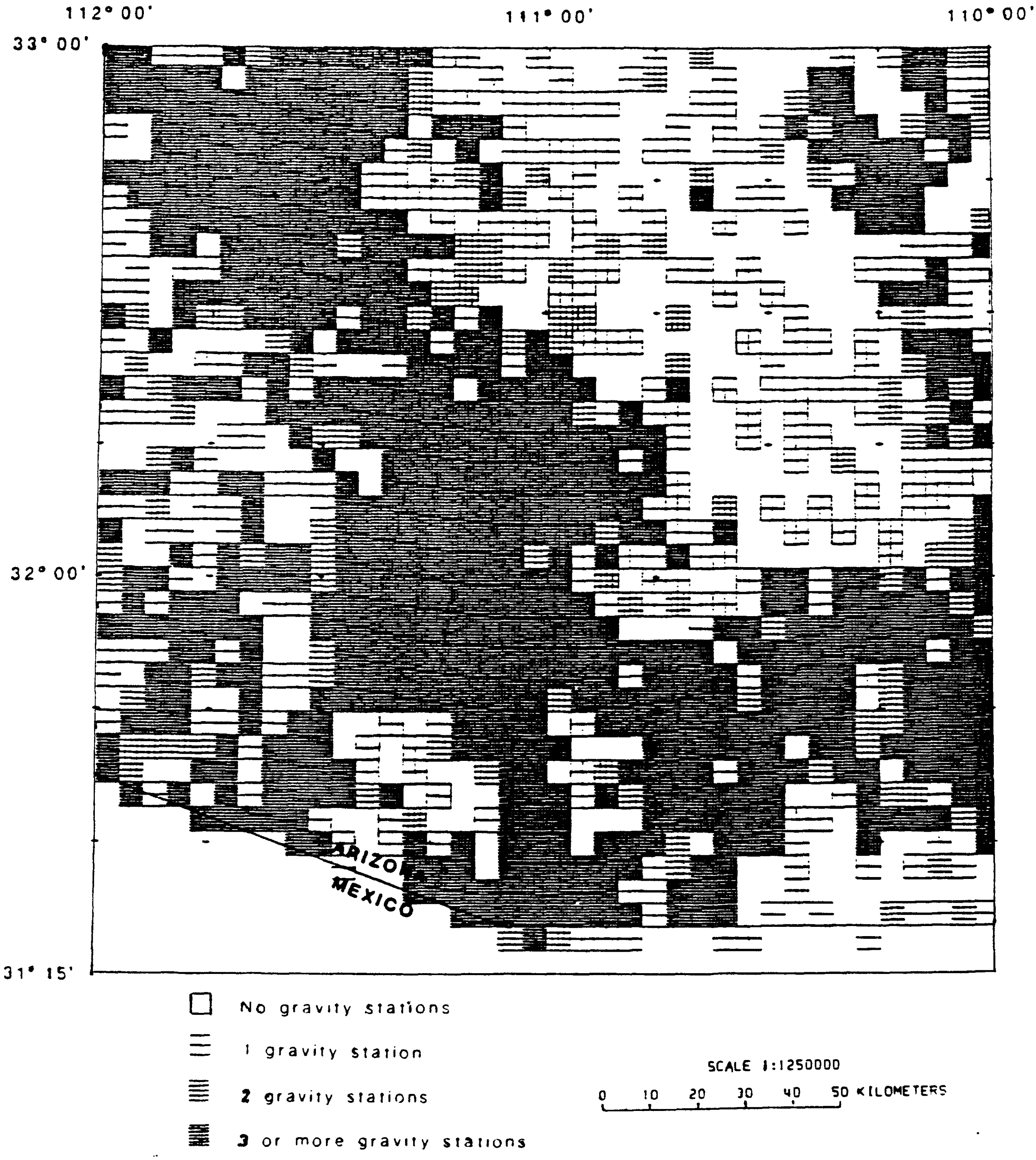

Figure 14. Index showing gravity stations in 5 by 5 km cells.

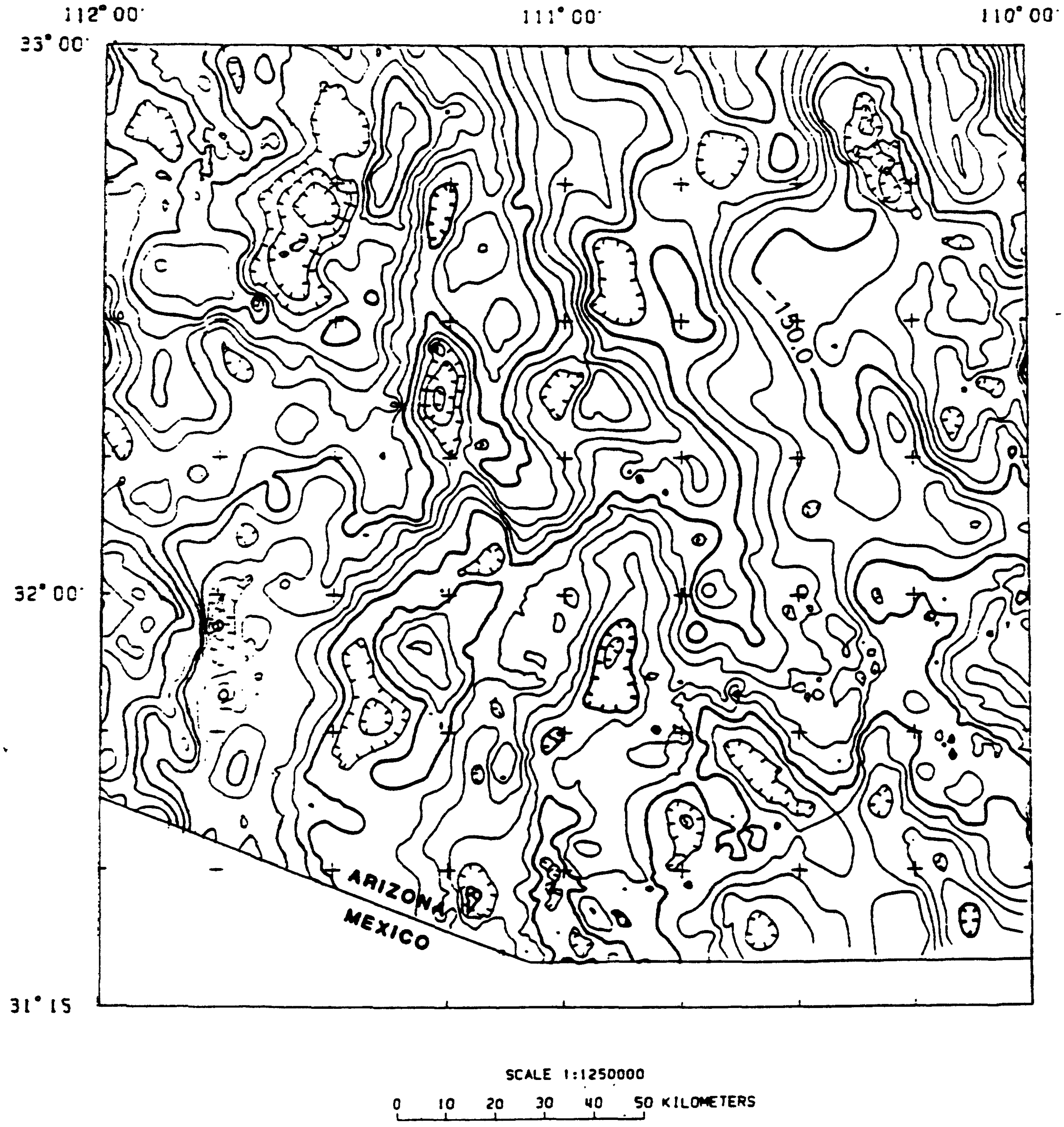

Figure 15. Complete Bouguer gravity map reduced for a density of 2.67 g/cm^3. Contour intervals 5 and 25 mGal. Compiled using data from U.S. Department of Defense gravity library.

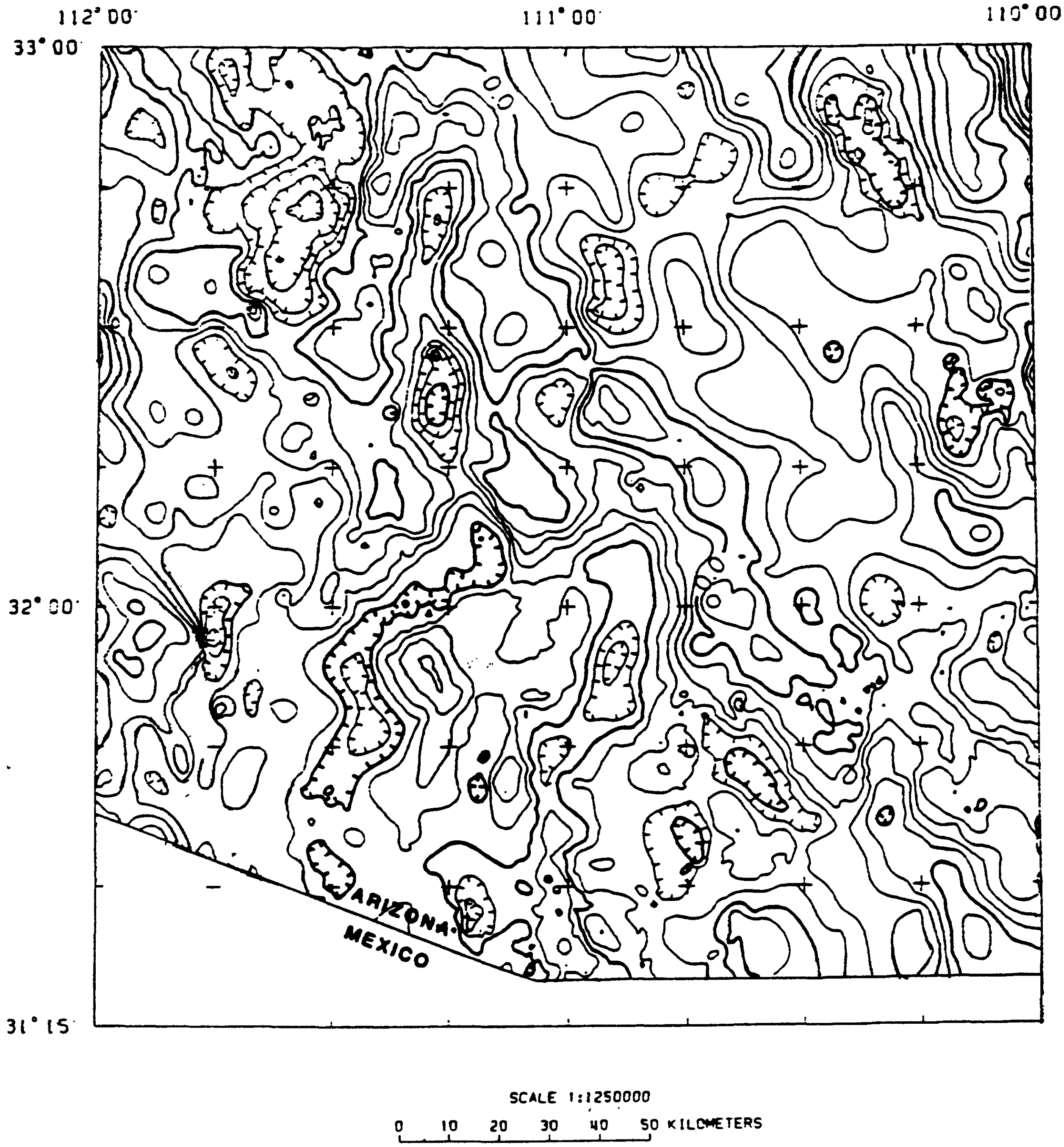

Figure 16. Isostatic gravity map reduced with an assumed upper crust density of 2.67 g/cm^3, a crustal thickness of 25 km, and a density contrast between the lower crust and upper mantle of 0.4 g/cm^3. Contour intervals 5 and 25 mGal. Compiled using data from the U.S. Department of Defense gravity library.

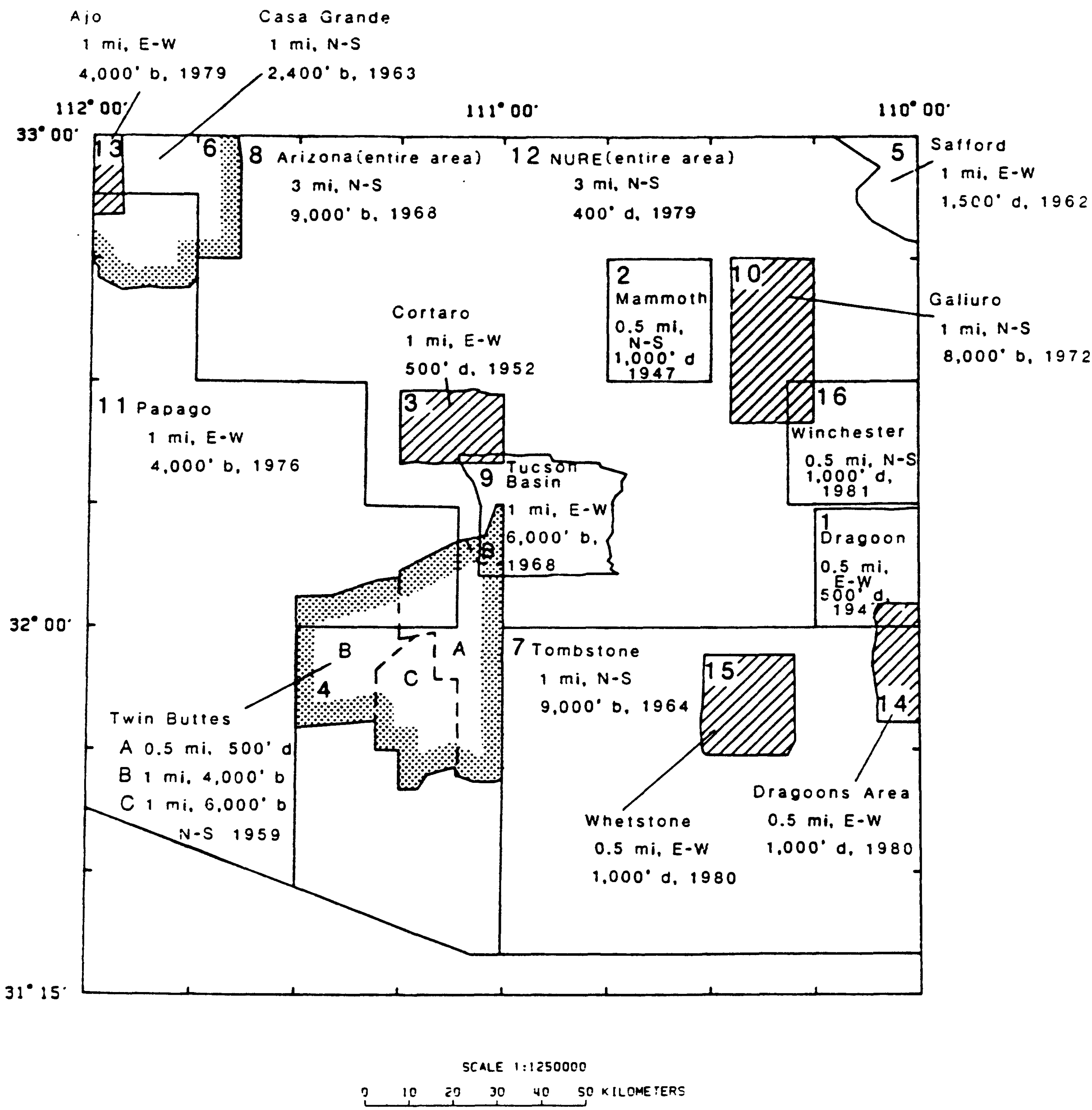

Figure 17. Index map showing boundaries of aeromagnetic surveys all or partly within the study area. Also shown are flightline spacing and direction; flightline elevation; and year flown, compiled, or published. Data correspond to that in table 9. Abbreviations: b, barometric; d, drape.

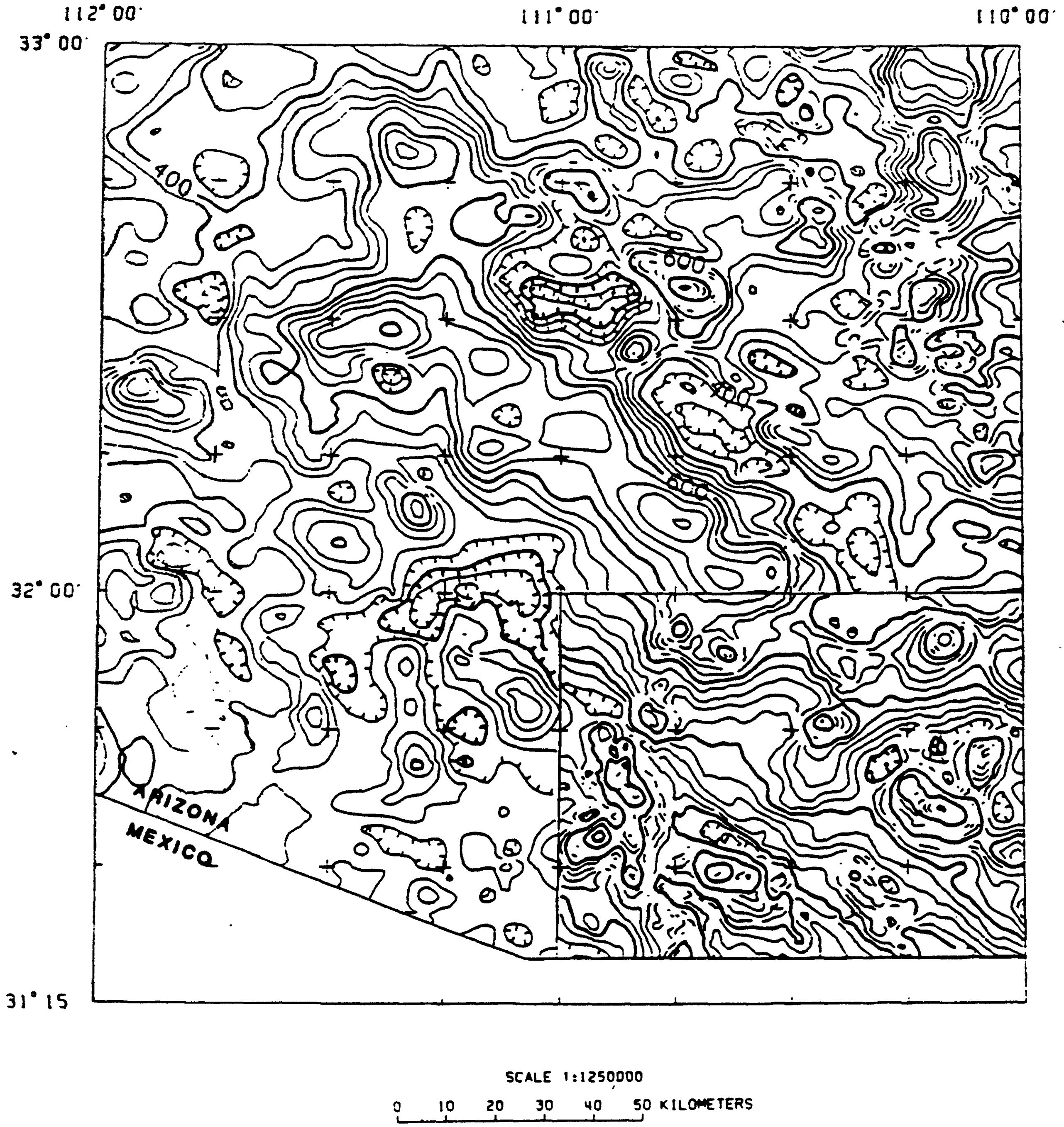

Figure 18. Aeromagnetic map. Contour intervals 40 and 200 nanoteslas. Compiled from Andreasen and others (1985) and Sauck and Sumner (1970). Datum is arbitrary.

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GEOPHYSICS - REMOTE SENSING

by

Susanne Hummer-Miller and Daniel H. Knepper, Jr.

Landsat Multispectral Scanner and Thematic Mapper

Data coverage

The USGS, Branch of Geophysics, maintains a library of Landsat satellite digital tape data. Complete coverage of the Tucson and Nogales quadrangles for both multispectral scanner (MSS) and thematic mapper (TM) data are available in this library. Four scenes of MSS or two full scenes of TM data are required for complete coverage of the quadrangles. For this investigation, Landsat MSS data for four scenes were registered to a UTM grid and digitally mosaicked to provide a 1:250,000-scale image base. The acquisition dates of the MSS scenes, clockwise from the northwest, are November 29, 1974; November 2, 1972; June 1, 1974; and September 28, 1972. A regional limonite map was constructed from the mosaicked data base at a 1:250,000 scale to identify areas that might be associated with hydrothermal alteration. (This and all other digitally-derived maps discussed in this section are available for inspection at the U.S. Geological Survey, Branch of Geophysics, Denver Federal Center, Denver, Colo. Excessive computer time and costs prohibited inclusion of these maps in this report.) Vegetation was included on this map to indicate areas that could not be assessed for limonite due to the masking effect of vegetation. Note that the southeastern part of the mosaic is a June scene; because vegetation is much more pronounced in June than in the fall, more of the limonitic areas there will be masked by vegetation. A computer-enhanced color-infrared composite at a 1:250,000 scale was also prepared from the mosaicked data for regional structural interpretations. Available Landsat TM data were previewed for suitability for follow-up detailed alteration mapping at higher spatial and spectral resolution than can be obtained with MSS data and should provide excellent results.

Interpretation

Limonite detection was made on the basis of the steep positive slope of the spectral reflectance of ferric-oxide minerals in the visible part of the spectrum resulting from strong absorption in the ultraviolet region. The single band MSS data were calibrated to percent reflectance (Robinove, 1982) and an image of the ratio of the green band (band 4) to the red band (band 5) was used as a measure of slope of the reflectance curves. The pixels containing limonite were defined by low 4/5 ratios (steep positive slope) of less than 0.88. The limonite map was filtered using a 9 x 9-pixel box filter to eliminate scattered isolated limonite pixels and to enhance clustered limonite pixels.

Several large expanses of limonitic material are conspicuous, primarily in the west half of the study area. These areas are mainly associated with Quaternary and (or) Tertiary sediments in the major valleys and basins, including Santa Cruz Flats and Santa Rosa, Aguirre, Avra, Altar, and Baboquivari Valleys. The limonitic response in these areas is most likely from weathering of ferric-oxide materials rather than from hydrothermal alteration. Extensive field evaluation is needed to distinguish the limonite caused by hydrothermal alteration from that due to weathering. Possible hydrothermally altered limonitic areas are generally small, commonly only the size of three or four pixels (240-320 m). They are described briefly below:

Picacho Mountains--The anomalies are only in the southern part of the range in granitoid rocks (Tg).

Silver Bell Mountains--Three disturbed mining areas are limonitic. In addition, a northwest-trending anomaly approximately 1 km long on the southwest edge of the West Silver Bell Mountains extends from rhyolitic volcanic rocks (TKr) to granitic rocks (TKg).

Roskruge Mountains--Limonitic anomalies are present in the northern and southern parts of the range in volcanic rocks (TKv). The southern anomalies cover a larger area.

Baboquivari Mountains--In the northern part of this range, there are small anomalies in the peraluminous granite (TKgm). The central region has anomalies in the southern and eastern parts of a volcanic unit (Tv) parallel to the fault separating it from unit Jv. The southern part of the range has numerous small limonitic anomalies in the peraluminous granite (TKgm). There are several anomalies along faults in volcanic and sedimentary rocks (Jvs).

Tortolita Mountains--Limonitic anomalies are present in granitic rocks (TKg) throughout the range.

Tucson Mountains--Only two anomalies are present; these are in the southwestern part, where the Bisbee Group and related rocks (KJb) are exposed.

Sierrita Mountains--Limonitic anomalies are present in the northern part of this range in granitoid rocks (TKg, Jg, and Yg).

Atascosa Mountains--These mountains are very heavily vegetated and only two small limonitic anomalies are seen in basaltic volcanic rocks (Tb).

Tortilla Mountains--A few limonitic anomalies are present in granitic rocks (Yg) and the Apache Group (Ya).

Galiuro Mountains--This range has numerous small limonitic anomalies throughout, mainly in rhyolitic tuff (Trt) and andesite (Ta).

Winchester Mountains--The limonitic pattern in this range is very similar to that in the Galiuro Mountains with numerous, evenly spaced anomalies. They are mainly in large exposures of rhyolite (Tr) and basalt (Tb).

Santa Teresa and Pinaleno Mountains--Limonitic anomalies are present within granitic rocks (Tg, Yg, and Xg). A conspicuous linear pattern, approximately 3 km long, of anomalies is seen in Early Proterozoic granitic rocks in the eastern part of the range.

Santa Catalina Mountains--Numerous limonitic anomalies are confined to the northeast flank of this range. The anomalies are in granitoid rocks (TKg), the Apache Group (Ya), and Paleozoic sedimentary rocks.

Little Dragoon Mountains--The few anomalies present in the range are all in the south in granitoid rocks (TKg) and the Bisbee Group and related rocks (KJb).

Empire Mountains--About 20 anomalies are evident in the center of this range in the Bisbee Group and related rocks (KJb) and granite (Yg). The Bisbee Group in the southern part of the range has three distinct anomalies.

Tombstone Mountains--The few limonitic anomalies are only in the western part of the range in the Bisbee Group (KJb) and volcanic rocks (Kv).

Patagonia Mountains--This range has only two limonitic anomalies, in volcanic rocks (Kv).

Gamma-ray Spectrometry

Data coverage

Existing gamma-ray radioactivity data for the Tucson and Nogales quadrangles consist of NURE aerial surveys of each quadrangle (U.S. Department of Energy, 1979a, b). These data were acquired along 3-mi-spaced east-west and 12-mi-spaced north-south flightlines at 400 ft above ground level. This represents about 6 percent coverage of the quadrangle because an aerial gamma-ray survey at 400 ft above ground level effectively detects terrestrial gamma radiation from a swath only 800 ft wide along each flightline. Therefore, these data are samples of the source populations in the study area but do not represent all radiometric sources that may be present.

Interpretation

NURE aerial gamma-ray data for the 1° by 2° quadrangles that include Arizona have been compiled into a data base for the COGEOMAP program. These data represent the near surface ($\leq$ 50 cm) distribution of the natural radioelements U (uranium), K (potassium), and Th (thorium)[1]. The gamma-ray data have been gridded with a cell size of 3 km to allow preparation of contour and color-composite maps (CCM) at various scales. The following discussion uses radioelement maps of Arizona and of the Nogales and Tucson quadrangles, all derived from the COGEOMAP data base.

Figures 19-21 are the U, K, and Th gray-scale contour maps of Arizona, which provide a synoptic view of the radioelement distributions in the state. The southwestern part of Arizona has a heterogeneous radioelement concentration, which reflects the heterogeneity of the rocks that compose the transition zone and Basin and Range provinces. These provinces contain a variety of igneous, metamorphic, and sedimentary rocks of Proterozoic to Cenozoic age with consequent variability in radioelement concentrations.

Seven radioelement maps at 1:250,000 scale were produced for this study: contour maps of U, K , and Th, a CCM of the three elements , and CCM's for U and its ratios U:K and U:Th, K and its ratios, and Th and its ratios. The contour maps show the quantitative distribution of the radioelements. The color maps were constructed using the color-compositing technique of simultaneously dipicting three parameters on the same map using the primary colors of red, green, and blue (Duval, 1983). The CCM for the three elements depicts U as red, K as green, and Th as blue. Combined highs are light or white and combined lows are dark or black. Areas of mixing of the radioelements in relative proportions show up as color mixes (for example, red (U) + green (K) = yellow). CCM's have qualitative relevance only. This technique is used to simultaneously portray each of the three radioelements and their ratios, thereby highlighting the distribution of each radioelement relative to the other two radioelements. The U CCM shows U as red, the ratios U:K as green, and U:Th as blue; the K CCM shows K as red, K:U as green, and K:Th as blue; the Th CCM shows Th as red, Th:K as green, and Th:U as blue. The color-compositing technique affords a method of extracting nuances in radioelement distribution and was used in this study to complement the contoured radioelement data.

The radioelement data for the Tucson and Nogales quadrangles show strong variations in concentrations, commonly reflecting the silica content of igneous rocks and of sedimentary rocks containing detritus derived from igneous rocks. The data are used to discriminate more radioactive, felsic rocks from less radioactive, mafic rocks. Thus, areas of higher concentrations are associated mostly with felsic igneous rocks. Source lithologies for areas of lower concentrations are not as readily discerned, although basalt, as expected, has low radioelement concentrations.

With two exceptions, the study area is characterized by widely varying concentrations of all the radioelements. In the east-central part of the area the contour maps show a distinctive southeast-trending band of low concentrations of all radioelements. In contrast, there is a distinct area of relatively higher concentrations that extends from the Baboquivari Mountains to the Santa Rita Mountains.

The U contour map shows several areas of distinct highs, all of which appear to be associated with granitic rocks. These areas are the northern Santa Catalina (Tg), northern Comobabi (Jg), Quinlan (Jg, appears on fig. 2 as northernmost Baboquivari Mountains), southern Baboquivari (TKgm), western Santa Rita (two distinct highs in TKg), Patagonia (mostly cover), and Huachuca (Yg) Mountains. Areas of relatively higher U commonly are found in basins and possibly reflect derivation of basin detritus from nearby felsic rocks. The U CCM displays[1]

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[1] The e for equivalent prefix for uranium and thorium, often used gamma-ray derived measurements to denote the possibility of disequilibrium in the respective decay series, is not used in this report.

a band of moderately to highly anomalous concentrations crossing Aravaipa Canyon, and the U source appears to be a combination of Mesozoic and Cenozoic igneous and sedimentary rocks (primarily Trt, Ta).

The K contour map shows that high K concentrations are fairly evenly distributed throughout the study area with the highest concentrations occurring in the south and southwest. The highest K concentration is in volcanic rocks (Kv, Jv) in the Canelo Hills. The Tat Momoli Mountains (Ya, Yg) and Silver Reef Mountains (Yg, Tb) have a dumbbell-shaped high connecting them. The K high at Picacho Peak (Tv, Tsv) is probably related to K metasomatism that occurred along the detachment fault in that area (S.J. Reynolds, oral commun., 1988). K metasomatism along a detachment fault indicates that the fault is a likely pathway for mineralizing fluids (Brooks, 1985). Other areas of K anomalies are the northern Comobabi (Tsm, Jg), southern Comobabi (Jg, Ja), Artesa (Jg, Jv, TKv, Tsm), Baboquivari (Tv, Ks, Trt, Jv), Atascosa (Jv), and the Galiuro (Ta, Tr) Mountains. The K CCM shows a "C"-shaped feature, open to the southwest, in the northern Whetstone Mountains and adjoining pediment. The tips of the "C" are mostly in Proterozoic granite, suggesting that the rest of the "C" could reflect detritus derived from these granites.

The Th contour map shows Th highs mostly in the south and southwest. The Quinlan and Baboquivari Mountains both exhibit highs due to Mesozoic and Cenozoic felsic igneous rocks. Just northwest of the Pajarito Mountains, the Th high is surrounded by lows. The high is in Tertiary volcanic rocks and reflects the presumed felsic composition of that unit. In the Santa Rita Mountains, Th highs trend south-southeast into the Canelo Hills. The major source for these features is granite (Jg, TKg) but may also be Jurassic volcanic and other felsic igneous rocks. In the Huachuca Mountains, there is a northwest-trending moderate Th concentration that is coincident with a high U concentration in the granite (Yg). A northwest-trending low Th anomaly is evident between the highs in the Huachuca Mountains and the Canelo Hills. It is located in QTa and KJb and is fault bounded. A large Th high west of the Dragoon Mountains may have resulted from granite detritus supplied by granite (Tg) in the western part of the Dragoon Mountains. This area is high in all three radioelements as seen on the CCM. The Th CCM shows an anomalous area in the valley between the Tortolita and the Santa Catalina Mountains, each of which has Tertiary granite. The high may represent detrital Th minerals derived from the granites and concentrated in the valley. East of the Picacho and southwest of the Tortilla Mountains, a Th feature is expressed as mostly white on the Th CCM. On the CCM map of the elements, this area shows moderate to low U and low K. This nuance in the radioelement distribution may have mineralogic significance.

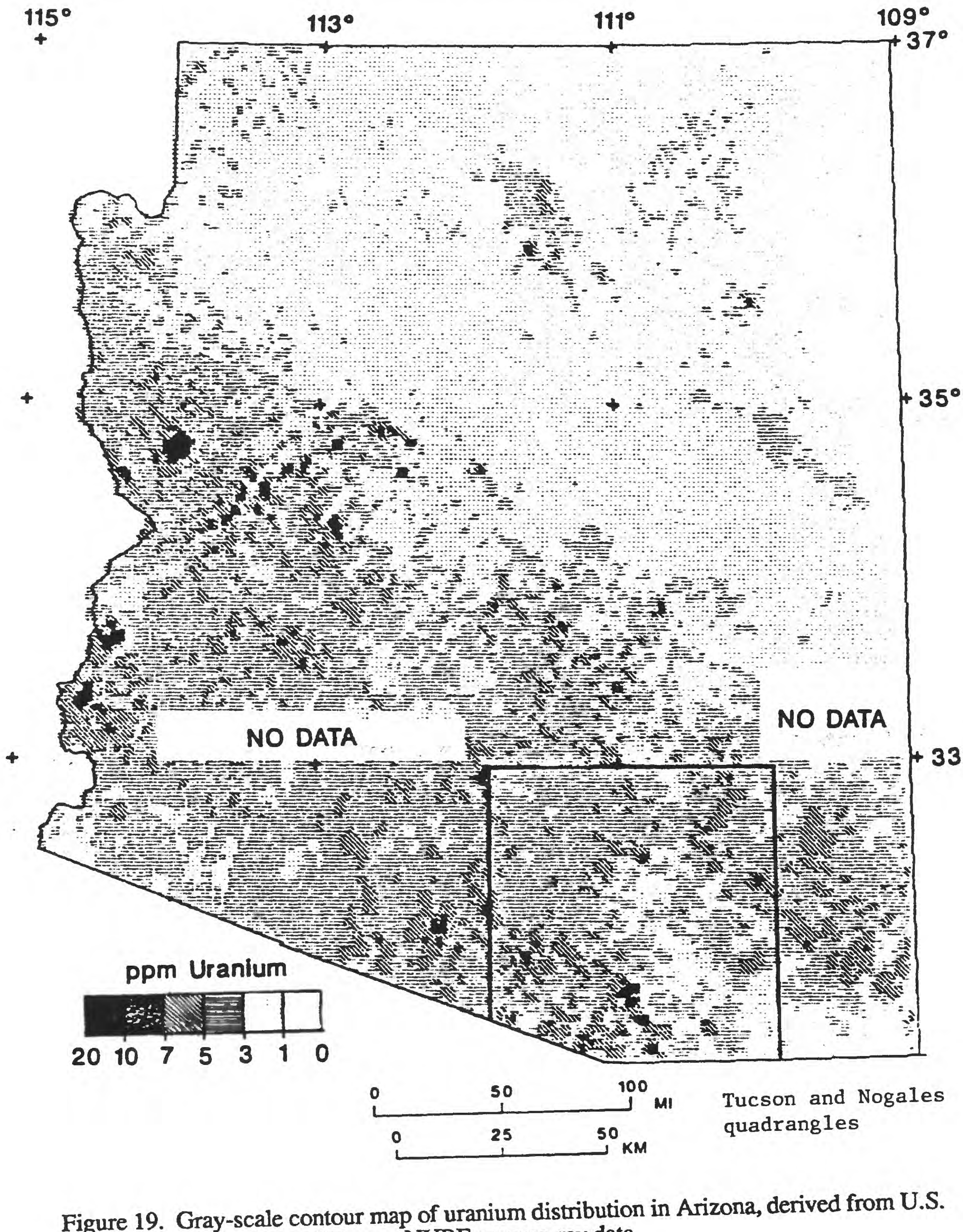

Figure 19. Gray-scale contour map of uranium distribution in Arizona, derived from U.S. Department of Energy NURE gamma-ray data.

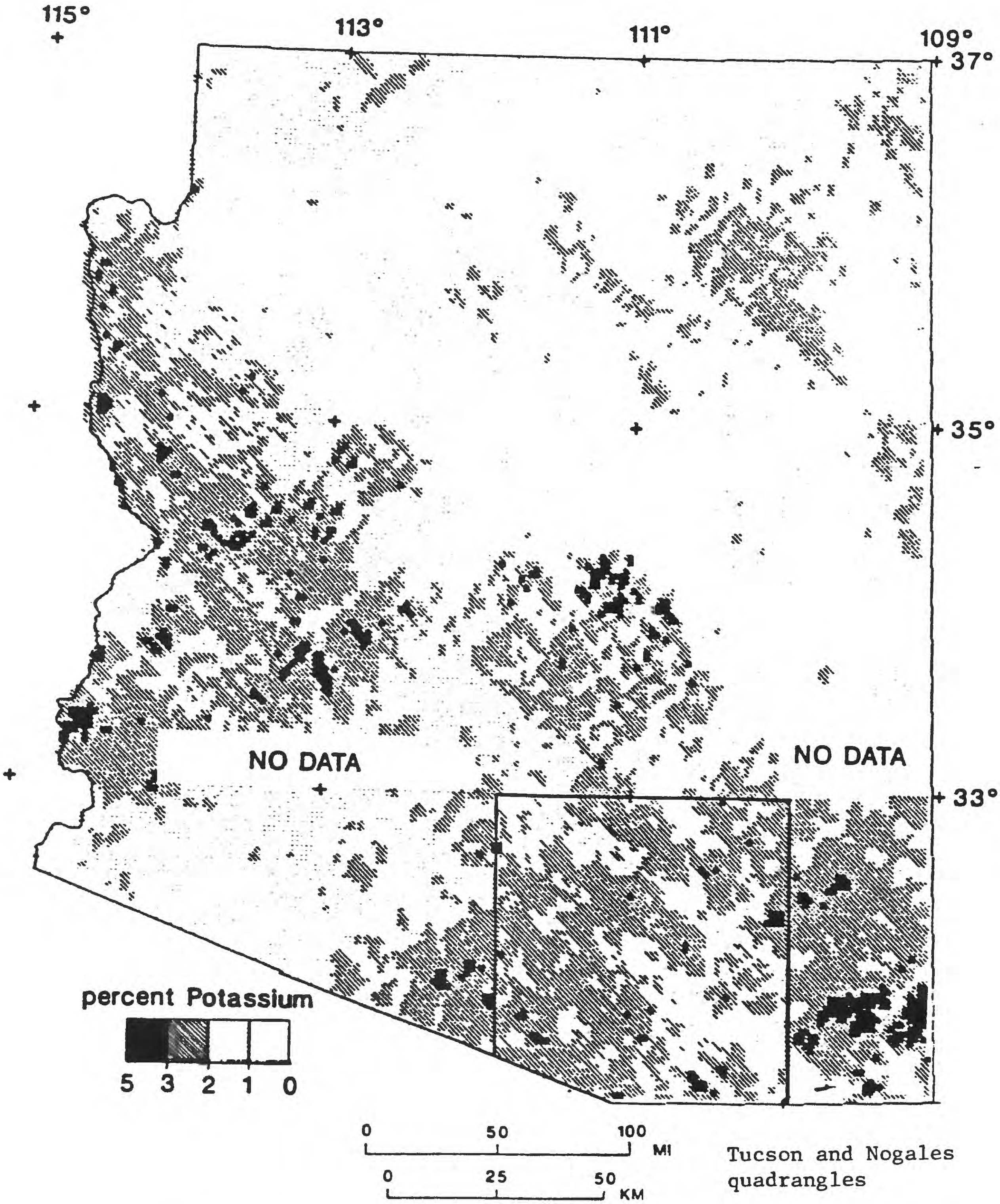

Figure 20. Gray-scale contour map of potassium distribution in Arizona, derived from U.S. Department of Energy NURE gamma-ray data.

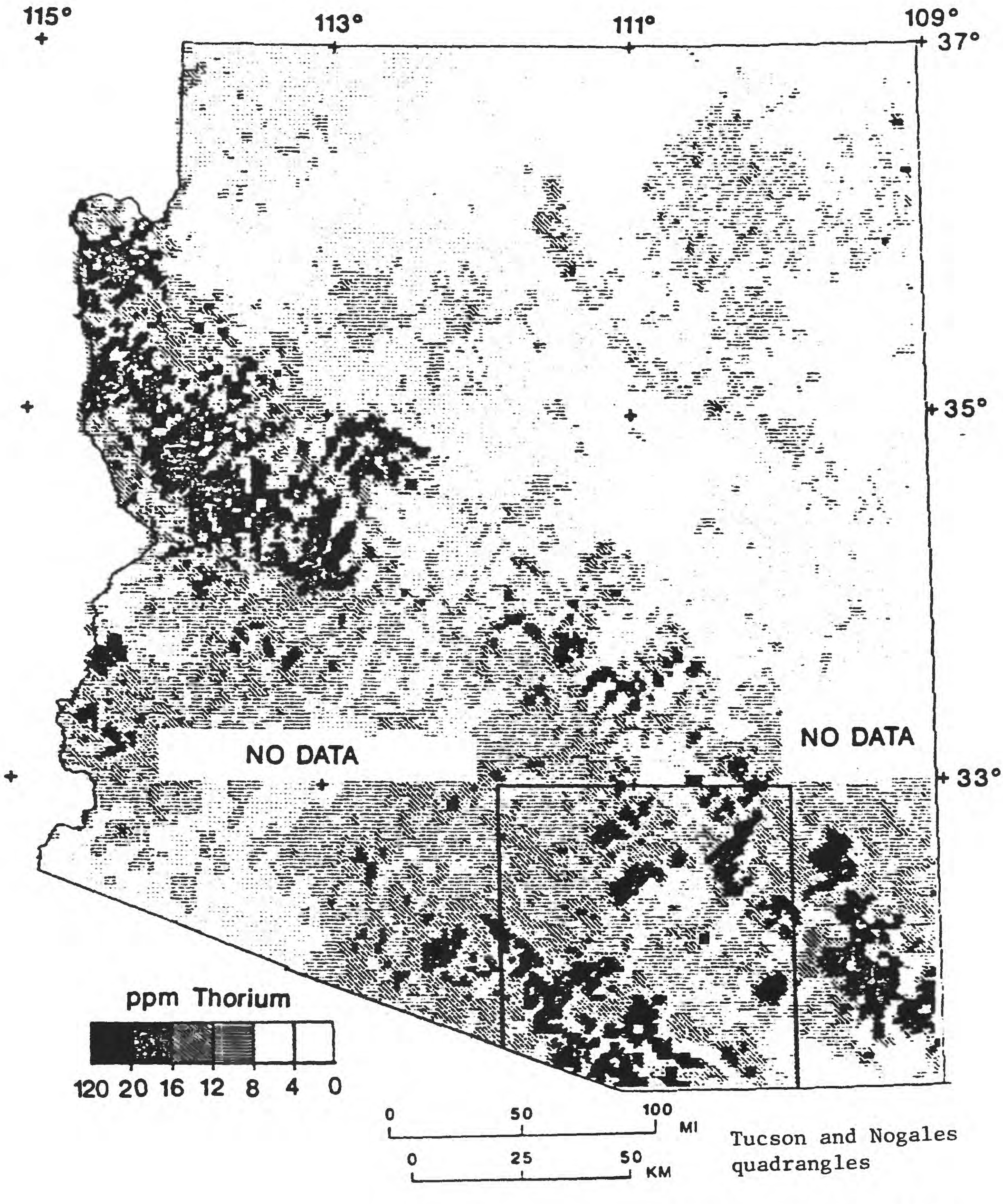

Figure 21. Gray-scale contour map of thorium distribution in Arizona, derived from U.S. Department of Energy NURE gamma-ray data.

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GEOPHYSICS - ELECTRICAL AND SEISMIC METHODS

by Robert J. Bisdorf

Electrical methods

Electrical methods include direct-current (dc) sounding, dc profiling, magnetotelluric (MT) and audio-magnetotelluric (AMT) sounding, controlled source AMT and electromagnetic sounding, and dipole-dipole profiling. These techniques, by themselves, do not generally detect a mineral tract (terrain), but are used as part of a multi-disciplinary study to add to the structural and lithologic knowledge of an area.

In the study area, 14 AMT soundings were made (Baer and Klein, 1984; Martin and others, 1982) as a part of wilderness mineral resource investigations of very small areas along the east boundary of the study area.

The USGS has access to about 25 MT soundings that were located along a line extending northeast from the Picacho Mountains. Additionally, an unknown number of MT soundings have been made along two lines, one running west to east from south of Tucson to El Paso, Tex., and the other running south to north from just southwest of Tucson. These data are in nonproprietary data sets available from Geotronics and from data acquired by the Los Alamos Scientific Laboratory.

Twenty-one Schlumberger soundings were made near and south of Tucson (Tucci, 1984) as part of a ground-water study by the Water Resources Division of the USGS and are publicly available. On the Tohono O'Odham Indian Reservation more than 100 Schlumberger soundings and more than 100 AMT soundings have been made by the USGS, but these data are currently proprietary.

Induced polarization (IP) is a dipole-dipole profiling electrical technique that responds to disseminated sulfide minerals such as those associated with porphyry deposits. Resistivity data are a byproduct of IP surveys. There are very few references to IP in the literature for this area (see references). This is not surprising because the technique is primarily used by mining companies and existing data would be part of proprietary company records.

Seismic methods

The most common seismic techniques are refraction and reflection. Both are typically high-cost, high-resolution techniques most effective for obtaining detailed information over a limited area, typically along a profile or series of profiles. About 87 seismic refraction profiles of varying lengths have been made from Tucson northwest to about Coolidge by the USGS, Geophysics Branch. Most of these data are available but not interpreted. Over 3,000 line miles of seismic reflection data were collected by Anschutz Oil to study part of an assumed overthrust area. Only about 35 line miles of these data have been published (Keith, 1980). For shallow (less than 1 km) mineral assessment or exploration, the data as shown are probably inappropriate.

Comments

Generally, resistivity studies are not appropriate for reconnaissance surveys because they cannot cover enough area to be cost effective in that capacity. Once specific tracts have been determined, resistivity techniques can be used effectively to help confirm or delineate resources.

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MINERAL RESOURCES

by Gail M. Jones

The Tucson and Nogales quadrangles have been mined since at least 1750, when placer mining began in Arivaca Creek. Underground silver mining at the Cerro Colorado Mine began as early as 1770. The study area represents an important part of this mineral-rich state. In 1985 Arizona produced 72 percent of the nation's copper and 18 percent, 12 percent, and 2 percent, respectively, of molybdenum, silver, and gold (Burgin, 1987). That year, production from the Tucson and Nogales quadrangles, as a percentage of state's metals output, was as follows: Mo, 77 percent; Pb, 42 percent; Zn, 29 percent; Ag, 27 percent; Cu, 22 percent; Au, 10 percent; Mn, 6 percent; V, 6 percent; and W, 2 percent (Keith and others, 1983a). Although many areas within these quadrangles have been extensively explored, opportunities exist for further exploration and possible exploitation. This section reviews the mineral deposit information available for the study area and presents preliminary indications of what types of undiscovered deposits might be present and the geologic environments permissive for such deposits.

Production and Occurrence Data

Metals

All of the major copper-producing mines in the study area are porphyry copper-molybdenum deposits (Sierrita, San Manuel, Lakeshore, San Xavier, Silver Bell) or skarns related to porphyry copper systems (Twin Buttes, Esperanza, Mission, Johnson Camp). Molybdenum, Pb, Ag, Au, and Re are coproducts or byproducts of Cu production. The study area contains 9 of the top 16 copper-producing mines in the state; their rank, in order of copper production in 1985, is shown in table 11. In 1985, the Sierrita mine led the state in molybdenum production and was the sole domestic producer of Re, an element used to produce low-lead and lead-free high-octane gasoline. U.S. consumption of Re is increasing (Burgin, 1987).

Figure 22 shows the location of the metal-mining districts in the study area. Table 12 gives the principal deposit types found in each district and the cumulative reported production as of 1981. The deposit types refer to those described in Cox and Singer (1986) (see also table 14). Porphyry copper deposits have been the largest producers in the area. As of 1981, the Pima mining district produced more Cu, Mo, and Ag than any other in the study area; the San Manuel district had the greatest cumulative Au production; and the Mammoth district produced the most Pb and significant V (about 1,270 short tons). The Tombstone district produced 6,890 short tons of Mn from manganese replacement deposits. About 7 metric tons of W were produced in the Reef district, probably mainly from tungsten veins.

The USGS Mineral Resource Data System (MRDS) was used extensively for this compilation. MRDS contains brief descriptions of 1,271 mines, prospects, and occurrences in the study area; however, most nonmetallic commodities are not included. Table 13 lists those mines having medium and large production, as defined in MRDS (Keefer and Calkins 1978, p. B14), along with the cumulative production and known reserves at each mine. Plate 21 shows the deposit types of the mines listed in table 13 as well as some mines with small known production. The appendix lists the metal mines and occurrences in MRDS and gives location, commodity, cumulative production, and deposit type where determined.

The Arizona Department of Mines and Mineral Resources (ADMMR) in Phoenix has developed the Arizona Mineral Inventory Location System (MILS) that includes data on both metallic and nonmetallic resources, incorporating information from MRDS and the U.S. Bureau of Mines' Map Overlay System (MOS). Entries in MILS are based on property ownership. Because of limited time and high cost, MILS records were not used for the report.

Nonmetals

Nonmetallic minerals accounted for about 17 percent of the dollar value of all mineral production in Arizona for 1985. In that year, production in the Tucson and Nogales quadrangles included clays, gypsum, lime, sand and gravel, and crushed stone. The following list of deposits was taken from Burgin (1987).

Clays--Common clay for brick and tile was quarried by two companies at the Pantano Pit in Pima County. Phoenix Brick Yard and Arizona Portland Cement Co. ranked second and fourth in the state, respectively, among common clay producers.

Gypsum and Anhydrite--Gypsum for use in agriculture and construction has been mined since the mid-1950's (Philips, 1987). National Gypsum Co. quarried gypsum at Feldman, in Pinal County near the northeast boundary of the Tucson quadrangle. Pinal Mammoth Gypsum Co. quarried gypsum at the Thunderbird Mine, 6 mi north of Mammoth. The Picacho Basin, west of the Picacho Mountains, contains 2,000 m of anhydrite (Sumner, 1985) and corresponds to a negative complete Bouger gravity anomaly (pl. 18).

Lime--Magma Copper Co. produced lime for the copper industry at San Manuel, ranking third in Arizona for lime production.

Sand and Gravel--Little Hills Mines, Inc., quarried sand and gravel, sold as metallurgical flux, from a location between Casa Grande and Lakeshore in Pinal County.

Crushed Stone--Arizona Portland Cement Co. quarried limestone from the Mississippian Escabrosa Limestone in Pima County. Potential for additional resources in the Escabrosa Limestone is good. Marble for crushed stone was quarried by Endrada Co. near Twin Buttes. Magma Copper Co. produced crushed sandstone for smelter flux in southeastern Pinal County.

Nonmetallic commodities that have been produced in the area in the past but not in 1985 include diatomite, feldspar, fluorite, scrap mica, and perlite, as well as quartz and quartzite for smelter flux. The following descriptions are taken from Philips (1987).

The White Cliffs Mine in Pinal County has been an important producer of diatomite that was used for filter aids, fillers, and cement additives. The diatomite is associated with gypsum.

The B M Group and the Darlene A Group in Pinal County are the only known occurrences of feldspar, which is used to manufacture ceramic and glass. The feldspar is in a pegmatite in the Oracle Granite. Potentially productive deposits may occur in other pegamtites associated with Proterozoic granites.

Metallurgical grade fluorite in epithermal veins and breccia zones is found in Cochise, Graham, and Pima Counties.

Scrap mica, produced at the Tucson Mica Property, Pinal County, and at several mines in Cochise County, occurs as hydrothermal sericite in faulted volcanic rocks.

A vermiculite deposit is known in the Oracle 15-minute quadrangle in Pinal County. The vermiculite exfoliation industry in Arizona currently depends on sources outside the state but may provide a market for this and other possible deposits in the study area.

"Popped" perlite is used in the construction industry for its light weight and insulating properties. Potential "popped" perlite occurs in the Silver Reef Mountains and in rhyolite vitrophyre in the Cerro Colorado Mountains. The potential is good for the presence of more perlite deposits.

Fuels and Energy Resources

No oil, natural gas, or coal have been produced in the Tucson and Nogales quadrangles. Beikman and others (1986) rated the probability for future discovery of oil and (or) gas as low to high. Most of the study area falls in the low to lower medium category; however, the basin northeast of the Tombstone Hills (fig. 2) was assessed as having a high potential for fuel discoveries. Surrounding this area, the valleys east of the Whetstone Mountains and the Huachuca

Mountains were assessed as having higher medium potential. Beikman and others (1986) also assessed Aravaipa Canyon as a higher medium potential area for fuel resources.

In the study area no geothermal areas were identified (Brook and others, 1979) with hydrothermal convection systems having reservoir temperatures greater than 90°C. However, at least 41 wells and springs have been identified as potential sources of geothermal fluids (Bliss, 1983). In an assessment of low-temperature (less than 90°C) geothermal resources in the western United States (Mariner and others, 1983), 10 geothermal systems were identified in the study area. Two kinds of low-temperature geothermal systems were identified, those which are isolated and those which are not. Nine of the systems in the study area are of the isolated type--springs and (or) wells that are found in areas less than 4 km^2 and reservoir volumes that are, by default, set at 1 km^3 (Mariner and others, 1983). Reed and others (1983) give location, temperature, and a summary of water chemistry for all systems used in the low-temperature assessment. In the study area, the isolated systems, as described in their table, (Reed and others, 1983, table 1) include springs west of Winchester, Hookers Hot Springs, agricultural and domestic well (Cochise County); Mercur springs, well north of Jaynes, domestic well, well north of Iron Butte (Pima County); and Agua Caliente Spring, Monkey Spring (Santa Cruz County). The nonisolated system is in the Chandler area (Pinal County) and is represented by eight wells.

Mineral Resource Potential

Delineated Deposit Types

Table 14 lists the deposit types considered in this preliminary study. Areas permissive for metallic resources were delineated for porphyry copper-molybdenum, skarn and replacement, epithermal precious-metal polymetallic veins, and flat-fault gold (pls. 22-24). Table 15 lists the criteria used to delineate tracts for each deposit type. Many of the rock types present in the area are permissive for one or more of the deposit types (table 16). Expected grades and tonnages for undiscovered deposits are given in table 17. These represent the 90th, 50th, and 10th percentiles of grades and tonnages of deposits used to construct the deposit models. Specific tracts are discussed below. Some deposit types were not delineated, generally because a short written disucssion seemed adequate.

Porphyry Copper

Eighteen tracts (pl. 22) were delineated for porphyry copper deposits including:

Sierrita Mountains--Four of the major porphyry copper deposits in the study area are within this tract. The core of the range, the Ruby Star Granodiorite, is known to be barren. The tract boundary includes shallowly buried rocks on the pediment, as determined from gravity data. The pediment areas have the best potential in the tract for the discovery of additional porphyry copper deposits.

Santa Catalina Mountains--This range includes the San Manuel-Kalamazoo porphyry copper system. Cox and Singer (1988) have recently defined and described porphyry copper-gold-molybdenum-type deposits based in part on geochemical work at the Kalamazoo orebody (Chaffee, 1982b). This deposit type is intermediate between porphyry copper-molybdenum (type 21a), such as in the Pima district, and porphyry copper-gold (type 20c), such as in the Dos Pobres district in Graham County east of the study area, and represents a continuum between the two end members. The median Au grade for porphyry copper-gold-molybdenum is 0.15 g/t as compared to a median grade 0.012 Au g/t for porphyry copper-molybdenum; however, the median Mo grades for the two types are very similar.

Patagonia Mountains and southern Santa Rita Mountains--This tract is delineated on the basis of the Red Mountain deposit in the Patagonia Mountains, the Cu-bearing polymetallic vein deposits in the southern Santa Rita Mountains, and the geochemical anomalies. The tract outline follows the Pb geochemical anomaly (pl. 11). It is separated from the Empire Mountains tract because of a tectonic break defined by the aeromagnetic data (pl. 20). Ludington (1984b) noted a northwest-trending zone of argillic alteration within the igneous rocks in the southern Santa Rita Mountains.

Whetstone Mountains--This tract was delineated on the basis of the porphyry copper occurrence in the Mine Canyon district and a magnetic high associated with Cretaceous granitic rock. Wrucke and McColly (1984) reported that the porphyry deposit in Mine Canyon contains substantiated resources of 32 million ton of ore containing 0.28 percent Cu and 0.01 percent Mo.

Galiuro Mountains--The tract is delineated on the basis of the Childs-Aldwinkle porphyry copper and related deposits of the Bunker Hill district in the northern part of the tract and a positive aeromagnetic anomaly in the southern part, apparently associated with Cretaceous or Tertiary granitic rocks (TKg). Creasey and others (1981) noted that past metal production, recent mining activity and exploration, and widespread hydrothermal alteration and metallization indicate high potential for one or more porphyry copper deposits in the northern part of the tract.

Pajarito Mountains--This tract is based on geochemical data and the occurrence of copper mineralization in Sonoro, Mexico (M.A. Chaffee, oral commun., 1988). Any porphyry copper deposits in this tract would be relatively deep.

Dragoon Mountains--This tract is delineated on the basis of anomalous Cu, Mo, and Pb in stream-sediment samples and the occurrence of Tertiary granite. Drewes and Kreidler (1984) suggested that this area as has potential for stockwork molybdenum or tungsten rather than porphyry copper.

Picacho Mountains--This tract is based on the presence of a Tertiary granitic pluton in conjunction with a positive gravity anomaly. The potential for porphyry copper deposits in this tract is relatively low.

Geochemical data are lacking for many parts of the study area. Because positive aeromagnetic anomalies can indicate the subsurface extent of a mineralized skarn or replacement body, the boundaries of tracts not specifically discussed above are delineated solely around positive aeromagnetic anomalies.

Skarn and Replacement Deposits

Skarn and replacement deposits were delineated on the basis of known deposits, the occurrence of favorable carbonate rock, and the presence of Mesozoic to Tertiary intrusions (except the Tertiary peraluminous granite, which is not favorable). For this study, tungsten skarn (type 14a), copper skarn (type 18b), zinc-lead skarn (type 18c), polymetallic replacement (type 19a), and manganese replacement (type 19b) deposit types were delineated together as a group because the tracts would be essentially the same for each deposit type. For example, polymetallic replacement, copper skarn, and tungsten skarn deposits are all present in the Empire Mountains. These deposit types are commonly associated with the same intrusions as porphyry copper deposits.

The available data do not clearly indicate the potential for gold skarns and carbonate-hosted disseminated gold deposits. However, some occurrences in the northern Santa Catalina, the northern Santa Rita, and the northern Huachuca Mountains, which are classified as copper or tungsten skarn, contain significant gold mineralization and should be evaluated for gold skarn and (or) replacement potential.

Fourteen tracts (pl. 22) were outlined for these predominantly carbonate-hosted deposits. Based on the known deposits within some of the tracts, they are favorable for one or more of the carbonate-hosted deposits. However, without additional knowledge, all tracts are permissive for all of the deposit types. They are in the following areas:

Huachuca Mountains--This tract is favorable for tungsten skarn deposits. Some of the known tungsten deposits in the tract are disseminated scheelite occurrences; others are quartz-scheelite veins more closely resembling quartz-wolframite vein deposits (type 15a) (S.D. Ludington, oral commun., 1988).

Dragoon Mountains--This tract is favorable for silver-bearing base-metal and tungsten skarn deposits associated with an Oligocene stock.

Galiuro Mountains--Known occurrences indicate that this tract is favorable for copper and tungsten skarn and manganese replacement deposits.

Tombstone Hills--Polymetallic replacement and manganese replacement deposits are known in this tract.

Santa Teresa Mountains--This tract is favorable for base-metal skarns and replacement deposits.

Silver Reef Mountains and Santa Rosa Mountains--These tracts are favorable for skarn and polymetallic replacement deposits peripheral to the Lakeshore porphyry copper system.

Santa Catalina Mountains--These tracts are favorable for copper and tungsten skarns.

Tracts not discussed above represent areas of permissive rock types but for which supporting data is lacking.

Epithermal Precious-Metal Deposits

Epithermal precious-metal deposits in the Tucson and Nogales quadrangles are likely to be Comstock type (type 25c) except in the tracts delineated in the Silver Reef Mountains, where deposits may be Sado type (type 25d). Thirteen tracts (pl. 23) were delineated on the basis of known occurrences, the presence of possibly favorable volcanic or hypabyssal intrusive rock, and a geochemical suite of Au, As, Sb, Hg, Te, and Ag. Because of a lack of adequate stream-sediment geochemical data for the Tucson quadrangle, tracts delineated for epithermal deposits in that quadrangle are speculative. Tracts delineated for epithermal precious-metal deposits include:

Patagonia Mountains--This tract contains widespread anomalous areas for Hg, As, Sb, Te, and Ag as well as isolated areas of anomalous Au in the southern part of the tract.

Pajarito Mountains--This tract includes the Oro Blanco district, which has produced nearly 900,000 short tons of ore. Stream-sediment geochemical data show widespread anomalous Hg, Sb, and Ag. Samples containing anomalous Au were collected from the southern and eastern parts of the tract.

Galiuro and Winchester Mountains--This tract was delineated around the exposed Tertiary intermediate to felsic volcanic rocks and small epithermal gold-vein deposits. In the Rattlesnake district, gold and pyrite occur in small mineralized pockets along faults and fractures in altered volcanic rocks.

Baboquivari Mountains--Stream-sediment geochemical data outline several areas of Au anomalies along the east flank of the mountains, and an area of anomalous Sb extending about 3 mi south-southeast of Mildred Peak.

Polymetallic Veins

Polymetallic vein deposits (type 22c) are delineated on the basis of known deposits, the occurrence of Mesozoic to Tertiary intrusions, and a geochemical suite of Ag, Cu, Zn, and Pb. The intrusions favorable for porphyry copper mineralization are also favorable for polymetallic veins, which are commonly peripheral to porphyry copper systems. Ten tracts have been delineated for polymetallic vein deposits (pl. 24). Three are discussed below.

Huachuca Mountains--The known Cu-Ag-Au polymetallic deposits are concentrated along the axis of an anticline. In the southern part of the tract the deposits surround the Huachuca Quartz Monzonite. The deposits are mostly restricted to exotic blocks of limestone (megabreccia?) in Triassic and Jurassic volcanic rocks and, thus, are strictly replacement deposits, but some mineralized fissures have also been noted. Production from known deposits has been small and, because of the observed lithologic control, undiscovered deposits are also likely to be small (Ludington, 1984a). In the northern part of the tract, the fissure veins appear related to the granodiorite pluton and associated sills exposed along an anticlinal axis.

Southern Santa Rita Mountains--This tract was delineated on the basis of known occurrences and the geochemical signature. The extent of the Cu stream-sediment anomaly defines the tract boundary. Silver anomalies are also present, although they are less widespread.

Silver Bell Mountains--This tract contains polymetallic veins in faults associated with a Cretaceous collapse caldera at the north end of the range. Geochemical data for the area suggest that gold and silver could also be important components of these veins (Nowlan and others, 1989). The veins are probably Tertiary, younger than the porphyry copper mineralization at Silver Bell.

Flat-Fault Gold Deposits

Nine tracts (pl. 24) were delineated for flat-fault gold deposits (type 37b). They include:

Rincon Mountains--The mineralization of the Rincon district on the southwest flank of the Rincon Mountains is spatially associated with a detachment fault (Welty and others, 1985b). The Aqua Verde Mine is described in MRDS as a copper-silver mine of small production, where the mineralization occurs fissures and fault zones in a "thrust", and may represent a flat-fault deposit of the type described by Bouley (1986). Also, the Heavy Boy barite deposit is southeast of Aqua Verde Mine; barite is commonly associated with these deposits. However, the mineralization in the Rincon district has been described as weak and spotty (Keith, 1974). Other areas in the Rincon Mountains where the upper plate of detachment faults contain abundant high-angle faults were delineated as permissive for such deposits. Because of a lack of samples and (or) sensitive Au analyses in the Tucson quadrangle, geochemical data for Au are unavailable.

Santa Teresa Mountains--A single sample from the eastern Santa Teresa Mountains with anomalous Cu may be associated with flat-fault mineralization. A highly speculative tract was delineated in the western Santa Teresa Mountains on the basis of the occurrence of the Copper Bar Prospect, which produced small amounts of Cu, Ag, and Au from brecciated rhyolite and schist cemented by specularite. Specularite is an abundant gangue mineral in flat-fault gold deposits in the Prescott 1° by 2° quadrangle (D.L. Mosier, oral commun., 1988). Although no detachment fault has been recognized in this area, the Tertiary volcanic rocks there may correlate with the Tertiary volcanic rocks that are present in the upper plate of detachment faults in the range. Perhaps an existing detachment fault has not yet been recognized in the area. Alternatively, the mineralization may be in the lower plate in an area where the upper plate of the detachment fault has been completely eroded.

Picacho Peak--Potassium metasomatism along the detachment fault is related to a 17 to 18 Ma regional thermal event (Brooks, 1985). Potassium metasomatism along a detachment fault indicates that the fault is a likely pathway for mineralizing hydrothermal fluids.

Deposit Types Not Delineated

Tungsten Deposits

Tungsten is present in the study area as both scheelite skarns and as quartz-tungsten vein deposits (type 15a). The veins commonly contain scheelite rather than wolframite but resemble wolframite veins in that they are present as discrete quartz veins associated with Tertiary granites.

The proposed Miller Peak Wilderness in the Huachuca Mountains is favorable for undiscovered disseminated tungsten deposits in granitic rocks especially beneath the cluster of tungsten veins near the rhyolite porphyry intrusive center at Sutherland Peak on the southwest side of the Huachuca Mountains (S.D. Ludington, oral commun., 1988) (unit Jv, pl. 1). This area may also contain tungsten vein deposits (Ludington, 1984a), although this deposit type is unlikely to be major source of tungsten.

Small wolframite-scheelite placers are present in the San Luis Mountains and at least one tungsten vein deposit is present near an intrusive contact of the peraluminous granite. Appreciable wolframite-quartz vein mineralization or a disseminated tungsten deposit may be associated with that granite. Alternatively, the tungsten mineralization may be associated with a buried granite.

Placer Gold

Placer gold deposits in the Tucson and Nogales quadrangles yielded small amounts of gold. The largest placers are the Arivaca Creek placers, which produced 4,400 oz Au between 1750 and 1974, and the Ash Creek placers (Papago District, western Sierrita Mountains), which produced 4,000 oz Au between 1880 and 1945 (Keith, 1974). Placer gold probably does not represent a major resource of gold in the area as compared to that recovered from porphyry copper deposits.

Rare-Earth Pegmatites

The Dollar Bill Claims on the east side of the Rincon Mountains are located on a U-Nb-Ta-bearing pegmatite in Middle Proterozoic quartz monzonite (Yg). Placer samarskite is found in natural troughs in stream bed for 2-3 mi downstream from the pegmatites. There was no known production. The placer deposits are not thick.

REE-Nb-Ta-bearing pegmatites in the middle Proterozoic granite of the Santa Teresa Mountains occur at the Lucky Strike Claim (U.S. Geological Survey and others, 1969; not listed in MRDS).

Uranium Veins and Vanadium Veins

Uranium-bearing veins with less than 1,000 tons of "ore" are present in the Duranium district (near Tyndall, Santa Cruz County), at the Santa Clara and White Oak Mines (both in the Pajarito Mountains west of Nogales), and in the Black Dike Claims in Pima County (these mines are not listed in MRDS). The Black Dike Claims are described as pitchblende in gneissic Mesozoic granite (unit Jg, pl. 1) on the west side of the Sierrita Mountains (Butler and Byers, 1969). This deposit type is not likely to be economically important in the study area.

Vanadate veins can occur in the oxidized zones of polymetallic vein deposits (Fischer, 1969). The Mammoth-St. Anthony deposit, Mammoth District, Pinal County, yielded 2.5 million lb of V_2O_5 in concentrate during 1934-1944. However, this type of deposit is unlikely to yield significant supplies of vanadium (U.S. Geological Survey and others, 1969).

Titaniferous Magnetite in Alluvium

The pediment gravels north of the Tortolita Mountains (fig. 2) contain titaniferous magnetite-bearing alluvium to depths greater than 250 ft in an area of about 800 mi^2. The titaniferous magnetite ranges from about 1 percent to 15 percent of the alluvium, forms stratified thin layers, and is disseminated in silty sand and gravel. The Omega Claim probably contains more than 100 million short tons of ore and may contain as much as 500 million tons; however, this deposit is probably not economic for titanium (U.S. Geological Survey and others, 1969). These alluvial deposits could have been derived from any of the granitic rocks of the area except the peraluminous granite.

Table 12.--Mining districts in the Tucson and Nogales 1° by 2° degree quadrangles.

[--, No data; nr, no reported production. Production figures from Keith and others (1983b)]

			Production[2]										
District	Deposit type(s)[1]	Years	Ore (thous. tons)	Cu (thous. lbs)	Pb (thous. lb)	Zn (thous. lb)	Mo (thous. lb)	Au (thous. oz)	Ag (thous. oz)	Mn (thous. lbs)	W (thous. short ton units)	U308 (thous. (lbs)	V205 (thous. lb)
Tucson Quadrangle													
Amole	18b, 25c, 25g	1901-62	10	286	472	10	34	0.6	11	--	--	--	--
Antelope	22c or 37b?	1908-22	1	199	--	--	--	<0.1	0.5	--	--	--	--
Aravaipa	22c, CaF vein, 18c, 19a, 37b?, 25c?	1901-71?	282	1,906	34,492	27,863	--	4.4	363	--	--	--	--
Black Beauty	15a?	nr	--	--	--	--	--	--	--	--	--	--	--
Black Hawk	not determined	--	0.265	--	--	--	--	--	--	0.23	--	--	--
Black Mtn.	22c	--	--	--	--	--	--	--	--	--	--	--	--
Blue Rock	not determined	1956	.051	--	--	--	--	--	--	--	--	85	--
Blue Bird	15a	1949	<0.01	0.1	--	--	--	--	<0.1	--	--	--	--
Bunker Hill	22c, 21a	1905-75	483	27,300	5,770	--	4,150	1	190	--	--	--	--
Burney	19a, 22c	1931-67	4.5	81	85	80	--	<0.1	6	--	--	--	--
Canada Del Oro	small Cu veins	nr	--	--	--	--	--	--	--	--	--	--	--
Cardinal Avenue	not determined	nr	--	--	--	--	--	--	--	--	--	--	--
Casa Grande	21a, 22c, 19a, 25c?	1929-81	28,988	302,540	--	--	--	25.4	1,081	--	--	--	--
Clark	25c or d	1906-56	0.1	7	17	--	--	<0.1	1	--	--	--	--
Cochise	18b, 15a, 14a, 19a	1882-1981	12,806	145,789	1,316	93,799	--	3.3	720	--	--	--	--
Comobabi	25c or d	1907-51	<0.1	7.5	--	--	--	--	1.8	--	--	--	--
Cottonwood	21a	1922-62	0.7	16	9	--	--	0.2	5	--	--	--	--
Crescent	19b	1915-54	4.0 (est)	2	--	--	--	<0.01	0.1	1,253	--	--	--
Durham-Suizo	25g	1948-62	6	188	--	--	--	<0.1	1.6	--	--	--	--
Francisco Grande	21a	nr	--	--	--	--	--	--	--	--	--	--	--
Gold Circle	15a	--	0.005	--	--	--	--	--	--	--	0.002	--	--
Grand Prize	22c	1931-54	0.4	1	--	--	--	0.2	0.3	--	--	--	--
Lakeshore	21a	1907-81	7,329	116,341	2	--	--	1	7	--	--	--	--
Little Hills	21a?	1929-1981	827	5,673	53	--	--	0.3	15	--	--	--	--
Magonigal	18a	1955-59	0.374	16	--	--	--	--	--	41.4	--	--	--
Mammon	22c (Au-Cu)	1893-1938	1.4	1.6	--	--	--	2	0.2	--	--	--	--
Mammoth	19a, 18c, 18b, 22c	1886-1954	5,310.094	10,445	132,680	87,312	3,943	349	1,660	41.6	--	--	2,540.8
Marble Peak	19a, 21a?	1905-68	137	6,337	81	37	--	0.3	103	--	--	--	--
North Star	21a?	1923-70	4	105	--	--	--	0.02	1	--	--	--	--
Oracle	14a, 15a, gold skarn?	1901-64	2	16	125	--	--	0.8	33	--	>21.02	--	--
Owl Head	22c	1879-1974	1.6	41	--	--	--	<0.1	8	--	--	--	--
Picacho	37b?	1939	0.1	2.4	--	--	--	<0.1	0.1	--	--	--	--
Rattlesnake	25c or d;	1923-40	0.3	--	--	--	--	0.1	1.4	--	--	--	--
Redington	18b, V vein, U vein	1913-42	0.1	12	--	--	--	--	0.15	--	--	--	--
Rincon	37b	1901-52	0.2	13	1	--	--	0.1	0.3	--	--	--	--
Ripsey	22c	1926-62	10	120	3	--	--	2	189	--	--	--	--
Roadside	21a	1917	0.097	--	--	--	--	0.01	0.02	37.7	--	--	--
Roskruge	22c, 21a?	1937-56	0.3	10	--	--	--	--	3	--	--	--	--
Saddle Mtn.	22c	1902-68	117	4,604	66	2.5	--	1	176	--	--	--	--
Saginaw Hill	18a	1918-49	6.8	144	97	217	--	0.2	9.4	--	--	--	--
San Manuel	21a	1956-81	383,824	4,478,655	--	--	72,525	486	9,261	--	--	--	--
Santa Rosa	22c (gash veins)	1916-40	0.2	21	6	--	--	<0.1	1.3	--	--	--	--
Sawtooth	Mn vein	--	0.121	--	--	--	--	--	--	65.2	--	--	--
Sedimentary Hills	21a	1941	<0.01	0.1	--	--	--	--	<0.1	--	--	--	--
Silver Bell	21a, 18a	1885-1981	90,351	1,277,233	3,439	40,780	6,570	2.2	5,843	--	--	--	--
Silver Reef	25d	1914-65	45.376	61	--	--	--	0.25	473	202.5	--	--	--
Slate	22c, 19a	1900-81	185	10	61	--	--	0.6	87	--	--	--	--
Swingle	19b	nr	--	--	--	--	--	--	--	--	--	--	--
Table Mtn.	19b, 26a?	1875-1974	100	16,000	--	--	--	19	<0.1	--	--	--	--
Tortolita	not determined	nr	--	--	--	--	--	--	--	--	--	--	--
Waterman	22c	--	30	1,820	1,131	821	--	0.1	73	--	--	--	--
Winchester	gold skarn? or 26a?	1941-49	<0.01	0.5	0.4	--	--	--	<0.1	--	--	--	--
Yellowstone	18b	1906-30	0.1	0.7	6	--	--	0.1	0.2	--	--	--	--
Zig Zag	Mn veins in granite	--	0.299	--	--	--	--	--	--	66.3	--	--	--
Nogales Quadrangle													
Aguirre Peak	not determined	1957-63	<0.1	0.6	--	--	--	<0.01	<0.1	--	>0.2	--	--
Amado	22c	1921-63	1.8	8	95	13	--	0.9	10	--	--	--	--
Arivaca	22c	to 1967	2.3	26	667	--	--	0.6	44.7	--	--	--	--
Baboquivari	22c	1895-1972	59	17	1	--	--	11.3	136	--	--	--	0.052
Black Dragon	25g	--	0.206	--	--	--	--	--	--	117	--	--	--
Blue Bird	Mn pods in Mz volcanic rocks	--	0.026	--	--	--	--	--	--	22	--	--	--
Bradford	21a	1912	0.03	55	5	--	--	--	1	--	--	--	--
Cababi	15a, 22c, 36a?	1864-1974	7	172.5	319	2	--	3	72.4	--	--	--	--
Cave Creek	19a	1933-63	1.5	26	0.2	--	--	6	6.3	--	--	--	--
Cerro Colorado	22c	1858-1956	4.6	21	38	--	--	0.1	313	--	--	--	--
Cerro De Fresnal	22c	1933-42	0.1	0.2	--	--	--	0.04	1	--	--	--	--
Coyote	18a	1916-64	1	140	--	--	--	<0.1	1.5	--	--	--	--
Cuprite	21a	1900-57	2.5	241	100	--	--	<0.1	4.3	--	--	--	--
Duranium	U veins	1956-57	0.677	--	--	--	--	--	--	--	--	2,700	--
Easter	15a	1941-42	<0.01	--	--	--	--	<0.01	<0.01	--	0.016	--	--
Empire	19a, 18b, 14a	1880-1928	17	164	6,673	152	16	0.8	667	--	0.012	--	--
Greaterville	22c	1912-60	2	7	652	11.1	--	0.3	16.8	--	--	--	--
Harshaw	22c, 21a	1858-1965	841	3,159	81,817	104,301	--	1.8	2,602	10,057	--	--	--
Hartford	25c, 19a, 15a	1897-1963	8.016	180	1,193	746	--	0.4	60	28.5	--	--	--
Helvetia-Rosemont	21a, 18b	1877-1969	443	37,371	378	1,146	26	1.3	369	--	--	--	--
Ivanhoe	19a	1903-49	0.938	37	157	--	--	0.6	23	19	--	--	--
Jackson	21a?	1915-40	0.2	37	--	--	--	--	1	--	--	--	--
Keystone	22c	1921-60	0.2	0.6	5	0.4	0.15	0.6	--	--	--	--	--
Kitt Peak	not determined	nr	--	--	--	--	--	--	--	--	--	--	--
Las Guijas	W placer	1930-41	1.8	6	--	--	--	<0.1	0.4	--	--	--	--
Mansfield	22c	1906-58	1.6	62	429	--	--	0.4	20	--	--	--	--
Middle Pass	18c, 19a	1898-1979	97	2,503	391	8,390	1.3	0.5	130	--	0.0015 (est.)	--	--
Mildred Peak	22c	1911-56	5.3	211	11	--	--	1	33.6	--	--	--	--
Mine Canyon	21a	1915-59	2.6	76	--	--	--	<0.1	1.6	--	--	--	--
Nogales	15a, 22c, 39a	1911-67	1	18	--	--	--	0.4	6	--	0.038	--	--
Oceanic	22c	1901-35	1.5	0.03	0.3	--	--	0.6	0.4	--	--	--	--
Old Baldy	21a or 21b?, 39a	nr	--	--	--	--	--	--	--	--	--	--	--
Oro Blanco	22c, 19a, 25c	1903-76	927	3,851	56,946	47,757	--	43.5	4,340	47	--	45	--
Pajarito	22c	1910-69	1.418	4	139	0.3	--	0.1	21	--	--	108	0.014
Palmetto	21a?, 22c?	1908-79	700	13,268	67,533	37,334	--	19.4	4,905	--	--	--	--
Papago	22c, CaF vein, 19a	1887-1969	4.6	38	699	--	--	0.1	110.6	--	--	--	--
Parker Canyon	22c	1933	<0.1	0.2	0.5	--	--	<0.1	0.1	--	--	--	--
Patagonia	18a, 18b, 18c, 19a, 22c	1903-62	6	759	378	1	--	0.7	45	--	--	--	--
Pima	21a, 18a, 22c	1880-1981	978,893	8,359,754	75,795	132,964	290,796	26.1	56,336	230	--	--	--
Queness	21a?	1912-55	18	2,604	--	--	--	0.4	13	--	--	--	--
Quinlan	not determined	1913-59	--	--	1	--	--	--	<0.1	--	>2.21	--	--
Red Rock	22c	1883-1969	0.5	20	22	3	--	<0.01	3	--	--	--	--
Reef	15a, 14a	--	21	--	--	--	--	--	--	--	12.35	--	--
Salero	22c	1880-1971	19	579	4,462	155	--	5	211	--	--	--	--
San Cayetano	22c (Cu-Ag), 25c	nr	--	--	--	--	--	--	--	--	--	--	--
Tombstone	19a, 18c, 19b	1879-1981	2,974.7	7,765	48,122	652	--	131.6	32,083	13.773	--	--	--
Tyndall	18b, 18c, 19a, 22c	1908-76	41.14	161	14,754	6,805	--	2	238	1.2	--	--	--
Washington Camp	19a, 18c	1875-70	573	33,137	38,406	74,643	--	9	2,994	--	--	--	--
Whetstone	15a, CaF vein, U vein	1955-57	0.162(est)	0.5	--	--	--	--	<0.01	<1	--	215	--
Wrightson	22c	1913-68	0.6	55	49	30	--	<0.1	3.6	--	--	--	--
Yellow Jacket	25c	--	0.7	4	0.2	95	--	<0.1	1	--	--	--	--

Table 11.--Rank in 1985 by copper production in Arizona of the main copper producers in the study area. Data from Burgin (1987).

Rank	Mine	County	By/Coproducts	Company	1985 Cu Production (metric tons)
2	Sierrita	Pima	Mo, Au, Ag, Re	Duval Corp.	98,078
3	San Manuel	Pinal	Mo, Au, Ag	Magma Copper Co.	87,132
9	Twin Buttes	Pima		Anamax Mining Co.	8,992
10	Lakeshore	Pinal		Noranda Lakeshore Mines, Inc.	6,148
11	San Xavier	Pima	Au, Ag, Pb	ASARCO, Inc.	5,525
12	Esperanza	Pima		Duval Corp.	4,657
13	Silver Bell	Pima		ASARCO, Inc.	4,036
15	Mission	Pima	Au, Ag, Pb	ASARCO, Inc.	3,154
16	Johnson	Cochise		Cyprus Johnson	2,812

Table 13. Mines with significant production and (or) reserves.

[--, not available. Grades are in percent except for Ag and Au, which are in g/mt]

Deposit Name	Model No.	Latitude	Longitude	Production: Years	Production: Ore (Thousand metric tons)	Production: Grade	Reserves: Ore (Thousand metric tons)	Reserves: Grade	Reserves: Year	References
Atlas Mine	18a	32°25'47"	111°32'48"	1900-47	133.8	16 Zn, 1.3 Cu, 21 Ag, minor Pb, Au	--	--	--	MRDS
Buena Vista	21a	31°22'50"	110°46'	--	1,814.4	1.5-2 Cu	13,700	1.24 Cu	1976	MRDS; Keith and others, 1983
Casa Grande	21a	32°57'37"	111°48'47"	1929-81	26,297.4	0.52 Cu, minor Pb, Zn, Ag	320,000	1 Cu	1978	MRDS; Gilmour, 1982
Childs - Aldwinkle	21a	32°45'11"	110°28'54"	1933-65	479.9	0.79 Cu, 0.39 Mo, minor Ag, Au	--	--	--	MRDS
Contention	19a	31°42'05"	110°03'47"	1880's	--	--	--	--	--	MRDS
Daily and Geesman	18b	32°28'32"	110°43'56"	1939-46	107	2.5-3 Cu	--	--	--	MRDS
Daisy Mine	18a	31°59'10"	111°04'38"	1954-63	3,400	1 Cu, 7 Ag, minor Zn, Pb	--	--	--	MRDS
El Tiro	18b	32°24'58"	111°32'13"	to 1931	184.6	5 Cu, 7 Ag, minor Pb, Au	--	--	--	MRDS
Emerald Mine	19a	31°41'20"	110°04'08"	1880's	36	--	--	--	--	MRDS
Esperanza	21a	31°52'11"	111°07'29"	1959-78	78,300	0.442 Cu, 0.021 Mo	23,600	0.38 Cu, 0.027 Mo	1978	MRDS
Flux Mines	22c	31°29'18"	110°45'15"	--	--	--	--	--	--	MRDS
Grand Central	19a	31°42'09"	110°03'44"	to 1886	--	--	--	--	--	Gilmour, 1982
Kansas - New York	19a	31°24"	110°43'	--	--	--	--	--	--	MRDS
Lakeshore	21a	32°31'25"	111°54'09"	1929-78	6,805	0.547 Cu	476,000	0.74 Cu	1975	MRDS; Gilmour, 1982
Mission Mine	18a	31°59'36"	111°03'30"	1959-77	98,790	0.626 Cu, 0.019 Mo, 3.8 Ag	122,000	0.73 Cu	1977	Gilmour, 1982
Morning Star	14a	32°33'26"	110°44'10"	1913-52	5.4	at least 1% W03	--	--	--	MRDS
Oro Blanco	25c	31°25'14"	111°14'43"	1936-48	0.2	--				
Oxide Mine	18b	32°23'49"	111°30'07"	1880's-18	4.5	11 Cu, 34 Ag	--	--	--	MRDS
Palo Verde	21a	31°59'52"	111°04'00"	1960-63	454	2.06 Cu (recovered)	110,000	0.61 Cu	1977	Gilmour, 1982
Paymaster	22c	31°56'44"	111°07'12"	1880-1941	30	3 Pb, 2 Cu, 685 Ag, minor Au, Zn	--	--	--	MRDS
Pima open pit	21a	31°59'11"	111°04'21"	1955-77	181,000	0.48 Cu, 0.004 Mo, 2 Ag	132,000	0.48 Cu, 0.015 Mo	1977	Gilmour, 1982
Rosemont	22c	31°45'	110°45'	--	--	--	308,000	0.63 Cu	1973	Gilmour, 1982
Sacaton	21a	32°57'37"	111°48'47"	--	--	--	43,000	0.94 Cu, 1.7 Ag	1975	Gilmour, 1982
San Manuel - Kalamazoo	21a	32°41'45"	110°41'20"	1956-78	--	1,700 mt contained Cu	980,000	0.74 Cu, 0.015 Mo	1978	MRDS; Gilmour, 1982
San Xavier	21a	32°01'39"	111°04'51"	1913-59, 1967-78	8,400	0.7 Cu, 44 Ag, minor Zn, Pb, Au	152,000	--	--	MRDS; Gilmour, 1982
Santa Catalina	19a	32°29'30"	110°45'	--	--	--	--	--	--	MRDS
Sierrita	21a	31°52'17"	111°08'53"	1968-78	204,000	0.27 Cu, 0.022 Mo (recovered)	417,000	0.32 Cu, 0.033 Mo	1978	Gilmour, 1982
Silver Bell	21a	32°25'13"	111°32'25"	1954-78	44,300	0.8 Cu, 0.01 Mo, 2.4 Ag	90,700 --	0.75-0.8 Cu, 0.017 Mo, 2.4 Ag	1970 --	Gilmour, 1982; MRDS
State of Maine	19a	31°41'57"	110°06'54"	1880's	27.2	--	--	--	--	MRDS
Tombstone-Extension	19a	31°41'49"	110°02'48"	1930-54	0.036	--	--	--	--	MRDS
Twin Buttes	18a	31°53'22"	111°02'32"	1965-77	62,900	0.702 Cu, 0.008 Mo	350,000	0.73 Cu, 0.026 Mo	1978	Gilmour, 1982
Vindicator	15a	31°39'15"	111°22'36"	1950-57	113	--	--	--	--	MRDS

Table 14. List of deposit types considered in Tucson and Nogales 1° by 2° preliminary assessment. The known occurrence of a deposit type in the study area is indicated by Y. An N indicates that the presence of a deposit type is not known. Some deposit types have been grouped for tract delineation.

[Level of assessment: 1, permissive environment delineated, grade-tonnage models exist, expected number of undiscovered deposits could be estimated; 2, permissive environment delineated, no grade-tonnage models exist, expected number of undiscovered deposits could be estimated and grade-tonnage models made; 3, probable permissive environment, grade-tonnage models exist, tracts could be outlined; 4, probable permissive environment, no grade-tonnage models exist, tracts could be outlined and grade-tonnage models made. Model numbers from Cox and Singer (1986); gold skarn model from Orris and others (1987).]

Model number	Deposit Type	Deposit type present	Level of assessment	Number of tracts
	Porphyry Copper Deposits	Y	1	18
21a	Porphyry copper-molybdenum	Y		
18a	Porphyry copper, skarn related	Y		
	Skarns and replacements	Y	1	14
14a	Tungsten skarn	Y		
18b	Copper skarn	Y		
18c	Zinc-lead skarn	Y		
19a	Polymetallic replacement	Y		
19b	Manganese replacement	Y		
	Gold skarn	N		
	Epithermal Deposits	Y	1	13
25c	Comstock epithermal veins	Y		
25d	Sado epithermal veins	Y?		
25g	Epithermal manganese	Y		
22c	Polymetallic veins	Y	1	10
37b	Flat-fault gold	Y?	2	9
15a	Tungsten vein	Y	3	--
21b	Porphyry molybdenum, low-F	Y	3	--
26a	Carbonate-hosted gold-silver	Y?	3	--
39a	Placer gold-PGE	Y	3	--
	Pegmatite REE, tantalum, niobium	Y	4	--
	Uranium vein	Y	4	--
	Vanadium vein	Y	4	--
	Placer tungsten	Y	4	--
	Fluorite veins	Y	4	--
	Barite veins	Y	4	--
	Alluvial titanium-bearing magnetite	Y	4	--
	Common clay	Y	4	--
	Perlite	Y	4	--
	Gypsum	Y	4	--
	Feldspar	Y	4	--
	Crushed stone -	Y	4	--
	Limestone	Y	4	--
	Marble	Y	4	--
	Sandstone	Y	4	--
	Diatomite	Y	4	--
	Sand and gravel	Y	4	--
	Coal	N	--	--
	Petroleum	N	--	--

Table 15. Criteria used to delineate tracts permissive for deposits in the Tucson and Nogales 1° by 2° quadrangles.

Deposit type	Criteria for tract delineation
Porphyry copper-molybdenum	Laramide-age intrusions Positive magnetic anomaly Positive gravity anomaly Indication of shallow pediment Geochemical anomalies for Mo, Cu, Pb
Skarn and replacement	Laramide-age intrusions Carbonate rocks
Comstock or Sado epithermal vein	Tertiary subaerial volcanic rocks Geochemical anomalies for Ag, Au, Te, Hg
Polymetallic vein	Mesozoic to Tertiary intrusions Geochemical anomalies for Ag, Cu, Zn, Pb
Flat-fault gold	Upper-plate rocks with high-angle faults above detachment fault Presence of specularite

Table 16.--Matrix showing which geologic units are permissive for certain deposit types within the Tucson and Nogales quadrangles.

[K, known deposits in quadrangles; O, present outside quadrangles; P, permissive for deposit type but not yet known in quadrangles; -, no indication for the deposit type in geologic map unit]

Deposit type	Geologic map unit																																									
	Xmv	Xms	Xm	Xg	Yg	Ya	Ydb	YPzs	Cs	MDs	PIPS	Ps	IPs	Pzs	Jg	Ja	Jv	Jvs	Jm	Js	KJs	KJb	Ks	Kv	Kg	TKr	TKv	TKi	TKs	TKg	TKgm	Tso	Tm	Tg	Ti	Ta	Trt	Tr	Tv	Tsv	Tb	Tsm	QTs[4]
Skarn deposits[1]	-	-	-	-	-	-	-	P	K	K	K	K	K	K	-	-	-	K	-	K	K	K	K	-	-	K	K	-	-	-	-	-	-	-	-	-	K	-	-	-	-	K	-
Porphyry copper	-	-	-	P	K	-	-	-	-	K	-	-	-	K	K	P	P	K	-	-	-	K	-	P	P	P	P	P	-	K	-	-	-	O	-	-	-	-	-	K	-	-	-
Porphyry molybdenum - low F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	K	-	-	-	-	-	-	-	-	-	-	-	-	-
Replacement Mn	-	-	-	-	-	-	K	K	-	K	-	-	-	-	K	-	-	-	-	-	-	K	-	-	-	-	-	-	-	K	-	-	-	-	-	-	-	K	-	-	-	-	-
Hydrothermal deposits[2]	O	O	O	-	K	-	-	-	-	-	-	-	-	-	K	K	K	K	-	-	-	K	-	K	K	K	K	-	-	K	-	-	-	-	K	K	K	-	K	K	K	-	-
Hot springs deposits[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	P	P	-	-	-
Placer deposits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	K
Pegmatites	-	-	-	P	O	-	-	-	-	K	-	-	-	-	O	-	-	K	O	-	-	-	-	-	P	-	-	P	-	-	K	-	-	-	-	-	-	-	-	-	-	-	-
Simple Sb	-	-	-	-	P	-	-	-	-	-	-	-	-	-	P	P	P	P	-	-	-	P	-	P	P	P	P	-	-	P	-	-	-	-	P	P	P	-	P	P	P	-	-
Disseminated Sb	-	-	-	-	P	-	-	-	-	-	-	-	-	-	P	P	P	P	-	-	-	P	-	P	P	P	P	-	-	P	-	-	-	-	P	P	P	-	P	P	P	-	-
Volcanics hosted Cu, As, Sb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flat-fault Au	-	-	-	-	K	-	-	P	P	P	P	P	P	P	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Evaporites	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	O
Clays	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P
Diatomite	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P?
Gem agate/chalcedony	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P?

[1] Includes porphyry copper-related skarns and Cu, Zn-Pb, Fe, and W skarns as well as polymetallic replacements deposits
[2] Includes polymetallic veins, several types of epithermal veins (see text), epithermal Mn, fluorite, barite, W veins, Be veins
[3] Includes Hg and Au-Ag deposits
[4] Includes all basin-fill material including Tertiary sediments on east side of quadrangles and deep in basins

Table 17.--Probability levels of tonnages and grades for undiscovered deposits, based on worldwide data (based on Cox and Singer, 1986 except gold skarn from Orris and others, 1987).

[Grade and tonnage are independent parameters. For example, an undiscovered porphyry Cu-Mo deposit has a 90 percent chance of containing at least 120 million metric tons ore. Similarly, an undiscovered deposit has a 90 percent chance of averaging at least 0.26 percent Cu. However, the probability that an undiscovered deposit contains 120 million metric tons of ore averaging 0.26 percent Cu is <u>less</u> than 90 percent]

Deposit types	Probability level	Tonnage (Thousand metric tons)	Grade
Porphyry copper-molybdenum	0.9	120	0.26% Cu, 0.0072% Mo, 0.36 g/t Ag
	0.5	500	0.42% Cu, 0.012% Mo, 1.2 g/t Ag
	0.1	2,100	0.69% Cu, 0.043% Mo, 4.2 g/t Ag
Porphyry copper skarn related	0.9	20	0.51% Cu,
	0.5	80	0.98% Cu, 1 g/t Ag
	0.1	320	1.9% Cu, 0.022% Mo, 0.83 g/t Au, 12 g/t Ag
Porphyry molybdenum, low F	0.9	16,000	0.055% Mo
	0.5	94,000	0.085% Mo
	0.1	560,000	0.13% Mo
Zinc-lead skarn	0.9	160	2.7% Zn, 0.87% Pb
	0.5	1,400	5.9% Zn, 2.8% Pb, 0.09% Cu, 58 g/t Ag
	0.1	12,000	13% Zn, 7.6% Pb, 1.3% Cu, 290 g/t Ag, 0.46 g/t Au
Tungsten skarn	0.9	50	0.34% WO_3
	0.5	1,100	0.67% WO_3
	0.1	22,000	1.4% WO_3
Copper skarn	0.9	34	0.7% Cu
	0.5	560	1.7% Cu
	0.1	9,200	4.0% Cu, 2.8 g/t Au, 36 g/t Ag
Gold skarn	0.9	20	1.5 g/t Au
	0.5	400	5.0 g/t Au
	0.1	10,000	20 g/t Au
Polymetallic replacement	0.9	240	1.2% Pb, 0.82% Zn
	0.5	1,800	5.2% Pb, 3.9% Zn, 0.094% Cu, 150 g/t Ag, 0.19 g/t Au
	0.1	14,000	21% Pb, 19% Zn, 0.87% Cu, 690 g/t Ag, 4.4 g/t Au
Replacement manganese	0.9	0.940	16% Mn
	0.5	22	36% Mn
	0.1	530	46% Mn, 0.53% Cu
Carbonate-hosted gold-silver	0.9	1,100	0.69 g/t Au
	0.5	5,100	2.5 g/t Au
	0.1	24,000	7.6 g/t Au, 15 g/t Ag
Epithermal veins, Comstock	0.9	65	2 g/t Au, 10 g/t Ag
	0.5	770	7.5 g/t Au, 110 g/t Ag
	0.1	9,100	27 g/t Au, 1,300 g/t Ag, 0.071% Cu, 0.11% Pb, 0.025% Zn
Epithermal veins, Sado	0.9	29	1.3 g/t Au, 5.3 g/t Ag
	0.5	300	6 g/t Au, 38 g/t Ag
	0.1	3,000	21 g/t Au, 270 g/t Au, 1.9% Cu
Epithermal manganese	0.9	2.4	20% Mn
	0.5	25	30% Mn
	0.1	260	42% Mn
Polymetallic vein	0.9	0.29	140 g/t Ag, 2.4% Pb
	0.5	7.6	820 g/t Ag, 0.13 g/t Au, 9% Pb, 2.1% Zn
	0.1	200	4,700 g/t Ag, 11 g/t Au, 33% Pb, 7.6% Zn, 0.89% Cu
Tungsten vein	0.9	45	0.6% WO_3
	0.5	560	0.91% WO_3
	0.1	7,000	1.4% WO_3
Placer gold-PGE	0.9	22	0.084 g/t Au
	0.5	1,100	0.2 g/t Au
	0.1	50,000	0.48 g/t Au

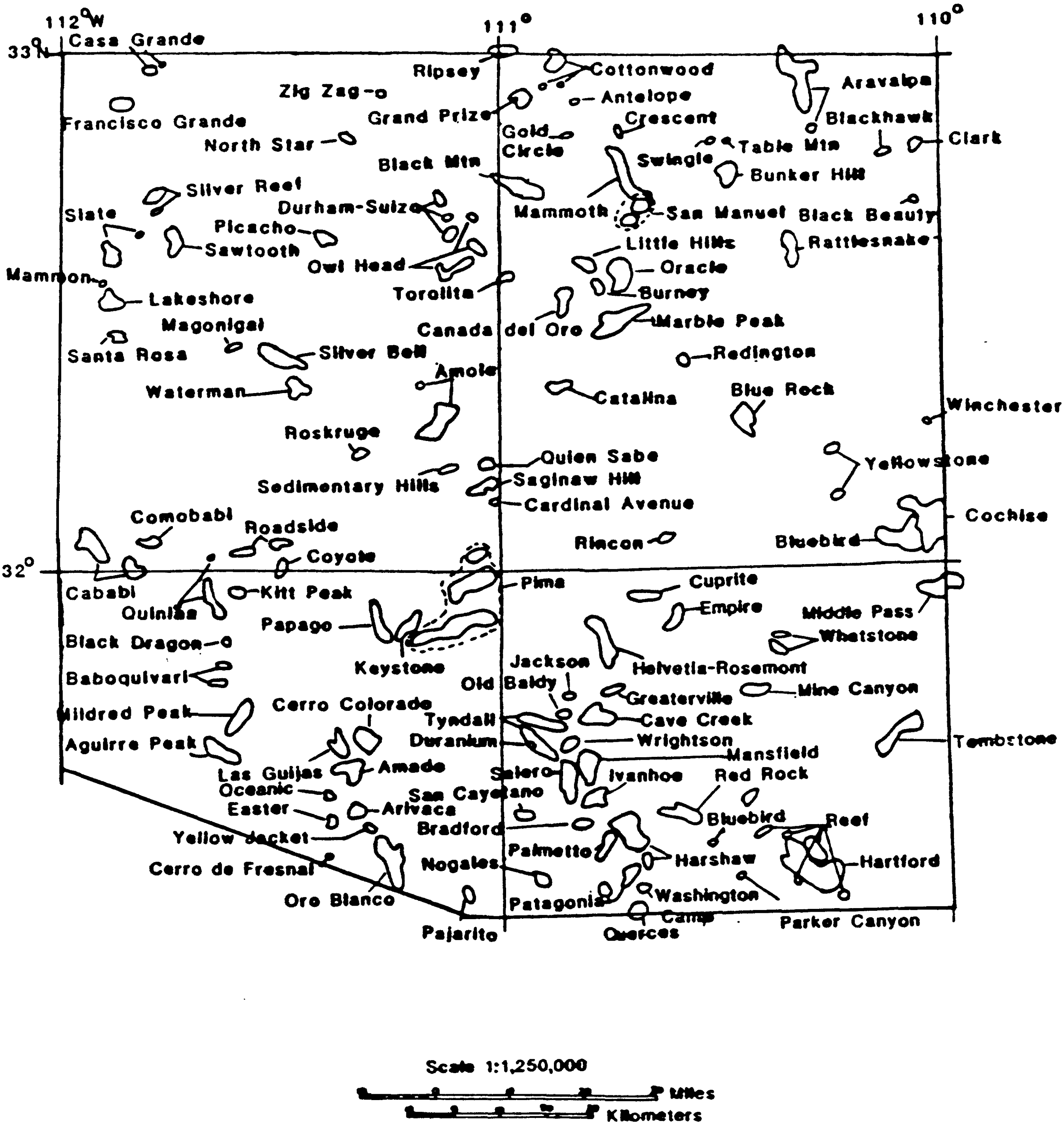

Figure 22. Metal-mining districts in the Tucson and Nogales quadrangles (after Keith and others, 1983a).

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Appendix. Mines & prospects

	A	B	C	D	E	F	G
1					MAJOR	PROD	DEPOSIT TYPE
2	DISTRICT	DEPOSIT NAME	LATITUDE	LONGITUDE	COMMODITIES	SIZE	MODEL NO.
3	AMADO	ALBATROSS MINE	31-37-06N	111-22-12W	AU AG	S	
4	AMADO	BACKBONE MINE	31-36-52N	111-20-28W	AU AG PB	S	22c
5	AMADO	ELZO #4 MINE	31-36-58N	111-20-30W	AU AG	S	22c
6	AMADO	FAIR VIEW MINE	31-35-58N	111-20-03W	PB AG AU	S	22c
7	AMADO	GOLDEN STAR MINE	31-35-00N	111-20-00W	AU AG CU	S	22c
8	AMADO	LA CARAVA MINE	31-35-00N	111-20-00W	AG AU	S	
9	AMADO	MAMMOTH GROUP	31-36-32N	111-21-33W	AG AU	S	
10	AMADO	MCCAFFERTY MINE	31-36-18N	111-21-49W	AG PB	S	
11	AMADO	SILVER FLAME MINE	31-35-00N	111-19-48W	PB AG	S	
12	AMOLE	ARIZONA CONSOLIDATED	32-18-48N	111-08-55W	CU AG	S	18a
13	AMOLE	BEE HIVE MINE	32-08-48N	111-02-56W	CU PB AG	S	
14	AMOLE	BUSTERVILLE MINE	32-19-43N	111-10-47W	CU	S	21a
15	AMOLE	COLUMBIA MINE	32-16-11N	111-08-53W	CU AG	S	18a/18b
16	AMOLE	COPPER KING MINE	32-15-48N	111-09-20W	CU	S	18b
17	AMOLE	DAKOTA SHAFT	32-08-14N	111-04-41W	PB	-	
18	AMOLE	GILA MONSTER MINE	32-17-56N	111-07-14W	PB	S	22c
19	AMOLE	GOULD MINE	32-15-29N	111-09-55W	CU	S	18a/18b
20	AMOLE	OLD MISSION MINE	32-10-03N	111-01-20W	CU PB AG	S	25c/25g
21	AMOLE	OLD PUEBLO MINE	32-12-18N	111-02-45W	CU	S	25c
22	AMOLE	OLD YUMA MINE	32-18-53N	111-07-16W	PB CU	S	22c
23	AMOLE	PALO VERDE MINE	32-08-24N	111-04-36W	ZN	S	18c
24	AMOLE	SAGINAW MINE	32-08-44N	111-04-43W	CU AG	S	18a
25	AMOLE	SEDIMENTARY HILLS	32-11-55N	111-07-27W	CU	-	21a
26	AMOLE	SIBLEY MINE	32-17-35N	110-09-57W	CU	S	18a
27	AMOLE	SILVER PASS MINE	32-11-58N	111-03-24W	CU AG	S	
28	AMOLE	SNYDER HILL PROSPECT	32-09-23N	111-06-47W	AG PB	S	19a
29	AMOLE	UNNAMED PROSPECT	32-15-02N	111-08-28W	PB CU	-	
30	AMOLE	UNNAMED PROSPECT	32-15-42N	111-09-18W	CU	-	
31	AMOLE	UNNAMED PROSPECT	32-15-08N	111-09-14W	PB ZN	-	
32	AMOLE	UNNAMED PROSPECT	32-15-09N	111-09-13W	PB	-	
33	AMOLE	UNNAMED PROSPECT	32-15-14N	111-09-08W	ZN PB CU	-	
34	AMOLE	UNNAMED PROSPECT	32-15-13N	111-09-05W	ZN PB CU	-	
35	AMOLE	UNNAMED PROSPECT	32-15-23N	111-08-50W	ZN CU	-	
36	AMOLE	UNNAMED PROSPECT	32-15-08N	111-09-00W	PB	-	
37	AMOLE	UNNAMED PROSPECT	32-15-02N	111-08-58W	PB CU	-	
38	AMOLE	UNNAMED PROSPECT	32-15-04N	111-08-53W	PB	-	
39	AMOLE	UNNAMED PROSPECT	32-15-09N	111-08-47W	PB CU	-	
40	AMOLE	UNNAMED PROSPECT	32-15-09N	111-08-45W	PB	-	
41	AMOLE	UNNAMED PROSPECT	32-15-09N	111-08-43W	PB	-	
42	AMOLE	UNNAMED PROSPECT	32-15-08N	111-08-40W	PB CU	-	
43	AMOLE	UNNAMED PROSPECT	32-15-08N	111-08-38W	PB CU	-	
44	AMOLE	UNNAMED PROSPECT	32-15-08N	111-08-36W	PB CU	-	
45	AMOLE	UNNAMED PROSPECT	32-15-57N	111-10-26W	CU	-	
46	AMOLE	UNNAMED PROSPECT	32-15-48N	111-10-22W	CU	-	

	A	B	C	D	E	F	G
47	AMOLE	UNNAMED PROSPECT	32-17-00N	111-08-36W		-	
48	AMOLE	UNNAMED PROSPECT	32-21-05N	111-11-56W	CU	-	
49	AMOLE	UNNAMED PROSPECT	32-12-13N	111-02-38W	CU	-	
50	AMOLE	UNNAMED PROSPECT	32-12-16N	111-02-56W	CU	-	
51	AMOLE	UNNAMED PROSPECT	32-12-20N	111-03-03W	CU	-	
52	AMOLE	UNNAMED PROSPECT	32-12-07N	111-02-53W	CU	-	
53	AMOLE	UNNAMED PROSPECT	32-12-33N	111-03-06W	CU	-	
54	AMOLE	UNNAMED PROSPECT	32-12-33N	111-03-03W	CU	-	
55	AMOLE	UNNAMED PROSPECT	32-12-50N	111-02-43W	CU	-	
56	AMOLE	UNNAMED PROSPECT	32-11-27N	111-07-22W	CU	-	
57	AMOLE	UNNAMED PROSPECT	32-11-27N	111-07-30W	CU	-	
58	AMOLE	UNNAMED PROSPECT	32-11-24N	111-07-20W	CU	-	
59	AMOLE	UNNAMED PROSPECT	32-11-25N	111-07-26W	CU	-	
60	AMOLE	UNNAMED PROSPECT	32-11-24N	111-07-08W	CU	-	
61	AMOLE	UNNAMED PROSPECT	32-11-20N	111-07-12W	CU	-	
62	AMOLE	UNNAMED PROSPECT	32-11-16N	111-07-15W	CU	-	
63	AMOLE	UNNAMED PROSPECT	32-11-12N	111-07-22W	CU PB	-	
64	AMOLE	UNNAMED PROSPECT	32-11-16N	111-07-06W	CU	-	
65	AMOLE	UNNAMED PROSPECT	32-11-10N	111-07-08W	CU	-	
66	AMOLE	UNNAMED PROSPECT	32-11-01N	111-07-08W	CU	-	
67	AMOLE	UNNAMED PROSPECT	32-11-09N	111-06-59W	CU	-	
68	AMOLE	UNNAMED PROSPECT	32-11-10N	111-06-55W	CU	-	
69	AMOLE	UNNAMED PROSPECT	32-11-25N	111-06-52W	CU	-	
70	AMOLE	UNNAMED PROSPECT	32-11-29N	111-06-51W	CU	-	
71	AMOLE	UNNAMED PROSPECT	32-11-32N	111-07-10W	CU	-	
72	AMOLE	UNNAMED PROSPECT	32-11-29N	111-06-59W	CU	-	
73	AMOLE	UNNAMED PROSPECT	32-11-34N	111-07-11W	CU	-	
74	AMOLE	UNNAMED PROSPECT	32-11-42N	111-06-59W	CU	-	
75	AMOLE	UNNAMED PROSPECT	32-11-33N	111-07-43W	CU	-	
76	AMOLE	UNNAMED PROSPECT	32-11-57N	111-07-31W	CU	-	
77	AMOLE	UNNAMED PROSPECT	32-11-35N	111-07-41W	CU	-	
78	AMOLE	UNNAMED PROSPECT	32-11-26N	111-07-33W	CU	-	
79	AMOLE	UNNAMED PROSPECT	32-14-27N	111-08-01W		-	
80	AMOLE	UNNAMED PROSPECT	32-14-24N	111-07-56W	CU	-	
81	AMOLE	UNNAMED PROSPECT	32-14-39N	111-08-17W	CU	S	
82	AMOLE	UNNAMED PROSPECT	32-15-00N	111-08-15W	PB ZN CU	-	
83	AMOLE	UNNAMED PROSPECT	32-14-42N	111-08-17W	PB	-	
84	AMOLE	UNNAMED PROSPECT	32-14-39N	111-08-13W	PB	-	
85	AMOLE	UNNAMED PROSPECT	32-14-44N	111-08-09W	CU	-	
86.	AMOLE	UNNAMED PROSPECT	32-14-45N	111-08-14W	CU	-	
87	AMOLE	UNNAMED PROSPECT	32-14-40N	111-08-05W	CU	-	
88	AMOLE	UNNAMED PROSPECT	32-14-28N	111-08-02W	CU	-	
89	AMOLE	UNNAMED PROSPECT	32-17-18N	111-08-29W	CU	-	
90	AMOLE	UNNAMED PROSPECT	32-18-12N	111-08-45W	CU	-	
91	AMOLE	UNNAMED PROSPECT	32-18-19N	111-08-49W	CU	-	
92	AMOLE	UNNAMED PROSPECT	32-16-10N	111-07-14W	CU	-	

Appendix. Mines & prospects

	A	B	C	D	E	F	G
93	AMOLE	UNNAMED PROSPECT	32-17-00N	111-06-49W	CU	-	
94	AMOLE	UNNAMED PROSPECT	32-16-09N	111-07-12W	CU	-	
95	AMOLE	UNNAMED PROSPECT	32-16-05N	111-07-25W	CU PB	-	
96	AMOLE	UNNAMED PROSPECT	32-16-04N	111-07-23W	CU	-	
97	AMOLE	UNNAMED PROSPECT	32-15-43N	111-07-14W	CU	-	
98	AMOLE	UNNAMED PROSPECT	32-15-58N	111-07-11W	CU	-	
99	AMOLE	UNNAMED PROSPECT	32-15-49N	111-06-46W	CU	-	
100	AMOLE	UNNAMED PROSPECT	32-15-16N	111-05-44W	CU	-	
101	AMOLE	UNNAMED PROSPECT	32-17-26N	111-07-15W	CU	-	
102	AMOLE	UNNAMED PROSPECT	32-17-29N	111-07-19W	CU	-	
103	AMOLE	UNNAMED PROSPECT	32-18-39N	111-07-27W	PB MO	-	
104	AMOLE	UNNAMED PROSPECT	32-17-00N	111-06-53W	CU PB	-	
105	AMOLE	UNNAMED PROSPECT	32-16-44N	111-06-45W	CU	-	
106	AMOLE	UNNAMED PROSPECT	32-18-37N	111-07-17W	PB MO CU	-	
107	AMOLE	UNNAMED PROSPECT	32-18-36N	111-07-15W	CU	-	
108	AMOLE	UNNAMED PROSPECT	32-16-20N	111-08-25W	CU	-	
109	AMOLE	UNNAMED PROSPECT	32-16-01N	111-08-11W	CU ZN	-	
110	AMOLE	UNNAMED PROSPECT	32-16-02N	111-08-07W	CU PB ZN	-	
111	AMOLE	UNNAMED PROSPECT	32-15-59N	111-08-05W	CU	-	
112	AMOLE	UNNAMED PROSPECT	32-16-00N	111-08-04W	CU PB ZN	-	
113	AMOLE	UNNAMED PROSPECT	32-16-51N	111-08-10W	CU	-	
114	AMOLE	UNNAMED PROSPECT	32-16-49N	111-08-10W	CU	-	
115	AMOLE	UNNAMED PROSPECT	32-16-48N	111-08-04W	CU	-	
116	AMOLE	UNNAMED PROSPECT	32-21-07N	111-11-60W	CU	-	
117	AMOLE	UNNAMED PROSPECT	32-19-40N	111-10-55W	CU	-	
118	AMOLE	UNNAMED PROSPECT	32-15-35N	111-08-38W	CU	-	
119	AMOLE	UNNAMED PROSPECT	32-18-07N	111-08-04W	CU	-	
120	AMOLE	UNNAMED PROSPECT	32-18-10N	111-08-01W	CU	-	
121	AMOLE	UNNAMED PROSPECT	32-16-16N	111-10-58W	CU	-	
122	AMOLE	UNNAMED PROSPECT	32-16-12N	111-11-27W	CU	-	
123	AMOLE	UNNAMED PROSPECT	32-15-44N	111-11-28W	CU	-	
124	AMOLE	UNNAMED PROSPECT	32-17-19N	111-10-12W	CU	-	
125	AMOLE	UNNAMED PROSPECT	32-17-39N	111-09-56W	CU	-	
126	AMOLE	UNNAMED PROSPECT	32-17-30N	111-09-22W	CU	-	
127	AMOLE	UNNAMED PROSPECT	32-17-43N	111-08-36W	CU	-	
128	AMOLE	UNNAMED PROSPECT	32-17-14N	111-08-24W	CU	-	
129	AMOLE	UNNAMED PROSPECT	32-17-03N	111-08-21W	CU	-	
130	AMOLE	UNNAMED PROSPECT	32-17-27N	111-08-17W	CU FE	-	
131	AMOLE	UNNAMED PROSPECT	32-16-55N	111-08-33W	CU	-	
132	AMOLE	UNNAMED PROSPECT	32-16-58N	111-08-36W	CU	-	
133	AMOLE	UNNAMED PROSPECT	32-16-50N	111-09-00W	CU	-	
134	AMOLE	UNNAMED PROSPECT	32-16-48N	111-09-06W	CU	-	
135	AMOLE	UNNAMED PROSPECT	32-18-47N	111-09-14W	CU	-	
136	AMOLE	UNNAMED PROSPECT	32-17-57N	111-08-45W	CU	-	
137	AMOLE	UNNAMED PROSPECT	32-18-08N	111-08-50W	CU	-	
138	AMOLE	UNNAMED PROSPECT	32-18-12N	111-08-49W	CU	-	

	A	B	C	D	E	F	G
139	AMOLE	UNNAMED PROSPECT	32-18-17N	111-08-34W	CU	-	
140	AMOLE	UNNAMED PROSPECT	32-18-15N	111-08-37W	CU	-	
141	AMOLE	UNNAMED PROSPECT	32-18-13N	111-08-47W	CU	-	
142	AMOLE	UNNAMED PROSPECT	32-18-16N	111-08-47W	CU	-	
143	AMOLE	UNNAMED PROSPECT	32-18-32N	111-08-52W	CU	-	
144	AMOLE	UNNAMED PROSPECT	32-18-45N	111-08-44W	CU	-	
145	AMOLE	UNNAMED PROSPECT	32-18-38N	111-08-44W	CU	-	
146	AMOLE	UNNAMED PROSPECT	32-18-40N	111-08-43W	CU	-	
147	AMOLE	UNNAMED PROSPECT	32-18-52N	111-08-29W	CU	-	
148	AMOLE	UNNAMED PROSPECT	32-18-51N	111-08-31W	CU	-	
149	AMOLE	UNNAMED PROSPECT	32-18-57N	111-08-34W	CU	-	
150	AMOLE	UNNAMED PROSPECT	32-19-00N	111-08-34W	CU	-	
151	AMOLE	UNNAMED PROSPECT	32-19-10N	111-08-35W	CU	-	
152	AMOLE	UNNAMED PROSPECT	32-19-05N	111-08-36W	CU	-	
153	AMOLE	UNNAMED PROSPECT	32-19-03N	111-08-36W	CU	-	
154	AMOLE	UNNAMED PROSPECT	32-18-52N	111-08-56W	CU	-	
155	AMOLE	UNNAMED PROSPECT	32-18-56N	111-08-55W	CU	-	
156	AMOLE	UNNAMED PROSPECT	32-19-06N	111-08-52W	CU	-	
157	AMOLE	UNNAMED PROSPECT	32-19-07N	111-09-15W	CU	-	
158	AMOLE	UNNAMED PROSPECT	32-19-05N	111-09-17W	CU	-	
159	AMOLE	UNNAMED PROSPECT	32-19-05N	111-09-24W	CU	-	
160	AMOLE	UNNAMED PROSPECT	32-18-51N	111-09-18W	CU	-	
161	AMOLE	UNNAMED PROSPECT	32-19-16N	111-09-24W	CU	-	
162	AMOLE	UNNAMED PROSPECT	32-19-04N	111-09-42W	CU	-	
163	AMOLE	UNNAMED PROSPECT	32-19-04N	111-09-41W	CU	-	
164	AMOLE	UNNAMED PROSPECT	32-15-14N	111-10-58W	PB CU	-	
165	AMOLE	UNNAMED PROSPECT	32-16-11N	111-09-16W	CU	-	
166	AMOLE	UNNAMED PROSPECT	32-15-37N	111-08-54W	CU	-	
167	AMOLE	UNNAMED PROSPECT	32-15-54N	111-09-32W	CU	-	
168	AMOLE	UNNAMED PROSPECT	32-15-51N	111-09-33W	CU	-	
169	AMOLE	UNNAMED PROSPECT	32-15-42N	111-09-00W	CU	-	
170	AMOLE	UNNAMED PROSPECT	32-18-57N	111-09-16W	CU	-	
171	AMOLE	UNNAMED PROSPECT	32-16-04N	111-09-19W	CU	-	
172	AMOLE	UNNAMED PROSPECT	32-19-02N	111-09-18W	CU	-	
173	AMOLE	UNNAMED PROSPECT	32-19-05N	111-09-12W	CU	-	
174	AMOLE	UNNAMED PROSPECT	32-19-14N	111-09-09W	CU	-	
175	AMOLE	UNNAMED PROSPECT	32-19-16N	111-09-06W	CU	-	
176	AMOLE	UNNAMED PROSPECT	32-19-30N	111-09-17W	CU	-	
177	AMOLE	UNNAMED PROSPECT	32-19-25N	111-09-18W	CU	-	
178	AMOLE	UNNAMED PROSPECT	32-19-22N	111-09-19W	CU	-	
179	AMOLE	UNNAMED PROSPECT	32-19-11N	111-09-19W	CU	-	
180	AMOLE	UNNAMED PROSPECT	32-19-14N	111-09-23W	CU	-	
181	AMOLE	UNNAMED PROSPECT	32-16-02N	111-09-23W	CU	-	
182	AMOLE	UNNAMED PROSPECT	32-16-03N	111-09-24W	CU	-	
183	AMOLE	UNNAMED PROSPECT	32-16-02N	111-09-24W	CU	-	
184	AMOLE	UNNAMED PROSPECT	32-15-53N	111-09-19W	CU	-	

	A	B	C	D	E	F	G
185	AMOLE	UNNAMED PROSPECT	32-15-49N	111-09-18W	CU	-	
186	AMOLE	UNNAMED PROSPECT	32-15-43N	111-09-21W	CU	-	
187	AMOLE	UNNAMED PROSPECT	32-16-14N	111-08-48W	CU	-	
188	AMOLE	UNNAMED PROSPECT	32-16-15N	111-08-50W	CU	-	
189	AMOLE	UNNAMED PROSPECT	32-16-03N	111-08-43W	CU	-	
190	AMOLE	UNNAMED PROSPECT	32-16-02N	111-08-43W	CU	-	
191	AMOLE	UNNAMED PROSPECT	32-16-00N	111-08-43W	CU	-	
192	AMOLE	UNNAMED PROSPECT	32-15-57N	111-10-24W	CU	-	
193	AMOLE	UNNAMED PROSPECT	32-15-54N	111-10-20W	CU PB	-	
194	AMOLE	UNNAMED PROSPECT	32-15-54N	111-10-22W	CU	-	
195	AMOLE	UNNAMED PROSPECT	32-15-52N	111-10-22W	CU	-	
196	AMOLE	UNNAMED PROSPECT	32-15-50N	111-10-20W	CU	-	
197	AMOLE	UNNAMED PROSPECT	32-15-50N	111-10-11W	CU PB	-	
198	AMOLE	UNNAMED PROSPECT	32-15-35N	111-09-48W	CU	-	
199	AMOLE	UNNAMED PROSPECT	32-15-44N	111-10-14W	CU	-	
200	AMOLE	UNNAMED PROSPECT	32-15-29N	111-09-51W	CU	-	
201	AMOLE	UNNAMED PROSPECT	32-15-27N	111-09-54W	CU	-	
202	AMOLE	UNNAMED PROSPECT	32-15-29N	111-09-59W	CU	-	
203	AMOLE	UNNAMED PROSPECT	32-16-16N	111-09-03W	CU	-	
204	AMOLE	UNNAMED PROSPECT	32-17-26N	111-07-34W	CU PB ZN	-	
205	AMOLE	UNNAMED PROSPECT	32-17-27N	111-07-30W	CU	-	
206	AMOLE	UNNAMED PROSPECT	32-18-38N	111-07-32W	CU	-	
207	ANTELOPE	ANTELOPE MINE	32-53-34N	110-50-31W	CU	S	37b
208	APACHE SPRINGS	KATCHINA GROUP	31-45- N	110-45- W	CU	S	18b
209	ARAVAIPA	ABE REED MINE.	32-59-01N	110-22-05W	PB ZN AG	S	
210	ARAVAIPA	ARIZONA MINE.	32-58-08N	110-21-33W	PB AG	-	25c/22c
211	ARAVAIPA	BEN HUR MINE.	32-56-57N	110-20-54W	PB	S	
212	ARAVAIPA	BOOKER T. WASHINGTON	32-58-35N	110-20-39W	PB CU MO	-	
213	ARAVAIPA	BUENA SUERTE CLAIM	32-45-30N	110-26-03W	CU	-	37b?
214	ARAVAIPA	BULLIS-SANDSMAN	33- N	110-10- W	PB ZN AG	S	18c
215	ARAVAIPA	COBRE GRANDE MINE	32-58-35N	110-17-30W	CU PB	S	
216	ARAVAIPA	COPPER BAR PROSPECT	32-57-12N	110-19-09W	CU	S	37b?
217	ARAVAIPA	COPPER HILL PROSPECT	32-45-38N	110-26-20W	CU	-	
218	ARAVAIPA	DOGWATER MINE	32-53-28N	110-18-51W	PB	S	
219	ARAVAIPA	FAIRVIEW PROSPECT	32-57-59N	110-21-46W	PB	S	
220	ARAVAIPA	FISHER PROSPECT	32-56-09N	110-13-47W	CU	-	21a
221	ARAVAIPA	GRAND CENTRAL MINE	32-58-33N	110-20-16W	PB ZN AG	S	18c
222	ARAVAIPA	GRAND REEF MINE	32-52-59N	110-19-00W	PB CU	S	22c/CaF vein
223	ARAVAIPA	HEAD CENTER MINE	32-58-37N	110-20-19W	PB ZN CU AG	S	
224	ARAVAIPA	IONIA CLAIM	32-58-29N	110-19-42W	PB CU MO ZN	-	
225	ARAVAIPA	IRON CAP MINE.	32-58-44N	110-19-40W	PB ZN	S	19a/CaF
226	ARAVAIPA	IRON REEF PROSPECT	32-58-12N	110-19-29W	PB AG ZN CU	S	
227	ARAVAIPA	JUNCTION PROSPECT	32-52-17N	110-18-29W	PB BA	-	
228	ARAVAIPA	LA CLEDE MINE	32-50-29N	110-17-22W	AG CU	S	
229	ARAVAIPA	LAST CHANCE MINE	32-58-39N	110-22-44W	PB	S	
230	ARAVAIPA	LEAD KING MINE.	32-56-46N	110-20-30W	ZN AG	S	

	A	B	C	D	E	F	G
231	ARAVAIPA	MISSION NO. 1 CLAIM	32-45-23N	110-26-25W	CU	S	25c
232	ARAVAIPA	MISSION NO. 4 PROSPECT	32-45-24N	110-26-20W	CU	-	
233	ARAVAIPA	MT. JACKSON MINE	32-56-13N	110-07-38W	AG	S	
234	ARAVAIPA	NO. 1 MINE.	32-57-23N	110-21-31W	PB	S	
235	ARAVAIPA	OREJANA MINE	32-58-09N	110-22-21W	CU PB	-	
236	ARAVAIPA	PANAMA MINE.	32-57-26N	110-21-18W	PB ZN	-	
237	ARAVAIPA	PRINCESS PAT MINE	32-59-50N	110-21-26W	CU ZN PB	S	
238	ARAVAIPA	SAM JONES PROSPECT	32-57-08N	110-19-08W	CU AG AU	-	
239	ARAVAIPA	SILVER COIN MINE	32-50-15N	110-16-41W	PB	S	
240	ARAVAIPA	SILVER REEF CLA	32-58-30N	110-21-03W	PB	-	
241	ARAVAIPA	SPAR MINE	32-55- N	110-10- W	F	-	CaF veins
242	ARAVAIPA	TENSTRIKE MINE	32-54-26N	110-19-33W	PB ZN CU	S	
243	ARAVAIPA	TOLMAN-BABCOCK	32-58-10N	110-21-19W	PB AG AU CU	S	
244	ARAVAIPA	TULE MINE	32-56-59N	110-19-42W	PB	-	
245	ARAVAIPA	UNNAMED PROSPECT	32-46-05N	110-25-44W	CU	-	
246	ARAVAIPA	UNNAMED PROSPECT	32-46-57N	110-25-30W	CU	-	
247	ARAVAIPA	UNNAMED PROSPECT	32-47-03N	110-25-47W	CU	-	
248	ARAVAIPA	UNNAMED PROSPECT	32-47-42N	110-24-26W	CU	-	
249	ARAVAIPA	UNNAMED PROSPECT	32-47-12N	110-24-46W	CU	-	
250	ARAVAIPA	UNNAMED PROSPECT	32-46-27N	110-25-42W	CU	-	
251	ARAVAIPA	UNNAMED PROSPECT	32-46-27N	110-25-57W	CU	-	
252	ARAVAIPA	UNNAMED PROSPECT	32-46-28N	110-26-03W	CU	-	
253	ARAVAIPA	UNNAMED PROSPECT	32-45-46N	110-26-18W	CU	-	
254	ARAVAIPA	UNNAMED PROSPECT	32-45-47N	110-26-06W	CU	-	
255	ARAVAIPA	UNNAMED PROSPECT	32-45-37N	110-25-58W	CU	-	
256	ARAVAIPA	UNNAMED PROSPECT	32-45-42N	110-25-27W	CU	-	
257	ARAVAIPA	UNNAMED PROSPECT	32-45-52N	110-25-28W	CU	-	
258	ARAVAIPA	UNNAMED PROSPECT	32-45-53N	110-25-36W	CU	-	
259	ARAVAIPA	UNNAMED PROSPECT	32-56-55N	110-19-16W	CU	-	
260	ARAVAIPA	UNNAMED PROSPECT	32-56-49N	110-20-44W	CU	-	
261	ARAVAIPA	UNNAMED PROSPECT	32-58-23N	110-19-22W	CU FE	-	
262	ARAVAIPA	UNNAMED PROSPECT	32-58-23N	110-20-01W	PB CU MO	-	
263	ARAVAIPA	UNNAMED PROSPECT	32-58-22N	110-20-54W	PB	S	
264	ARAVAIPA	UNNAMED PROSPECT	32-59-50N	110-20-04W	CU	-	
265	ARAVAIPA	UNNAMED PROSPECT	32-57-49N	110-21-00W	PB ZN	-	
266	ARAVAIPA	UNNAMED PROSPECT	32-57-25N	110-21-02W	PB ZN	-	
267	ARAVAIPA	UNNAMED PROSPECT	32-51-51N	110-18-13W	CU	-	
268	ARAVAIPA	UNNAMED PROSPECT	32-54-46N	110-19-40W	CU	-	
269	ARAVAIPA	UNNAMED PROSPECT	32-53-54N	110-19-20W	CU	-	
270	ARAVAIPA	UNNAMED PROSPECT	32-50-06N	110-15-36W	CU	-	
271	ARAVAIPA	WINDSOR MINE	32-56-21N	110-20-12W	PB CU AG	-	
272	ARIVACA	AJAX MINE GROUP	31-32-28N	111-20-16W	AU AG PB	S	
273	ARIVACA	AMADO MINE GROUP	31-35-34N	111-20-32W	AU AG PB	S	
274	ARIVACA	ARIVACA CREEK PLACER	31-35-29N	111-21-30W	AU	S	39a
275	ARIVACA	ARIVACA PLACERS	31-30-06N	111-24- W	W	S	W placer
276	ARIVACA	ARIZONA MINE	31-38-51N	111-16-24W	AG CU	S	

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277	ARIVACA	BLACK GOLD MINE	31-41-42N	111-23- W	W AU AG PB ZN	S	
278	ARIVACA	CONEJO MINE	31-32-11N	111-20-46W	AU AG	S	22c
279	ARIVACA	CONTACT MINE	31-31-59N	111-20-23W	AU AG PB	S	22c
280	ARIVACA	COTTONTAIL MINE	31-32-50N	111-20-40W	AU	S	
281	ARIVACA	EDWARDS MINE	31-32-10N	111-20-38W	AU AG	S	
282	ARIVACA	FAIR PLAY MINE	31-31-43N	111-21-18W	CU PB AU	S	
283	ARIVACA	GUADALUPE MINE	31-32-20N	111-20-03W	AG PB	S	
284	ARIVACA	LONG SHOT MINE	31-32-40N	111-20-33W	AG PB	S	
285	ARIVACA	M.C.M. MINE GROUP	31-32-14N	111-20-02W	AG PB	S	
286	ARIVACA	MOORE MINE	31-36-57N	111-25-18W	CU	S	
287	ARIVACA	NEW DEAL 2 PROSPECT	31-27-19N	111-25-50W	CU	-	
288	ARIVACA	OBREGON CLAIMS	31-39- N	111-22-12W	W	S	
289	ARIVACA	PAYOFF MINE	31-32-11N	111-33-49W	CU	S	
290	ARIVACA	SAN LUIS TUNGSTEN	31-30-58N	111-24-01W	W	S	W placer
291	ARIVACA	SAN LUIS WASH PLACER	31-33-35N	111-24-51W	AU	S	39a
292	ARIVACA	SHAMROCK MINE	31-33-35N	111-20-33W	PB AG	S	
293	ARIVACA	SILVER CROWN MINE	31-32-12N	111-20-57W	AU AG	S	
294	ARIVACA	VINDICATOR GROUP	31-39-15N	111-22-36W	W	M	15a
295	BABOQUIVARI	ALLISON MINE	31-49-01N	111-37-58W	AU	S	25c
296	BABOQUIVARI	ARIZONA MOLYBDENUM	31-43-11N	111-35-54W	MO	S	21b
297	BABOQUIVARI	BERKLEY MINE	31-40-40N	111-37-34W	CU AG	S	22c
298	BABOQUIVARI	BLACK DRAGON GROUP	31-51-23N	111-35-58W	MN	S	25g
299	BABOQUIVARI	CABLE AND GAJEWSKI	31-56-10N	111-41-12W	W	-	
300	BABOQUIVARI	CALVERT PROSPECT	31-57-04N	111-41-25W	W	S	14a
301	BABOQUIVARI	CIRCLE CLAIMS	31-43-08N	111-35-37W	W	-	15a
302	BABOQUIVARI	EDNA J. PLACER	31-43-33N	111-33-34W	AU	S	39a
303	BABOQUIVARI	GIANT CLAIMS	31-39-36N	111-40-28W	W MO	S	14a
304	BABOQUIVARI	GOLD BULLION MINE	31-43-24N	111-35-47W	AU MO	S	21b?
305	BABOQUIVARI	INDEPENDENCE GROUP	31-56-00N	111-41-11W	W	S	14a
306	BABOQUIVARI	IOWANA MINE	31-43-57N	111-35-03W	AU AG	S	22c
307	BABOQUIVARI	JEZEBEL MINE	31-55-35N	111-40-32W	W	S	15a
308	BABOQUIVARI	LAST CHANCE MINE	31-54-57N	111-40-33W	W	S	15a
309	BABOQUIVARI	LESJIMFRE CLAIM	31-38-01N	111-37-37W	W	S	15a
310	BABOQUIVARI	LINDA CLAIM	31-54-50N	111-39-38W	W	-	
311	BABOQUIVARI	LOBOS GROUP	31-38-39N	111-40-18W	U	-	
312	BABOQUIVARI	LONE EAGLE MINE	31-58-06N	111-41-45W	W	S	14a
313	BABOQUIVARI	LOST HORSE GROUP	31-50-57N	111-34-56W	CU AG	S	22c
314	BABOQUIVARI	MEGO NOS. 1 & 2	31-58-50N	111-41-39W	W	-	
315	BABOQUIVARI	RUSHBEY PROSPECT	31-56-12N	111-40-49W	W	S	15a
316	BABOQUIVARI	SAN JUAN MINE	31-55-06N	111-40-13W	W	S	15a
317	BABOQUIVARI	SOUTHSIDE MINE	31-56-42N	111-41-17W	W	S	14a
318	BABOQUIVARI	SPARKS MINE	31-54-47N	111-40-14W	W	S	14a
319	BABOQUIVARI	UTAH PROSPECT	31-39-29N	111-35-53W	CU BE?	-	
320	BABOQUIVARI	VENTANA MINE GROUP	31-46-51N	111-39-44W	CU	S	22c
321	BABOQUIVARI	YELLOW STAR MINE	31-55-47N	111-41-01W	W	S	14a
322	BLACK BEAUTY	BLACK BEAUTY GROUP	32-41-20N	110-03-33W	W	S	15a

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323	BLACK HAWK	EIGHT	32-48-54N	110-06-32W	CU PB	-	
324	BLACK HAWK	NINE	32-48-48N	110-08-39W	CU PB	-	
325	BLACK MTN	MARY & JAMES CLAIMS	32-44-47N	110-54-14W	CU AU	-	
326	BLACK MTN	OWL HEAD MINE	32-45-52N	111-08-48W	CU	S	22c
327	BLACK MTN	UNNAMED PROSPECT	32-45-06N	110-55-47W	CU	-	
328	BLUEBIRD	BLUEBIRD MINE	32-04- N	110-05- W	W	S	15a
329	BLUEBIRD	HAWK GROUP (HILLSIDE)	32-03-19N	110-05-18W	W	S	15a
330	BLUE ROCK	ROBLES SPRING	32-16-12N	110-26-49W	U	-	
331	BLUE ROCK	SURE FIRE NO. 1	32-18-09N	110-29-48W	U	-	
332	BLUE ROCK	VAN HILL NO. 5	32-18-01N	110-29-46W	U	-	
333	BLUE ROCK	VAN HILL NO. 7	32-17-40N	110-27-49W	U	-	
334	BUNKER HILL	AMERICAN EAGLE	32-44-58N	110-29-44W	CU	S	21a
335	BUNKER HILL	BLUE BIRD MINE	32-45-47N	110-28-17W	PB AG	S	22c w/V
336	BUNKER HILL	BUNKER HILL MINE	32-44-14N	110-28-43W	CU PB	S	22c
337	BUNKER HILL	CHILDS-ALDWINKLE	32-45-11N	110-28-54W	CU MO	S	21a
338	BUNKER HILL	CLARK MINE	32-45-24N	110-29-08W	CU AG	S	21a
339	BUNKER HILL	COPPER GIANT MINE	32-45-32N	110-29-08W	CU	S	21a
340	BUNKER HILL	COPPER PRINCE MINE	32-45-44N	110-29-07W	CU	S	21a
341	BUNKER HILL	GLORY HOLE MINE	32-45-35N	110-29-26W	CU MO	-	21a
342	BUNKER HILL	HOT SPOT CLAIM	32-50-57N	110-34-21W	CU U	-	
343	BUNKER HILL	MAGNA MINE	32-43-37N	110-28-41W	CU	S	21a
344	BUNKER HILL	MAMMOTH BUTTE MINE	32-43-29N	110-28-45W	CU	S	18a
345	BUNKER HILL	OLD RELIABLE MINE	32-45-07N	110-29-21W	CU	S	21a
346	BUNKER HILL	UNNAMED PROSPECT	32-44-58N	110-27-09W	CU	-	
347	BUNKER HILL	UNNAMED PROSPECT	32-45-15N	110-27-09W	CU	-	
348	BUNKER HILL	UNNAMED PROSPECT	32-45-04N	110-27-24W	CU	-	
349	BUNKER HILL	UNNAMED PROSPECT	32-45-03N	110-27-54W	CU	-	
350	BUNKER HILL	UNNAMED PROSPECT	32-45-02N	110-29-33W	CU	-	
351	BUNKER HILL	UNNAMED PROSPECT	32-45-21N	110-27-54W	CU	-	
352	BUNKER HILL	UNNAMED PROSPECT	32-45-24N	110-27-50W	CU	-	
353	BUNKER HILL	UNNAMED PROSPECT	32-45-25N	110-28-42W	CU	-	
354	BUNKER HILL	UNNAMED PROSPECT	32-45-26N	110-28-46W	CU	-	
355	BUNKER HILL	UNNAMED PROSPECT	32-45-31N	110-28-26W	CU PB	-	
356	BUNKER HILL	UNNAMED PROSPECT	32-45-36N	110-28-45W	CU	-	
357	BUNKER HILL	UNNAMED PROSPECT	32-45-59N	110-29-11W	CU	-	
358	BUNKER HILL	UNNAMED PROSPECT	32-45-15N	110-28-59W	CU	-	
359	BUNKER HILL	UNNAMED PROSPECT	32-45-18N	110-28-58W	CU	-	
360	BUNKER HILL	UNNAMED PROSPECT	32-45-35N	110-28-01W	CU	-	
361	BUNKER HILL	UNNAMED PROSPECT	32-45-31N	110-29-01W	CU	-	
362	BURNEY	BURNEY MINES	32-33-08N	110-47-52W	PB ZN AG CU	S	19a/22c
363	CABABI	BADGER MINE	31-59-33N	111-49-13W	AU AG	S	
364	CABABI	CABABI PLACERS	31-58-54N	111-48-35W	AU	S	39a
365	CABABI	COLUMBIA MINE GROUP	32-03-30N	111-47-15W	CU AG	S	
366	CABABI	COMOBABI & CRUSADER	32-00-49N	111-53-16W	AG CU	S	22c
367	CABABI	CORONA GROUP	32-00-31N	111-49-23W	AU	S	22c
368	CABABI	COYOTE HOLE CLAIM	32-04-57N	111-57-11W	W	S	15a

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369	CABABI	CUNQUIAN MINE	32-02-26N	111-57-54W	AU AG	S	22c
370	CABABI	DESERT LODE MINE	32-02-26N	111-57-19W	AU AG	S	22c
371	CABABI	GRAND CENTRAL MINE	32-00-04N	111-58-38W	AU	S	22c
372	CABABI	HIGH CARD MINE	31-58-40N	111-50-30W	AU AG	S	
373	CABABI	JAEGER GROUP MINE	31-59-05N	111-48-47W	AU	S	22c
374	CABABI	LITTLE MARY MINE	32-00-58N	111-54-45W	AU AG CU PB	S	22c
375	CABABI	LUCIDO CLAIM GROUP	31-59-08N	111-49-01W	AU AG	S	
376	CABABI	MIDNIGHT MINE	31-58-53N	111-51-38W	PB AG AU	S	22c
377	CABABI	MILDREN MINE	32-02-14N	111-55-48W	PB AG	S	22c
378	CABABI	OLD TIMER MINE	32-03-42N	111-55-52W	AG	S	22c
379	CABABI	PICACHO MINE	32-03-23N	111-56-49W	AG	S	22c
380	CABABI	RED WING MINE	32-00-30N	111-51-14W	AU	S	25c or d
381	CABABI	SHERWOOD MINE	31-59-49N	111-51-49W	CU AG	S	
382	CABABI	SILVER DOLLAR CLAIM	32-04-41N	111-57-09W	W	-	15a
383	CABABI	SILVER GIANT MINE	32-08-21N	111-50-54W	AG	S	
384	CABABI	SILVER QUEEN MINE	32-03-59N	111-56-12W	AG CU	S	22c
385	CABABI	SUN GOLD MINE	32-01-50N	111-54-58W	AU PB AG	S	22c
386	CABABI	SUNSET MINE	32-01-43N	111-55-47W	AG	S	
387	CANADA DE ORO	UNNAMED PROSPECT	32-24-34N	110-52-41W	CU	-	
388	CANADA DE ORO	UNNAMED PROSPECT	32-26-04N	110-52-47W	CU	-	
389	CANADA DE ORO	UNNAMED PROSPECT	32-24-28N	110-54-19W	CU	-	
390	CANADA DE ORO	UNNAMED PROSPECT	32-22-55N	110-53-10W	CU	-	
391	CANADA DE ORO	UNNAMED PROSPECT	32-23-21N	110-54-06W	CU	-	
392	CANADA DE ORO	UNNAMED PROSPECT	32-25-02N	110-52-24W	CU	-	
393	CANADA DE ORO	UNNAMED PROSPECT	32-23-55N	110-53-49W	CU	-	
394	CANADA DE ORO	UNNAMED PROSPECT	32-28-58N	110-58-11W	CU	-	
395	CASA GRANDE	SACATON/CASA GRANDE	32-57-37N	111-48-47W	CU MO	S	21a
396	CATALINA	PONTATOC MINE	32-19-55N	110-53-50W	CU	S	21a?
397	CATALINA	UNNAMED PROSPECT	32-20-31N	110-53-27W	CU	-	
398	CATALINA	UNNAMED PROSPECT	32-20-05N	110-54-11W	CU	-	
399	CATALINA	UNNAMED PROSPECT	32-24-51N	110-53-56W	CU	-	
400	CATALINA	UNNAMED PROSPECT	32-21-12N	110-56-51W	CU	-	
401	CATALINA	UNNAMED PROSPECT	32-21-29N	110-56-37W	CU	-	
402	CATALINA	UNNAMED PROSPECT	32-22-15N	110-57-23W	CU	-	
403	CATALINA	UNNAMED PROSPECT	32-20-31N	110-48-24W	CU	-	
404	CATALINA	UNNAMED PROSPECT	32-20-04N	110-55-21W	CU	-	
405	CATALINA	UNNAMED PROSPECT	32-19-36N	110-46-13W	CU	-	
406	CATALINA	UNNAMED PROSPECT	32-19-07N	110-46-60W	CU	-	
407	CATALINA	UNNAMED PROSPECT	32-20-19N	110-53-53W	CU	-	
408	CATALINA	UNNAMED PROSPECT	32-25-32N	110-44-53W	CU	-	
409	CATALINA	UNNAMED PROSPECT	32-27-14N	110-57-50W	CU	-	
410	CERRO COLORADO	BLACK PRINCESS	31-40-57N	111-16-55W	AG	S	22c
411	CERRO COLORADO	CERRO COLORADO	31-39-36N	111-16-24W	AG	S	22c
412	CERRO COLORADO	GISMO CLAIMS	31-38-03N	111-20-11W	AU AG CU	-	
413	CERRO COLORADO	LIBERTY MINE	31-41-38N	111-19-09W	AG	S	22c
414	CERRO COLORADO	MARY G. MINE	31-40-27N	111-18-54W	AG	S	

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415	CERRO COLORADO	NEW COLORADO MI	31-41-21N	111-20-16W	AG AU	S	22c
416	CERRO COLORADO	SILVER HILL MIN	31-41-15N	111-20-05W	AG	S	22c
417	CERRO COLORADO	SILVER SHIELD M	31-39-04N	111-17-05W	AG	S	22c
418	CERRO DE FRESNAL	BORDER MINE GROUP	31-26-52N	111-25-11W	AU AG W	S	22c
419	CLARK	BLACK HAWK GROUP	32-47-45N	110-08-11W	MN	S	
420	CLARK	GOLD BUG TUNNEL	32-44-34N	110-00-17W	CU AU	-	
421	CLARK	GRAHAM PROSPECT	32-43-48N	110-06-55W	BA	-	
422	CLARK	MARCOTTE GROUP	32-44-34N	110-09-32W	BA CU AG AU	-	25c?
423	COCHISE	BANKS VEINS	32-04-07N	110-03-06W	W	S	15a
424	COCHISE	BLACK PRINCE WORKINGS	32-06-50N	110-04-04W	CU AG	S	18b
425	COCHISE	BOULDER CLAIM GROUP	32-03-14N	110-05-27W	W	S	15a
426	COCHISE	BURRELL CLAIMS	32-01-39N	110-04-02W	W	S	14a
427	COCHISE	BURRO PIT	32-05-40N	110-03-48W	CU AG	S	18a
428	COCHISE	CENTURION AREA	32-03-06N	110-02-48W	W CU AG	S	15a/14a
429	COCHISE	CENTURION MINE	32-03-09N	110-02-60W	CU	S	18b
430	COCHISE	CHICORA MINE	32-05-48N	110-03-44W	CU AG	S	18a
431	COCHISE	COPPER CHIEF MINE	32-06-26N	110-04-12W	CU	S	18b
432	COCHISE	COPPER KING MINE	32-06-07N	110-04-07W	AG	S	18a
433	COCHISE	DIVIDEND TUNNEL	32-04-20N	110-04-58W	W	S	15a
434	COCHISE	DONNA ANNA VEIN	32-05-50N	110-04-34W	W	S	15a
435	COCHISE	DRAGOON COPPER	32-05-03N	110-03-38W	CU	S	18b
436	COCHISE	EMPIRE NO. 2 SHAFT	32-01-05N	110-03-21W	CU AG	S	18b
437	COCHISE	EMPIRE WORKINGS	32-06-05N	110-05-04W	CU	-	18b
438	COCHISE	HOMESTAKE CLAIM	32-04-24N	110-07-35W	W CU AU F	-	14a
439	COCHISE	JOHNSON CAMP MINE	32-06-37N	110-03-47W	CU AG PB AU ZN	S	18b
440	COCHISE	KEYSTONE MINE	32-05-34N	110-03-28W	CU ZN	S	18b
441	COCHISE	LEGAL TENDER PROSPECT	32-04-39N	110-02-01W	CU	-	18b
442	COCHISE	LIME MOUNTAIN WORKINGS	32-06-37N	110-05-15W	CU	-	18b
443	COCHISE	LITTLE FANNY GROUP	32-03-29N	110-06-01W	W	S	15a
444	COCHISE	MAMMOTH MINE	32-06-35N	110-04-35W	CU ZN	S	18b
445	COCHISE	MAYFLOWER MINE	32-05-56N	110-03-50W	CU AG	S	18a
446	COCHISE	MCKAY MINE	32-06-48N	110-03-29W	CU	S	18b
447	COCHISE	MOORE MINE	32-06-37N	110-04-27W	CU ZN	S	18b
448	COCHISE	O. K. MINE	32-05-47N	110-03-39W	CU ZN	S	18b
449	COCHISE	PEABODY MINE	32-06-58N	110-03-54W	CU AG	S	18b
450	COCHISE	PEACOCK MINE	32-06-01N	110-02-57W	CU	S	18b
451	COCHISE	PITTSBURGH SHAFT	32-06-54N	110-03-33W	CU	-	18b
452	COCHISE	PRIMOS CLAIMS	32-04-02N	110-05-17W	W	S	15a
453	COCHISE	PRINCESS GROUP	32-01-38N	110-02-60W	CU	-	
454	COCHISE	REPUBLIC MINE	32-05-24N	110-03-35W	CU ZN	S	14a
455	COCHISE	SOUTHERN MINE	32-05-45N	110-03-15W	CU AG	S	18a
456	COCHISE	ST. GEORGE CLAIM	32-05-28N	110-03-30W	CU ZN	S	18b
457	COCHISE	STANDARD PROSPECT	32-03-56N	110-02-26W	CU ZN MO	-	18b
458	COCHISE	STROUD BROS. MINE	32-03-49N	110-00-09W	PB AG	S	19a
459	COCHISE	TEXAS ARIZONA MINE	32-04-30N	110-00-39W	PB AG	S	19a
460	COCHISE	TUNGSTEN KING MINE	32-04-26N	110-08-35W	W	S	15a

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461	COCHISE	UNNAMED DEPOSIT	32-04-40N	110-03-52W	W	S	
462	COCHISE	UNNAMED DEPOSIT	32-07-15N	110-01-12W	PB AG	S	22c
463	COCHISE	UNNAMED DEPOSIT	32-00-51N	110-03-16W	AG	S	
464	COCHISE	UNNAMED PROSPECT	32-04-02N	110-06-60W	W	-	
465	COCHISE	UNNAMED PROSPECT	32-04-01N	110-06-52W	W	-	15a
466	COCHISE	UNNAMED PROSPECT	32-02-53N	110-03-10W	W CU	-	14a
467	COCHISE	UNNAMED PROSPECT	32-02-38N	110-03-33W	W	-	14a
468	COCHISE	UNNAMED PROSPECT	32-01-45N	110-03-02W	CU AG W	S	18b
469	COCHISE	YANKEE PRIDE ADIT	32-03-25N	110-05-14W	W	S	15a
470	COMOBABI	HERCULES & MONARCH	32-09-28N	111-45-18W	AG	S	
471	COMOBABI	LITTLE MARY ET AL	32-13- N	111-58- W	AG CU ZN	-	
472	COMOBABI	STEPPE MINE	32-01- N	111-55- W	AU AG PB CU	-	22c
473	COMOBABI	SUN GOLD MINING	32-02- N	111-55- W	CU PB AU AG	S	
474	COTTONWOOD	COPPER HILL PROSPECT	32-56-55N	110-51-47W	CU	-	21a
475	COTTONWOOD	SILVER BONANZA	32-48-01N	110-56-34W	CU PB	S	
476	COTTONWOOD	SILVER QUEEN MINE	32-57-07N	110-53-57W	AG	S	
477	COTTONWOOD	UNNAMED DEPOSIT	32-50-39N	110-51-50W	W	S	15a
478	COTTONWOOD	UNNAMED PROSPECT	32-54-31N	110-50-02W	CU ZN PB V	-	
479	COYOTE	BLACK HAWK GROUP	32-01-48N	111-36-11W	MN	S	
480	COYOTE	BONANZA MINE	32-00-22N	111-31-09W	CU	S	18a
481	COYOTE	JEAN E GROUP	32-01-44N	111-35-50W	MN	S	
482	COYOTE	ROADSIDE MINE	32-02-43N	111-30-33W	CU AG	-	21a
483	CRESCENT	CRESCENT DEPOSIT	32-50-15N	110-43-52W	MN	S	19b
484	CUPRITE	C & H MINE GROUP	31-56-12N	110-42-49W	CU	S	18b
485	CUPRITE	DIMPLE MINE	31-55-23N	110-42-11W	PB AG	S	19a
486	CUPRITE	LA LIBRE MINE	31-56-29N	110-42-52W	CU	S	18b
487	DURHAM-SUIZO	BLUE COPPER MINE	32-43-51N	111-07-56W	CU	S	
488	DURHAM-SUIZO	BLUE STAR MINE	32-41-29N	111-07-09W	CU	S	
489	EASTER	EASTER MINE	31-30-48N	111-23-36W	W	S	15a
490	EMPIRE	CALIFORNIA MINE	31-56-21N	110-38-46W	CU	S	18b
491	EMPIRE	CHIEF MINE	31-52-17N	110-38-24W	PB AG CU	S	19a
492	EMPIRE	COPPER MTN. MINE	31-53-10N	110-38-11W	AU AG	S	19a
493	EMPIRE	COPPER POINT PROSPECT	31-53-38N	110-36-56W	CU AG	S	18b
494	EMPIRE	COPPER TOP PROSPECT	31-52-20N	110-37-40W	PB AG CU ZN	-	19a
495	EMPIRE	GOPHER MINE	31-52-14N	110-38-36W	PB AG	S	19a
496	EMPIRE	GRAVEYARD MINE	31-52-56N	110-36-37W	PB CU AG ZN	S	19a
497	EMPIRE	HILTON MINE	31-52-42N	110-37-14W	PB AG	S	19a
498	EMPIRE	HILTON TUNGSTEN	31-53-20N	110-37-15W	W	S	14a
499	EMPIRE	JEROME NO. 2 MINE	31-52-15N	110-38-35W	PB ZN AG	S	19a
500	EMPIRE	JUSTICE MINE	31-52-27N	110-38-28W	PB AG	S	19a
501	EMPIRE	LAVERY MINE	31-54-20N	110-38-23W	CU AG	S	18b
502	EMPIRE	LEAD CARBONATE	31-52-22N	110-38-35W	PB AG	S	19a
503	EMPIRE	LONE MOUNTAIN MINE	31-52-39N	110-37-22W	PB AG	S	19a
504	EMPIRE	MONTANA MINE	31-54-59N	110-39-16W	CU	S	18b
505	EMPIRE	PRINCE MINE	31-52-10N	110-38-40W	PB AG	S	19a
506	EMPIRE	RED CLOUD MINE	31-52-17N	110-38-25W	PB AG	S	19a

	A	B	C	D	E	F	G
507	EMPIRE	TOTAL WRECK MINE	31-53-44N	110-35-31W	PB AG	S	19a w/V
508	EMPIRE	VERDE QUEEN MINE	31-51-54N	110-37-54W	AG PB	S	19a
509	EMPIRE D	WATERFALL MINE	31-53-01N	110-36-47W	AG	S	18b
510	FRANCISCO GRANDE	FRANCISCO GRANDE	32-53-00N	111-52-30W	CU MO	-	21a
511	GALIURO MTN	TABLE MOUNTAIN	32-38- N	110-20- W	V PB ZN CU	-	
512	GALIURO MTN	WHEELBARROW NO. 5	32-45-54N	110-26-11W	CU	-	
513	GOLD CIRCLE	GOLD CIRCLE GROUP	32-49-40N	110-51-30W	W	-	15a
514	GOLD CIRCLE	UPSHAW TUNGSTEN	32-50-21N	110-52-11W	W AU MO	-	15a
515	GREATERVILLE	ANDERSON PROSPECT	31-43-48N	110-46-00W	PB	S	18c
516	GREATERVILLE	ARRASTRA MINE	31-47-58N	110-46-07W	AU	S	22c
517	GREATERVILLE	BUCKHORN MINE	31-47-01N	110-46-27W	AG AU CU PB	S	22c
518	GREATERVILLE	COMSTOCK MINE GROUP	31-45-39N	110-46-11W	PB	S	22c
519	GREATERVILLE	CONGLOMERATE MINE	31-43-56N	110-45-45W	PB	S	
520	GREATERVILLE	ENZENBERG MINE.	31-46-24N	110-47-14W	AG AU	S	
521	GREATERVILLE	FRIEZ PROSPECT.	31-46-06N	110-46-52W	CU	-	
522	GREATERVILLE	GREATERVILLE PLACER	31-45-47N	110-45-10W	AU	S	39a
523	GREATERVILLE	HANCOCK MINE.	31-46-53N	110-46-28W	AG	S	
524	GREATERVILLE	HUGHES MINE.	31-45-44N	110-47-50W	AG AU	S	
525	GREATERVILLE	OPHIR PROSPECT	31-45-39N	110-46-11W	PB FE CU	-	22c
526	GREATERVILLE	QUEBEC MINE.	31-45-32N	110-46-36W	AG PB	S	22c
527	GREATERVILLE	RED BERRY & HIDDEN TUNNEL	31-43-13N	110-47-39W	CU AG	S	
528	GREATERVILLE	ROYAL MOUNTAIN	31-45-18N	110-46-46W	CU PB AG ZN	-	
529	GREATERVILLE	SANTA RITA GROUP	31-44-03N	110-48-25W	AU AG	S	
530	GREATERVILLE	ST. LOUIS MINE	31-45-32N	110-45-49W	PB AG	S	19a
531	GREATERVILLE	SUMMIT MINE.	31-45-53N	110-47-54W	PB AG CU	-	
532	GREATERVILLE	SWEETWATER MINE	31-43-04N	110-47-24W	CU AG	S	
533	GREATERVILLE	YUBA MINE	31-45-41N	110-46-51W	AG AU	S	22c
534	HARSHAW	ALTA MINE	31-27-40N	110-43-04W	CU AG PB ZN	S	
535	HARSHAW	AMERICAN MINE	31-27-15N	110-43-22W	AG ZN AU PB	S	
536	HARSHAW	AUGUSTA MINE	31-26-27N	110-43-53W	PB AG ZN AU	S	
537	HARSHAW	AZTEC MINE GROUP	31-30-36N	110-44-57W	CU AG AU	S	
538	HARSHAW	BASIN MINE GROUP	31-28-51N	110-42-57W	CU AU AG PB	S	
539	HARSHAW	BENDER MINE	31-26-58N	110-43-00W	MN PB ZN CU	S	
540	HARSHAW	BLACK EAGLE MINE	31-27-04N	110-42-58W	MN AG PB CU	S	
541	HARSHAW	BLUE EAGLE MINE	31-29-32N	110-45-22W	CU AU ZN AG	S	
542	HARSHAW	BLUE NOSE MINE	31-26-52N	110-43-58W	AG AU PB	S	
543	HARSHAW	BUFFALO GROUP	31-29-01N	110-43-09W	ZN AG AU PB	S	
544	HARSHAW	BULLWHACKER MINE	31-26-00N	110-42-10W	PB ZN AU AG	S	19b
545	HARSHAW	CALIFORNIA MINE	31-29-42N	110-45-17W	CU AG AU PB	S	
546	HARSHAW	CHIEF MINE	31-28-27N	110-44-41W	CU AG AU PB	S	
547	HARSHAW	CHRISTMAS GIFT	31-31-30N	110-43-02W	CU AG PB AU	S	
548	HARSHAW	ELEVATION MINE	31-31-15N	110-43-23W	CU PB AG	-	
549	HARSHAW	ENDLESS CHAIN MINE	31-26-02N	110-43-34W	CU	S	18b
550	HARSHAW	EXPOSED REEF MINE	31-29-40N	110-44-53W	CU AG PB ZN	S	
551	HARSHAW	FLUX MINES	31-29-18N	110-45-15W	ZN CU AU PB	M	22c
552	HARSHAW	HAMPSON PROSPECT	31-29-23N	110-44-18W	CU FE	-	

	A	B	C	D	E	F	G
553	HARSHAW	HARDSHELL MINE	31-27-34N	110-42-59W	PB AG MN CU	S	
554	HARSHAW	HARSHAW PLACERS	31-30-52N	110-46-31W	AU	S	39a
555	HARSHAW	HERMOSA MINE	31-27-22N	110-42-33W	AG MN PB CU	S	
556	HARSHAW	HUMBOLDT MINE	31-28-09N	110-44-00W	AU PB AG CU	S	
557	HARSHAW	INVINCIBLE PROSPECT	31-30-14N	110-45-22W	CU AU	-	
558	HARSHAW	IRON CAP MINE	31-30-04N	110-45-31W	CU AG AU PB	S	
559	HARSHAW	JANUARY AND NORTON	31-28-21N	110-43-45W	ZN AG AU PB	S	
560	HARSHAW	LEAD QUEEN MINE	31-29-01N	110-43-09W	PB ZN AG AU	S	22c
561	HARSHAW	MEADOW VALLEY MINE	31-30-36N	110-35-04W	AG PB CU	-	
562	HARSHAW	MORNING GLORY MINE	31-25-45N	110-43-37W	CU AG ZN PB	S	
563	HARSHAW	MOWRY MINE	31-25-42N	110-42-12W	PB AG ZN CU	S	19a
564	HARSHAW	MOWRY PLACERS	31-24-57N	110-41-36W	AU	S	39a
565	HARSHAW	PHOENIX MINE	31-25-23N	110-41-43W	PB AG	S	
566	HARSHAW	RED MOUNTAIN MI	31-30-13N	110-43-07W	CU	S	21a
567	HARSHAW	SALVADOR MINE	31-27-12N	110-42-53W	AG	S	
568	HARSHAW	SUNNYSIDE COPPER	31-28- N	110-44- W	CU	-	
569	HARSHAW	SUNNYSIDE MINE	31-27-04N	110-44-46W	CU	S	21a
570	HARSHAW	THUNDER AND STADARD	31-26-41N	110-44-55W	CU AG AU MO	-	
571	HARSHAW	TRENCH AND JOSE	31-27-55N	110-43-44W	PB ZN AG	S	22c
572	HARSHAW	WORLD'S FAIR MINE	31-28-43N	110-44-16W	AG PB	S	
573	HARTFORD	ALTO MINE	31-21-55N	110-16-33W	CU PB ZN AG	S	19a
574	HARTFORD	ARMISTICE MINE	31-24-20N	110-16-08W	PB AG CU AU	S	19a
575	HARTFORD	ARROW MINE GROUP	31-28-56N	110-25-22W	AU W	S	15a
576	HARTFORD	BAUMKIRSCHER MINE	31-24-02N	110-14-49W	PB ZN CU AU	S	19a
577	HARTFORD	CAVE CREEK CANYON	31-23-10N	110-19-05W	ZN PB CU AG	S	19a
578	HARTFORD	COPPER GLANCE MINE	31-25-14N	110-21-30W	CU AU AG	S	
579	HARTFORD	EUREKA MINE	31-25-43N	110-22-46W	PB AG CU AU	S	22c
580	HARTFORD	GOLDEN FLEECE MINE	31-22-33N	110-17-12W	AU	S	
581	HARTFORD	HAMBURG MINE	31-25-28N	110-19-23W	CU PB AG ZN	S	19a
582	HARTFORD	HARPER MINE	31-23-53N	110-21-08W	AU AG W CU	S	15a
583	HARTFORD	JAMES GROUP	31-27-16N	110-19-54W	W PB CU	S	14a/19a
584	HARTFORD	LUCY BELL MINE	31-22-35N	110-14-27W	CU PB AG AU	S	19a
585	HARTFORD	LUTZ TUNNEL	31-23-04N	110-17-09W	CU AG AU	S	19a
586	HARTFORD	MANILA MINE MINE	31-33-23N	110-26-49W	PB	S	19a or 18c
587	HARTFORD	MILLER CANYON P	31-24-09N	110-17-26W	PB CU	-	22c
588	HARTFORD	MORGAN MINE	31-22-07N	110-15-27W	AU AG	S	
589	HARTFORD	NELLY JAMES MINE	31-02-31N	110-17-37W	ZN	S	
590	HARTFORD	PETERSON MINE	31-27-17N	110-24-00W	CU AG AU	S	22c
591	HARTFORD	POWER MINE (ANOZIRA)	31-24-43N	110-16-53W	MN AG PB CU	S	22c
592	HARTFORD	RESERECTOR MINE	31-20-04N	110-16-57W	AU	S	
593	HARTFORD	SAMPSON, BOSTON	31-22-12N	110-17-40W	CU ZN AG AU	S	19a
594	HARTFORD	STATE OF TEXAS	31-21-05N	110-16-23W	ZN	S	19a
595	HARTFORD	TRACY MINE	31-21-51N	110-15-29W	AU	S	22c
596	HARTFORD	WAKEFIELD GROUP	31-24-15N	110-20-52W	AU AG W	S	25c/15a
597	HARTFORD	WALTER AND MILDRED	31-22-13N	110-17-41W	AG	S	
598	HARTFORD	WESTERN TUNGSTEN	31-24-03N	110-19-28W	PB AG CU	S	18c

	A	B	C	D	E	F	G
599	HARTFORD	ZALESKI MINE	31-21-47N	110-15-20W	AU W	S	15a
600	HELVETIA	BLACK HORSE MIN	31-51-45N	110-45-56W	CU	S	18b
601	HELVETIA	BLUE JAY MINE	31-52-32N	110-47-36W	AG	S	
602	HELVETIA	BROAD TOP MINE	31-51-05N	110-45-27W	AG CU	S	18b
603	HELVETIA	BULLDOZER MINE	31-52-24N	110-47-52W	CU	S	18b/26a?
604	HELVETIA	COPPER DUKE MINE	31-52-11N	110-47-48W	CU	S	18b
605	HELVETIA	COPPER WORLD MINE	31-51-38N	110-46-02W	CU	S	18b
606	HELVETIA	CROWN CLAIMS NO 1 & 2	31-56-01N	110-44-43W	PB ZN AG	S	22c
607	HELVETIA	CUPRITE MINE	31-55-41N	110-42-32W	CU AG	S	skarn
608	HELVETIA	CURTIS CLAIM	31-50-40N	110-46-23W	AG	S	
609	HELVETIA	DAYLIGHT MINE	31-50-42N	110-45-19W	CU PB ZN	S	19a
610	HELVETIA	EAST HELVETIA DEPOSIT	31-49-59N	110-45-33W	CU	-	18a
611	HELVETIA	ECLIPSE GROUP	31-51-14N	110-45-40W	CU	S	18b
612	HELVETIA	ELGIN MINE	31-51-38N	110-47-16W	CU	S	18b
613	HELVETIA	FALLS CLAIM	31-50-20N	110-45-46W	CU	S	18b
614	HELVETIA	GOLDEN GATE GROUP	31-48-31N	110-45-54W	AU AG	S	
615	HELVETIA	HEAVY WEIGHT MINE	31-51-51N	110-46-47W	CU	S	18b
616	HELVETIA	HELENA MINE	31-52-25N	110-42-28W	AU	S	
617	HELVETIA	HENRIETTA PROSPECT	31-53-08N	110-47-35W	AU AG CU	-	
618	HELVETIA	INDIAN CLUB PROSPECT	31-51-28N	110-45-54W	CU	-	
619	HELVETIA	ISLE ROYAL MINE	31-51-28N	110-46-02W	CU	S	
620	HELVETIA	KING-EXILE MINE	31-51-18N	110-45-27W	CU AG	S	18a
621	HELVETIA	LEADER MINE	31-51-34N	110-46-08W	CU MO	S	18a
622	HELVETIA	MOHAWK MINE	31-51-33N	110-46-56W	CU	S	18b
623	HELVETIA	MOHAWK SILVER MINE	31-49-03N	110-46-02W	ZN	S	22c
624	HELVETIA	MUHEIM - GRAFEN	31-49-49N	110-44-58W	CU AG	S	18b
625	HELVETIA	NARRAGANSETT MINE	31-50-45N	110-45-33W	CU	S	18b
626	HELVETIA	NEW YORK MINE	31-55-59N	110-43-26W	PB CU AG	S	19a
627	HELVETIA	NEWMAN MINE	31-51-51N	110-46-33W	CU	S	18b
628	HELVETIA	NOONDAY PROSPECT	31-52-08N	110-47-53W	CU	-	
629	HELVETIA	OLD DICK MINE	31-51-29N	110-46-54W	CU	S	
630	HELVETIA	OLD PAP CLAIM	31-50-09N	110-45-26W	CU	S	
631	HELVETIA	OMEGA MINE	31-51-14N	110-46-07W	CU	S	
632	HELVETIA	OREGON COPPER MINE	31-49-43N	110-46-19W	CU	S	18a
633	HELVETIA	PAULINE MINE	31-55-29N	110-41-47W	PB CU AG	S	19a
634	HELVETIA	PEACH PROSPECT	31-52-00N	110-47-42W	CU ZN	S	18a
635	HELVETIA	PICKWICK PROSPECT	31-49-51N	110-45-32W	CU	S	
636	HELVETIA	PILOT CLAIM	31-51-33N	110-45-42W	CU	-	18b
637	HELVETIA	RIDLEY MINE	31-51-08N	110-48-35W	PB CU	S	
638	HELVETIA	SILVER SPUR MINE	31-50-57N	110-46-03W	AG	S	18b
639	HELVETIA	SOUTH END MINE	31-51-54N	110-42-38W	CU	S	18b
640	HELVETIA	SWEET BYE AND BYE	31-49-40N	110-45-33W	CU AG	S	18b
641	HELVETIA	TIP TOP MINE	31-52-10N	110-47-36W	CU	S	18a
642	HORSE RANCH	BEE GROUP	32-54-08N	110-56-43W	CU PB	S	
643	HORSE RANCH	UNNAMED PROSPECT	32-53-22N	110-56-36W	CU PB AG	-	
644	HORSE RANCH	UNNAMED PROSPECT	32-53-07N	110-55-54W	CU PB AG	-	

	A	B	C	D	E	F	G
645	HORSE RANCH	UNNAMED PROSPECT	32-53-39N	110-57-48W	CU PB	-	
646	IVANHOE	GRINGO MINE	31-34-18N	110-46-11W	AU	S	19a
647	IVANHOE	IVANHOE MINE	31-33-42N	110-48-03W	AG CU	S	
648	JUNIPER FLAT	STOUT MINE	31-30-24N	110-00-44W	CU	S	
649	KEYSTONE	BLACK HAWK CLAIM	31-51-54N	111-13-55W	PB AG	S	22c
650	LAKESHORE	CONFIDENCE CLAIM 1-19	32-45- N	111-55- W	CU	S	
651	LAKESHORE	LAKESHORE MINE	32-31-25N	111-54-09W	CU	M	18a
652	LAS GUIJAS	BUSTER LODE PROSPECT	31-39-54N	111-23-	W AU AG	S	
653	LAS GUIJAS	GENERAL ELECTRIC	31-39-51N	111-22-51W	W	S	
654	LAS GUIJAS	GOOD ENOUGH CLAIM	31-38-54N	111-21-51W	W	S	15a
655	LAS GUIJAS	LAS GUIJAS MINE	31-50- N	111-25- W	W	-	15a
656	LAS GUIJAS	LAS GUIAS TUNGSTEN	31-39-48N	111-22-09W	W	S	W placer
657	LITTLE HILL	LITTLE HILL MINE	32-35-12N	110-49-53W	CU	S	
658	MAGONIGAL	UNNAMED PROSPECT	32-31-09N	111-40-46W	CU	-	
659	MAMMOTH	BOSE (BURSON)	32-42-30N	110-42-49W	MN PB	-	
660	MAMMOTH	HARVE HATCHER (TIGER)	32-40- N	110-50- W	CU	-	
661	MAMMOTH	HATCH MINE	32-42-04N	110-44-21W	CU	S	
662	MAMMOTH	MAMMOTH - ST. ANTHONY	32-42-22N	110-41-02W	AU PB	S	22c
663	MAMMOTH	MOHAWK-NEW YEAR	32-42-14N	110-40-53W	PB CU	S	
664	MAMMOTH	PEARL MINE	32-44-02N	110-44-15W	CU PB	S	
665	MAMMOTH	SANTA MARIA MINE	32-47-06N	110-44-37W	MN	-	
666	MAMMOTH	TARR PROPERTY	32-43-37N	110-42-45W	W	S	15a
667	MAMMOTH	UNNAMED PROSPECT	32-42-53N	110-44-09W	MN	-	
668	MAMMOTH	UNNAMED PROSPECT	32-42-39N	110-44-11W	CU	-	
669	MAMMOTH	UNNAMED PROSPECT	32-40-12N	110-42-22W	CU	-	
670	MANSFIELD	AMERICAN BOY MINE	31-37-28N	110-49-19W	PB AG	S	
671	MANSFIELD	MANSFIELD MINE	31-37-01N	110-47-57W	CU AG PB	S	22c
672	MARBLE PEAK	ALDER CANYON PLACER	32-28-48N	110-40-12W	AU	S	39a
673	MARBLE PEAK	BLUFF MINE GROU	32-28-25N	110-40-55W	PB ZN	S	
674	MARBLE PEAK	CORONADO	32-29- N	110-45- W	W	-	14a
675	MARBLE PEAK	DAILY GROUP	32-28-22N	110-43-45W	CU	S	18b
676	MARBLE PEAK	HARTMAN HOMESTAKE	32-28-37N	110-45-02W	CU	-	18b
677	MARBLE PEAK	LEATHERWOOD GROUP	32-27-52N	110-44-12W	CU AG	S	
678	MIDDLE PASS	BUENA VISTA MINE	31-58-01N	110-01-27W	PB AG CU	S	19a
679	MIDDLE PASS	BURRITO DE FIERRO	31-56-39N	110-03-30W	PB ZN CU AG	S	19a
680	MIDDLE PASS	HUBBARD MINE	31-56-27N	110-01-55W	ZN	S	18c
681	MIDDLE PASS	RAINBOW MINE	31-58-33N	110-00-37W	ZN PB	-	18c
682	MILDRED PEAK	BABOQUIVARI MI	31-42-27N	111-36-06W	MN	S	
683	MILDRED PEAK	EMMETT AND ELGIN	31-42-47N	111-39-19W	AU	S	
684	MILDRED PEAK	GOLD KING MINE	31-42-27N	111-36-44W	AU AG	S	22c
685	MILDRED PEAK	JUPITER MINE	31-44-05N	111-35-13W	AU AG	S	22c
686	MILDRED PEAK	PAPAGO CHIEF MINE	31-40-33N	111-37-42W	CU AG	S	
687	MINE CANYON	CHIMNEY PROSPE	31-45-51N	110-25-38W	CU AG AU	-	18b
688	MINE CANYON	COPPER PLATE MINE	31-46-04N	110-27-46W	CU AG	S	
689	MINE CANYON	NEVADA AND MASCOT	31-46-23N	110-25-43W	CU AG AU	S	20c
690	MINE CANYON	TWO PEAKS MINE	31-46-15N	110-25-28W	CU PB AG AU	S	18b

	A	B	C	D	E	F	G
691	NOGALES	CALABASAS AREA	31-26- N	110-57- W	W	S	15a
692	NOGALES	COLUMBIA MINE GROUP	31-24-11N	110-55-31W	PB AG	S	22c
693	NOGALES	DURA MINE	31-23-34N	110-54-48W	AU PB	S	
694	NOGALES	FARMER MINE	31-23-43N	110-55-36W	AU PB	S	
695	NOGALES	GOLD HILL MINE	31-23-55N	110-55-37W	AU PB	S	
696	NOGALES	J. REED CLAIMS	31-23-34N	110-52-18W	MN	-	22c
697	NOGALES	LION MINE MINE	31-23-57N	110-54-31W	AU AG CU PB	S	
698	NOGALES	NOGALES PLACERS	31-26-59N	110-52-25W	AU	S	39a
699	NOGALES	TWO BROTHERS MINE	31-23-49N	110-55-35W	AU PB	S	
700	NORTH STAR	NORTH STAR MINE	32-49-31N	111-20-33W	CU SIL	S	21a
701	OCEANIC	OCEANIC MINE	31-34-11N	111-24-43W	AU AG PB	S	22c
702	OLD BALDY	CARRIE NATION MINE	31-41-53N	110-52-32W	CU	S	
703	OLD BALDY	COPPER QUEEN MINE	31-42-16N	110-51-40W	CU	S	
704	OLD BALDY	DANIELS MINE	31-43-32N	110-52-13W	MO	-	
705	OLD BALDY	IRON CLIFF PROSPECT	31-41-46N	110-51-45W	AU CU	-	
706	OLD BALDY	IRON MASK PROSPECT	31-45-47N	110-51-54W	CU	-	
707	OLD BALDY	JACKSON MINE	31-46-07N	110-51-55W	CU AG	S	
708	OLD BALDY	LUCKY LEDGE MINE	31-42-48N	110-51-37W	CU AU AG	-	
709	OLD BALDY	MADERA CANYON P	31-44-10N	110-53-02W	AU	S	39a
710	OLD BALDY	MCLEARY PROSPECTS	31-43-37N	110-52-47W	CU MO	-	21a/21b
711	OLD BALDY	OLD BALDY COPPER	31-42-58N	110-45-35W	CU MO AG AU	-	
712	OLD BALDY	STAR POINTER MINE	31-46-20N	110-51-16W	CU	S	
713	OLD BALDY	SUN LODE CLAIM	31-43-30N	110-52-50W	MO CU	-	
714	OLD HAT	DAILY AND GEESMAN	32-28- N	110-44- W	CU	S	18a
715	OLD HAT	MORNING STAR	32-31- N	110-44- W	W	M	14a
716	OLD HAT	SANTA CATALINA	32-29-30N	110-45- W	CU PB	M	19a
717	ORACLE	AMERICAN FLAG MINE	32-34-30N	110-44-00W	CU AG	S	
718	ORACLE	BEAR CAT CLAIMS	32-34-20N	110-43-48W	W	S	14a
719	ORACLE	CAMPO BONITO GROUP	32-33-06N	110-43-36W	W	S	14a
720	ORACLE	CANADA DEL ORO	32-32-52N	110-47-13W	AU	S	39a
721	ORACLE	CODY TUNNEL	32-33-34N	110-44-04W	W AU	S	14a
722	ORACLE	CORRIGEDOR CLAIM	32-28-34N	110-43-12W	W	S	14a
723	ORACLE	DEAD BULL MINE	32-32-56N	110-42-42W	AG AU CU	S	
724	ORACLE	GEESMAN GROUP	32-28-32N	110-43-56W	CU	S	18b
725	ORACLE	LOVEJOY (BEAR CAT)	32-34-31N	110-43-51W	W AU	S	15a
726	ORACLE	MAUDINA MINE	32-33-07N	110-43-37W	W	S	14a/Au skarn?
727	ORACLE	MORNING STAR CLAIM	32-33-26N	110-44-10W	W	M	14a
728	ORACLE	PURE GOLD	32-33-30N	110-44-08W	W	S	14a
729	ORACLE	SOUTHERN BELLE	32-34-35N	110-44-17W	PB AU	S	
730	ORACLE	STRATTON MINE	32-27-57N	110-44-37W	CU MO	S	18b
731	ORACLE	TAYLOR X CLAIMS	32-28-49N	110-45-34W	W	S	
732	ORACLE	THREE C RANCH MINE	32-32-00N	110-44-29W	PB CU	S	
733	ORACLE	UNNAMED PROSPECT	32-26-01N	110-49-43W	CU	-	
734	ORACLE	UNNAMED PROSPECT	32-28-24N	110-44-60W	CU	-	
735	ORACLE	UNNAMED PROSPECT	32-27-54N	110-46-28W	CU	-	
736	ORACLE	UNNAMED PROSPECT	32-26-25N	110-46-03W	CU	-	

	A	B	C	D	E	F	G
737	ORACLE	UNNAMED PROSPECT	32-26-42N	110-45-52W	CU	-	
738	OROBLANCO	ANNIE LAURIE PROSPECT	31-26-08N	111-14-41W	U MN	-	
739	OROBLANCO	AUSTERLITZ MINE	31-27-60N	111-16-02W	AU AG	S	
740	OROBLANCO	BIG LODE MINE	31-27-16N	111-13-55W	AG PB AU	S	
741	OROBLANCO	BRICK MINE	31-27-40N	111-15-06W	AG AU	S	
742	OROBLANCO	BROWN BIRD MINE	31-27-22N	111-15-09W	AU AG	S	22c
743	OROBLANCO	CHOCTAW MINE	31-29-38N	111-16-10W	PB ZN AG	S	
744	OROBLANCO	CLEVELAND DEPOSIT	31-26-58N	111-14-22	AU	S	
745	OROBLANCO	COMMODORE MINE	31-24-40N	111-15-09W	AG AU	S	
746	OROBLANCO	COPPER MTN. MINE	31-26-42N	111-15-18W	CU AG	S	
747	OROBLANCO	CRAMER MINE MINE	31-25-29N	111-14-08W	AU AG	S	25c
748	OROBLANCO	DOS AMIGOS MINE	31-25-03N	111-14-18W	AU AG	S	25c?
749	OROBLANCO	FRANKLIN DEPOSIT	31-23-37N	111-14-27	AU AG PB CU	S	
750	OROBLANCO	HOLDEN MINE	31-24-40N	111-16-25W	AU AG	-	
751	OROBLANCO	IDAHO MINE GROUP	31-27-49N	111-14-28W	AG PB	S	
752	OROBLANCO	IRIS AND NATALIE	31-33-56N	111-11-50W	U CU AU AG	-	
753	OROBLANCO	LOMA DE MANGANESE	31-26-58N	111-16-08W	MN CU AG	S	
754	OROBLANCO	LUCKY SHOT MINE	31-26-50N	111-14-31W	ZN PB	S	
755	OROBLANCO	MARGARITA MINE	31-26-42N	111-15-18W	AU AG	S	
756	OROBLANCO	MISSOURI MINE	31-27-08N	111-17-38W	CU AU AG	-	
757	OROBLANCO	MONARCH MINE	31-24-54N	111-15-01W	AG AU CU	-	
758	OROBLANCO	MONTANA MINE	31-27-28N	111-14-06W	PB ZN AG	S	22c
759	OROBLANCO	NEAR "SKY LINE"	31-28-36N	111-16-50W	CU AG AU PB	-	
760	OROBLANCO	NEAR AUSTERLITZ	31-27-56N	111-16-03W	CU	-	
761	OROBLANCO	OLD GLORY MINE	31-26-07N	111-15-22W	AU AG	S	
762	OROBLANCO	ORO MINE MINE	31-25-30N	111-16-54W	AG AU	S	
763	OROBLANCO	ORO BLANCO MINE	31-25-14N	111-14-43W	AU AG	M	25c?
764	OROBLANCO	ORO FINO MINE	31-24-27N	111-15-03W	ZN CU	S	
765	OROBLANCO	RAGNAROC MINE	31-28-03N	111-16-25W	AU AG	S	
766	OROBLANCO	RUBIANA	31-27-26N	111-15-28W	AG AU	S	22c
767	OROBLANCO	SKUNK (OSTRICH)	31-29-30N	111-18-29W	AG AU	S	25c
768	OROBLANCO	TRES AMIGOS MINE	31-25-02N	111-15-00W	AU AG	S	25c
769	OROBLANCO	TRIANGLE MINE	31-24-24N	111-15-03W	AU AG	-	
770	OROBLANCO	UNION MINE	31-23-43N	111-16-07W	AG PB	S	
771	OWL HEAD	APACHE MINES	32-35-17N	111-07-56W	CU	-	
772	OWL HEAD	APACHE MINES #20	32-35-04N	111-07-55W	CU	-	
773	OWL HEAD	APACHE MINES #6	32-34-32N	111-07-53W	CU	-	
774	OWL HEAD	APACHE MINES #2	32-35-41N	111-07-52W	CU AU AG	-	
775	OWL HEAD	APACHE MINES 8	32-34-47N	111-06-46W	PB AU AG CU	-	
776	OWL HEAD	BIG FLO MINE	32-32-00N	111-07-46W	CU AG	-	
777	OWL HEAD	BIG MINE	32-37-30N	111-04-05W	CU	S	
778	OWL HEAD	BLUE COPPER MINE	32-43-27N	111-08-26W	CU	S	
779	OWL HEAD	BUCKHORN MINE	32-34-30N	111-07-28W	AU AG CU PB	-	
780	OWL HEAD	CACTUSTAIL MINE	32-34-58N	111-06-05W	CU AG	-	
781	OWL HEAD	DESERT II	32-35-11N	111-05-33W	AG AU PB	-	
782	OWL HEAD	EASTER #3 CLAIM	32-36-06N	111-03-11W	CU AG PB	-	

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783	OWL HEAD	GERONIMO STRIKE	32-36-05N	111-03-50W	AU AG CU PB	-	
784	OWL HEAD	HONEY POT 1 & 2	32-41-40N	111-07-09W	CU	-	
785	OWL HEAD	JEFFORD'S MINE	32-34-60N	111-07-36W	CU	-	
786	OWL HEAD	JESSE BENTON MINE	32-35-55N	111-03-23W	AG	S	22c
787	OWL HEAD	JOE'S ELBOW MINE	32-32-29N	111-02-35W	CU	-	
788	OWL HEAD	LAST CHANCE & EBELING CU	32-44-30N	111-05- W	CU	-	
789	OWL HEAD	MAIN SAN JUAN CLAIM	32-38-52N	111-05-11W	CU	-	
790	OWL HEAD	MOCKINGBIRD MINE	32-35-48N	111-02-56W	CU PB AU AG	-	
791	OWL HEAD	OLD CHIEF MINE	32-37-19N	111-03-48W	CU AG	-	
792	OWL HEAD	OLD EAGLE MINE	32-35-30N	111-04-42W	AG AU PB	S	22c
793	OWL HEAD	OLD VICTOR MINE	32-34-29N	111-07-45W	CU AG PB	-	
794	OWL HEAD	OWL CLAIMS	32-35-29N	111-07-50W	CU	-	
795	OWL HEAD	SAN JUAN CLAIMS	32-38-36N	111-04-50W	CU	-	
796	OWL HEAD	SAVANAH & EASTER	32-36-17N	111-03-23W	CU B PB AG	-	
797	OWL HEAD	SUNDOWN MINE	32-35-32N	111-12-19W	CU BA	-	
798	OWL HEAD	UNNAMED COPPER	32-42-45N	111-08-40W	CU	-	
799	OWL HEAD	UNNAMED COPPER	32-32-30N	111-01-11W	CU	-	
800	OWL HEAD	UNNAMED COPPER	32-30-03N	111-01-12W	CU	-	
801	OWL HEAD	UNNAMED COPPER	32-37-30N	111-04-39W	CU	-	
802	OWL HEAD	UNNAMED COPPER	32-43-46N	111-08-60W	CU	-	
803	OWL HEAD	UNNAMED COPPER	32-34-07N	111-07-47W	CU	-	
804	OWL HEAD	UNNAMED COPPER	32-33-09N	111-07-52W	CU	-	
805	OWL HEAD	UNNAMED COPPER	32-32-28N	111-08-02W	CU	-	
806	OWL HEAD	UNNAMED COPPER	32-31-30N	111-08-52W	CU	-	
807	OWL HEAD	UNNAMED COPPER	32-32-11N	111-08-18W	CU	-	
808	OWL HEAD	UNNAMED COPPER	32-34-10N	111-07-34W	CU	-	
809	OWL HEAD	UNNAMED COPPER	32-39-05N	111-05-08W	CU	-	
810	OWL HEAD	UNNAMED COPPER	32-37-04N	111-03-33W	CU	-	
811	OWL HEAD	UNNAMED COPPER	32-34-59N	111-02-39W	CU	-	
812	OWL HEAD	UNNAMED COPPER	32-35-05N	111-03-53W	CU	-	
813	OWL HEAD	UNNAMED COPPER	32-34-51N	111-00-00W	CU	-	
814	OWL HEAD	UNNAMED COPPER	32-34-35N	111-01-08W	CU	-	
815	OWL HEAD	UNNAMED COPPER	32-41-26N	111-05-28W	CU	-	
816	OWL HEAD	UNNAMED COPPER	32-43-16N	111-05-02W	CU	-	
817	OWL HEAD	UNNAMED COPPER	32-41-15N	111-04-33W	CU	-	
818	OWL HEAD	UNNAMED COPPER	32-40-52N	111-04-12W	CU	-	
819	OWL HEAD	UNNAMED COPPER	32-41-37N	111-04-03W	CU	-	
820	OWL HEAD	UNNAMED COPPER	32-41-19N	111-06-13W	CU	-	
821	OWL HEAD	UNNAMED COPPER	32-41-29N	111-06-04W	CU	-	
822	OWL HEAD	UNNAMED COPPER	32-41-30N	111-06-18W	CU	-	
823	OWL HEAD	UNNAMED COPPER	32-41-57N	111-09-13W	CU	-	
824	OWL HEAD	UNNAMED CU DEPOSIT	32-39-12N	111-07-44W	CU	-	
825	OWL HEAD	UNNAMED CU DEPOSIT	32-31-04N	111-01-23W	CU	-	
826	OWL HEAD	UNNAMED IRON DEPOSIT	32-44-43N	111-00-03W	FE	-	
827	OWL HEAD	UNNAMED PROSPECT	32-53-11N	111-08-21W	CU	-	
828	OWL HEAD	UNNAMED PROSPECT	32-34-30N	111-07-28W	CU	-	

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829	OWL HEAD	VICTOR CLAIMS	32-37-35N	111-06-12W	CU	-	
830	PAJARITO	MORNING AND EVENING	31-22-43N	111-05-30W	AG PB	S	
831	PAJARITO	ST. PATRICK MINE	31-22-33N	111-05-59W	AG PB	S	22c
832	PAJARITO	SUNSET MINE GROUP	31-22-27N	111-05-48W	AG PB AU	S	
833	PAJARITO	WHITE OAKS AND BIG STEVE	31-22-24N	111-04-59W	PB AG	S	22c
834	PALMETTO	BIG STICK MINE	31-27-60N	110-47-03W	CU	-	
835	PALMETTO	COLLICELLO AND LURAY	31-27-55N	110-46-06W	CU AG	S	21a
836	PALMETTO	COX GULCH PROSPECT	31-27-59N	110-46-54W	CU	-	
837	PALMETTO	DOMINO MINE GROUP	31-28-23N	110-47-14W	AG PB	S	
838	PALMETTO	EUROPEAN MINE GROUP	31-27-55N	110-45-47W	CU AG	S	21a/22c
839	PALMETTO	JARILLAS MINE GROUP	31-26-21N	110-48-32W	AG PB	S	
840	PALMETTO	MINE SHAFT WINDMILL	31-25- N	110-47- W	CU	-	
841	PALMETTO	NEW HOPE MINE GROUP	31-28-44N	110-47-03W	CU AG	S	
842	PALMETTO	PALMETTO PLACER	31-29-32N	110-47-60W	AU	S	39a
843	PALMETTO	THREE R MINE GROUP	31-28-30N	110-45-43W	CU	S	
844	PALMETTO	TRES DE MAYO MINE	31-26-45N	110-48-05W	AG PB	S	
845	PALMETTO	VENTURA MINE GROUP	31-27-27N	110-45-53W	CU AG AU	S	
846	PAPAGO	AGUINALDO MINE	31-55-05N	111-17-08W	PB AG	S	19a/19b
847	PAPAGO	ASH CREEK PLACER	31-52-33N	111-15-13W	AU	S	39a
848	PAPAGO	BANNER MINE	31-53-18N	111-17-07W	AG PB	S	19a
849	PAPAGO	BIG JOHNNY - LITTLE JOHNNY	31-55-47N	111-17-27W	AG PB	S	19a
850	PAPAGO	BLACK DIKE MINE	31-55-42N	111-16-53W	PB AG CU	S	
851	PAPAGO	CLARK GROUP	31-54-21N	111-16-41W	AU CU	S	
852	PAPAGO	COPPER GLANCE PROSPECT	31-58- N	111-16- W	CU	-	
853	PAPAGO	COPPER GRANTZ	31-56-06N	111-18-19W	CU	-	
854	PAPAGO	EL CONQUISTADOR	31-58-26N	111-30-16W	U	-	
855	PAPAGO	FLUORINE MINE	31-54-23N	111-12-30W	F	S	
856	PAPAGO	GENIE NO. 1 CLAIM	31-53-00N	111-14-07W	U	-	
857	PAPAGO	GLEN CLAIMS	31-55-33N	111-16-21W	U	-	
858	PAPAGO	GOLD HILL MINE	31-53-06N	111-16-33W	FE	-	18d
859	PAPAGO	HOPEFUL NO. 1	31-54-22N	111-10-24W	U	-	
860	PAPAGO	LENA NO. 1 - 11	31-53-04N	111-14-26W	U	-	U veins
861	PAPAGO	MAR GARITA MINE	31-54-42N	111-18-09W	CU	S	
862	PAPAGO	MONTEZUMA MINE	31-53-57N	111-17-04W	CU	-	
863	PAPAGO	PHILIMENA MINE	31-55-08N	111-18-39W	CU	-	
864	PAPAGO	PROSPECT SE OF PHILIMENA	31-54-52N	111-18-11W	CU	-	
865	PAPAGO	PROSPECT K-10	31-54-50N	111-19-02W	CU	-	
866	PAPAGO	PROSPECT N OF AGUINALDO	31-55-21N	111-17-08W	MN	-	
867	PAPAGO	PROSPECT NNW OF BANNER	31-53-37N	111-17-15W	CU MN	-	
868	PAPAGO	PROSP. W OF STEVENS RANCH	31-54-23N	111-17-27W	CU	-	
869	PAPAGO	PROSPECTS E OF PHILIMENA	31-55-06N	111-18-12W	CU	-	
870	PAPAGO	PROVIDENCE MINE	31-55-06N	111-17-51W	CU AG	S	
871	PAPAGO	RED STREAK MINE	31-51-23N	111-18-20W	CU	S	
872	PAPAGO	SUNSHINE - SUNRISE	31-52-31N	111-16-03W	PB CU AG	S	
873	PAPAGO	UNNAMED PROSPECT K-11	31-54-34N	111-17-39W	CU	-	
874	PATAGONIA	ANNIE MINE	31-22-38N	110-42-01W	ZN PB	S	18c

	A	B	C	D	E	F	G
875	PATAGONIA	BENNETT MINE	31-22-58N	110-46-43W	CU	S	20c
876	PATAGONIA	BIG LEAD MINE	31-23-36N	110-47-19W	PB CU	-	22c
877	PATAGONIA	BONANZA	31-18- N	110-40- W	AG PB ZN CU	S	19a
878	PATAGONIA	BROOKS PROSPECT	31-21-27N	110-42-21W	CU	S	
879	PATAGONIA	BUENA VISTA	31-22-50N	110-46- W	CU MO	M	21b?
880	PATAGONIA	BUENA VISTA MINE	31-22-51N	110-46-05W	CU AG MO	S	21a/21b?
881	PATAGONIA	CALIFORNIA - GR	31-22-36N	110-42-02W	PB ZN CU AG	S	19a
882	PATAGONIA	DAVE ALLEN MINE	31-22-30N	110-42-17W	ZN PB CU AG	S	18c
883	PATAGONIA	DOUBLE STANDARD	31-22-30N	110-42-17W	ZN CU	S	19a
884	PATAGONIA	EDNA MINE GROUP	31-21-25N	110-46-07W	W	S	14a
885	PATAGONIA	FOUR METALS MINE	31-23-54N	110-44-14W	CU AG AU PB	S	
886	PATAGONIA	GLADSTONE MINE	31-23-53N	110-45-03W	CU AG AU PB	S	
887	PATAGONIA	GOLDEN ROSE MINE	31-23-21N	110-46-34W	CU MO PB AG	S	
888	PATAGONIA	GOOD LUCK MINE	31-27-54N	110-42-19W	AU AG PB	S	
889	PATAGONIA	GROSS COPPER PROSPECT	31-23-08N	110-46-17W	CU MO	-	
890	PATAGONIA	GUAJOLOTE MINE	31-24-33N	110-44-13W	CU AG AU	S	
891	PATAGONIA	HAIST MINE	31-25-09N	110-43-09W	CU AG AU	S	
892	PATAGONIA	HOMESTAKE MINE	31-25-15N	110-44-32W	CU AG AU PB	S	
893	PATAGONIA	INDIANAPOLIS MINE	31-22-30N	110-42-20W	PB CU	S	19a
894	PATAGONIA	ISABELLA MINE	31-24-06N	110-47-29W	PB MN	-	
895	PATAGONIA	JABALINA MINE	31-24-08N	110-47-24W	PB AG MN	-	
896	PATAGONIA	KANSAS - NEW YORK	31-24- N	110-43- W	PB ZN	M	19a
897	PATAGONIA	MANZANITA MINE	31-22-30N	110-42-58W	ZN PB	S	
898	PATAGONIA	MINNESOTA MINE	31-23-19N	110-45-19W	CU AG	S	
899	PATAGONIA	MOWRY MINE	31-25-42N	110-42-12W	PB AG ZN CU V	S	
900	PATAGONIA	NATIONAL MINE	31-24-33N	110-46-54W	CU AG AU PB	S	
901	PATAGONIA	PAYMASTER MINE	31-24-49N	110-44-29W	CU AG AU PB	S	
902	PATAGONIA	PROTO MINE GROUP	31-24-00N	110-44-58W	CU AG AU PB	S	
903	PATAGONIA	PROVIDENCIA CLAIM	31-23-17N	110-45-52W	CU MO	-	
904	PATAGONIA	RED HILL	31-24- N	110-44- W	MO W CU	-	
905	PATAGONIA	RED RACER	31-23-33N	110-44-06W	MO FE	S	
906	PATAGONIA	ROY MINE	31-25-04N	110-44-13W	CU AG	S	
907	PATAGONIA	ROYAL AND DEER	31-18- N	110-40- W	AG PB CU ZN	S	19a
908	PATAGONIA	SAN ANTONIO MINE	31-22-29N	110-41-31W	ZN PB	S	
909	PATAGONIA	SANTO NINO	31-22- N	110-48- W	MO CU AU	S	
910	PICACHO	GOLD BELL MINE	32-43-08N	111-22-18W	CU	S	37b
911	PICACHO	GREEN MONSTER	32-37-58N	111-23-42W	AU AG CU	S	37b
912	PICACHO	TEPAYOC CLAIM	32-45-33N	111-24-50W	CU	-	37b
913	PICACHO	UNNAMED PROSPECT	32-42-50N	111-24-54W	CU	-	37b
914	PICACHO	UNNAMED PROSPECT	32-42-45N	111-22-58W	CU	-	37b
915	PICACHO	UNNAMED PROSPECT	32-41-20N	111-24-03W	CU	-	
916	PICACHO	UNNAMED PROSPECT	32-50-24N	111-20-15W	CU FE	-	
917	PICACHO	UNNAMED PROSPECT	32-50-22N	111-20-54W	CU	-	
918	PICACHO	UNNAMED PROSPECT	32-50-06N	111-20-16W	CU	-	
919	PICACHO	UNNAMED PROSPECT	32-51-06N	111-20-40W	CU	-	
920	PICACHO	UNNAMED PROSPECT	32-51-54N	111-20-11W	CU	-	

Appendix. Mines & prospects

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921	PICACHO	UNNAMED PROSPECT	32-50-11N	111-19-22W	CU FE	-	
922	PICACHO	UNNAMED PROSPECT	32-50-38N	111-19-33W	CU	-	
923	PICACHO	UNNAMED PROSPECT	32-50-30N	111-19-02W	CU	-	
924	PICACHO	UNNAMED PROSPECT	32-49-36N	111-21-35W	CU	-	37b
925	PICACHO	UNNAMED PROSPECT	32-49-03N	111-21-05W	CU	-	
926	PICACHO	UNNAMED PROSPECT	32-48-21N	111-21-21W	CU	-	
927	PICACHO	UNNAMED PROSPECT	32-45-58N	111-22-56W	CU	-	
928	PICACHO	UNNAMED PROSPECT	32-45-32N	111-23-56W	CU	-	
929	PICACHO	UNNAMED PROSPECT	32-38-32N	111-25-05W	CU	-	
930	PICOCHO	UNNAMED PROSPECT	32-42-07N	111-25-32W	CU	-	
931	PIMA	ABE LINCOLN MINE	31-54-20N	111-11-52W	MO U CU	-	
932	PIMA	ALPHA MINE	31-56-52N	111-06-01W	CU AG	S	21a
933	PIMA	ANNETE MINE	31-57-44N	111-05-31W	AG	S	22c
934	PIMA	ANTELOPE CLAIMS	31-58- N	110-06- W	PB ZN AG	-	
935	PIMA	ARIZONA NO. 3 MINE	31-56-25N	111-07-20W	PB AG	S	22c
936	PIMA	ARMARGOSA ARROYO	31-50-30N	111-07-48W	AU	S	39a
937	PIMA	BULLION PROSPECT	31-53-39N	111-03-02W	CU	-	
938	PIMA	C. W. T. PROPERTY	31-59- N	111-05- W	CU AG	-	
939	PIMA	CONTENTION MINE	31-53-23N	111-04-32W	ZN	S	18c
940	PIMA	COPPER BUTTE MINE	31-53-42N	111-03-56W	CU	S	18b
941	PIMA	COPPER GLANCE	31-53-47N	111-03-14W	CU	S	18a
942	PIMA	COPPER KING MINE	31-53-55N	111-03-35W	ZN CU	S	18a
943	PIMA	COPPER QUEEN MINE	31-53-55N	111-03-27W	CU AG	S	18a
944	PIMA	COWBOY MINE	31-52-20N	111-09-21W	CU	S	21a
945	PIMA	CROWN KING & TIGER	31-51-45N	111-06-21W	PB CU AG	S	22c
946	PIMA	CWT MINE	31-56-27N	111-05-39W	ZN	S	18c
947	PIMA	DAISY MINE	31-59-10N	111-04-38W	CU	M	18a
948	PIMA	DIAMOND HEAD GROUP	31-54-05N	111-12-33W	U CU	-	
949	PIMA	ENGLAND - HILL	32-02-34N	111-06-59W	U TH	-	
950	PIMA	ESCONDIDA CLAIM	31-54-23N	111-12-22W	CU U	-	
951	PIMA	ESPERANZA MINE	31-52-11N	111-07-29W	CU	M	21a
952	PIMA	GLADSTONE PROSPECT	31-53-16N	111-04-52W	CU	-	
953	PIMA	HIGH HILL MINE	31-50-56N	111-08-49W	PB ZN	S	22c
954	PIMA	IRON VEIN	31-56-50N	111-07-09W	CU	-	
955	PIMA	LEADVILLE GROUP	31-54-22N	111-12-26W	CU U	-	
956	PIMA	LONE VALLEY MINE	31-55- N	111-05- W	W	-	14a
957	PIMA	MARCONI MINE	31-52-50N	111-04-11W	ZN PB	S	22c
958	PIMA	MINERAL HILL MINE	31-59-11N	111-05-13W	CU AG	S	18a
959	PIMA	MINNIE MINE	31-53-58N	111-04-10W	CU	S	18a
960	PIMA	MISSION MINE	31-59-36N	111-03-30W	CU MO	M	18a
961	PIMA	NEW YEARS EVE MINE	31-53-17N	111-04-52W	MO U	-	
962	PIMA	OLD POWERS MINE	31-52-39N	111-12-26W	PB	S	
963	PIMA	OLIVETTE MINE	31-57-44N	111-05-40W	AG	S	21a
964	PIMA	PALO VERDE MINE	31-59-52N	111-04-00W	CU AG	S	18a
965	PIMA	PANDORA MINE	31-52-50N	111-04-15W	CU	S	
966	PIMA	PAYMASTER MINE	31-56-44N	111-07-12W	AG PB	M	22c

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967	PIMA	PIMA OPEN PIT MINE	31-59-11N	111-04-21W	CU	L	21a
968	PIMA	PLUMED KNIGHT MINE	31-59-06N	111-05-04W	CU	S	18b
969	PIMA	PROSPERITY MINE	31-57-31N	111-05-56W	PB ZN	S	
970	PIMA	SAN CARLOS GROUP	31-58-11N	111-05-26W	CU PB	-	
971	PIMA	SAN XAVIER EXTENSION	31-58-26N	111-05-45W	CU AG	S	
972	PIMA	SAN XAVIER MINE	31-58-23N	111-05-35W	ZN PB	S	18c
973	PIMA	SAN XAVIER MINE	32-01-39N	111-04-51W	CU	M	21a
974	PIMA	SCORPIO ANNEX CLAIM	31-55- N	111-04-30W	CU PB ZN	-	
975	PIMA	SENATOR MORGAN	31-53-12N	111-04-32W	CU	S	18a
976	PIMA	SIERRITA MINE	31-52-17N	111-08-53W	CU	M	21a
977	PIMA	SILVER HELMET MINE	31-57-53N	111-04-42W	PB AG	S	
978	PIMA	SOUTH SAN XAVIER	31-58-14N	111-06-12W	CU	S	18b
979	PIMA	TIT FOR TAT, HELMET	31-59- N	111-05-10W	PB ZN	-	
980	PIMA	TWIN BUTTES MINE	31-53-22N	111-02-32W	CU	M	18a
981	PIMA	TWO FRIENDS MINE	31-52-17N	111-07-18W	PB AG	S	
982	PIMA	VICTOR MINE	31-50-00N	111-05-00W	AG PB	S	
983	PIMA	VIVIENNE MINE	31-57-06N	111-06-21W	PB	S	19a
984	PIMA	VULCAN MINE	31-58-55N	111-05-39W	CU	S	18a
985	PIMA	WELLINGTON MINE	31-55-13N	111-04-06W	CU	-	
986	PIMA	WEST SAN XAVIER	31-58-15N	111-05-55W	CU	-	
987	PIMA	WHITCOMB MINE	31-57-57N	111-05-30W	PB AG	S	
988	QUERCES	ALFONSO VILLEY	31-20-08N	110-42-39W	CU	-	
989	QUERCES	BENTON MINE	31-20-26N	110-41-40W	CU MO AU	-	
990	QUERCES	LINE BOY MINE	31-20-07N	110-41-27W	CU AG	S	
991	QUERCES	SANTO NINO MINE	31-21-39N	110-43-05W	CU AG	S	
992	QUIEN SABE	BATTLE AXE MINE	32-12-35N	111-03-01W	SIL	S	
993	QUINLAN	BIG BANANA MINE	31-54-31N	111-39-21W	W	S	15a
994	QUINLAN	BIG JUANITA MINE	31-55- N	111-35- W	W	-	15a
995	QUINLAN	BROWN PROSPECT	31-54-52N	111-40-01W	W	S	15a
996	RATTLESNAKE	GOLD MOUNTAIN MINE	32-37-17N	110-21-13W	AU	S	25c
997	RATTLESNAKE	LONG TOM MINE	32-34-37N	110-20-12W	AU AG	S	25c?
998	RATTLESNAKE	POWERS MINE	32-35-34N	110-20-41W	AU	S	25c?
999	RED ROCK	APACHE MINE	32-35-17N	111-07-56W	AG	S	22c
1000	RED ROCK	BLUE BIRD MINE	31-27-53N	110-32-13W	MN	S	Mn pods in volc
1001	RED ROCK	DURHAM COPPER C	31-31-09N	110-39-09W	CU AG	S	
1002	RED ROCK	FRISCO FAIR MINE	31-31-17N	110-38-12W	PB AG	S	22c
1003	RED ROCK	HALE PROSPECT #3	31-30-60N	110-35-00W	CU	-	
1004	RED ROCK	LA PLATA MINE	31-31-28N	110-35-34W	AG CU	S	
1005	RED ROCK	NEW YORK MINE	31-31-35N	110-36-44W	MN AG PB CU	-	
1006	RED ROCK	POWERS PROSPECT	31-23-35N	110-47-23W	FE	S	
1007	REDINGTON	BIG BUG CLAIMS	32-21-09N	110-32-17W	W	-	14a
1008	REDINGTON	CHRISTMAS CLAIM	32-26-56N	110-30-38W	U	-	
1009	REDINGTON	COPPER HILL MIN	32-20-33N	110-31-57W	CU	S	
1010	REDINGTON	HALF MOON #3 PR	32-28-43N	110-30-38W	U	-	
1011	REDINGTON	KORN KOB MINE	32-23-14N	110-34-37W	CU MO W	S	18b
1012	REDINGTON	LUCKY STRIKE CLAIM	32-28- N	110-35- W	V	-	15a

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013	REDINGTON	SURE FIRE NO. 1	32-18-09N	110-29-49W	U CU	-	
014	REDINGTON	UNNAMED PROSPECT	32-17-52N	110-29-58W	F	-	
015	REDINGTON	UNNAMED PROSPECT	32-18-45N	110-29-21W	CU	-	18b
016	REDINGTON	VAN HILL CLAIMS	32-18-01N	110-29-46W	U CU	-	
017	REEF	LUCKY DAY GP.	31-28-56N	110-25-59W	W AU	S	14a
018	REEF	LUCKY STRIKE MINE	31-27-49N	110-19-01W	W PB	S	15a
019	REEF	REEF MINE	31-25-37N	110-17-16W	W AU	S	14a
020	REEF	VAN HORN MINE	31-23-41N	110-21-03W	W	S	14a
021	REEF	VICTORY TUNGSTEN	31-26- N	110-18- W	W	-	15a
022	RINCON	AQUA VERDE MINE	32-02-32N	110-38-08W	CU AG	S	
023	RINCON	DOLLAR BILL CLAIM	32-06-50N	110-28-29W	U NB TA	-	pegmalite
024	RINCON	HEAVY BOY PROSPECT	32-03-36N	110-37-37W	BA	-	31b
025	RINCON	RED HILS CLAIMS	32-04-00N	110-38-16W	U	-	
026	RIPSEY	CROW CLAIMS	32-57-38N	110-57-42W	CU	-	
027	RIPSEY	NEW DAWN CLAIMS	32-58-57N	110-59-57W	CU	-	
028	RIPSEY	SILVER KING MINE	32-58-06N	110-52-14W	CU	-	
029	RIPSEY	UNNAMED PROSPECT	32-59-40N	110-59-19W	CU	S	
030	RIPSEY	UNNAMED PROSPECT	32-54-04N	111-03-57W	CU	-	
031	ROSKRUGE	ROXANNE 1-6 MINE	32-17-02N	111-26-07W	CU AG	S	22c
032	ROSKRUGE	ST. JUDE MINE	32-07-14N	111-27-11W	AG	S	
033	SADDLE MOUNTAIN	LITTLE TREASURE	33-00- N	110-50- W	AG PB CU AU	S	22c
034	SAGINAW HILL	ARIZONA-TONOPAH	32-08-48N	111-02-51W	CU PB	S	
035	SAGINAW HILL	IVY MAY MINE	32-08-23N	111-02-59W	CU	S	22c
036	SALERO	ALTO VEIN SWARM	31-36-41N	110-51-40W	PB AG	S	22c
037	SALERO	JEFFERSON MINE	31-35-54N	110-51-26W	PB AG	S	
038	SALERO	MOHAWK MINE	31-34-34N	110-50-14W	PB AG	-	22c
039	SALERO	TYNDALL PLACERS	31-33-33N	110-52-51W	AU	S	39a
040	SAN CAYETO	TUBUTANA MINE	31-31-27N	110-58-04W	CU AG	S	22c
041	SAN CAYETO	WISE PROSPECT	31-31-57N	110-56-54W	AG CU	-	25C
042	SAN JUAN	SAN JUAN	31-55- N	111-35- W	W	-	14a
043	SAN MANUEL	SAN MANUEL-KALAMAZOO	32-41-45N	110-41-20W	CU	L	21a
044	SAN PEDRO	BLACK HILLS GROUPS	32-32-36N	110-32-35W	V PB W AG	-	
045	SAN PEDRO	BRANCH MANGANESE	32-49-26N	110-44-48W	MN	S	
046	SAN PEDRO	MOGUL GROUP	32-48-34N	110-44-37W	MN	-	
047	SANTA CATALINA	CATALINA GROUP	32-28-49N	110-45-19W	CU AG AU W	-	
048	SANTA ROSA	LA FORTUNA MINE	32-21-10N	111-54-01W	CU	S	
049	SAWTOOTH	BLACK JEWEL CLAIM	32-43-38N	111-46-38W	MN	S	25g
050	SAWTOOTH	BLACK PRINCE NO 1	32-43-37N	111-46-40W	MN	S	
051	SAWTOOTH	EYER MANGANESE	32-36-25N	111-44-07W	MN	-	
052	SAWTOOTH	POINTING CACTUS	32-37-56N	111-44-23W	MN	S	
053	SAWTOOTH	TELLER CLAIM	32-38-43N	111-45-56W	MN	S	
054	SEDIMENTARY HILLS	SILVER FLOWER MINE	32-11-26N	111-07-22W	CU	S	
055	SIERRITA	SUNSHINE MINE	31-58- N	111-14-30W	PB AG	S	18c
056	SILVER BELL	ATLAS MINE	32-25-47N	111-32-48W	ZN CU	M	18a
057	SILVER BELL	COYOTE CLAIM -	32-01- N	111-30- W	CU	-	
058	SILVER BELL	EL TIRO OPEN PIT	32-24-58N	111-32-13W	CU	L	18a/18b

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1059	SILVER BELL	FRANCO RIQUEZA	32-27-04N	111-30-07W	CU	S	
1060	SILVER BELL	GRAND MOGUL MINE	32-27-57N	111-32-32W	PB	S	19a
1061	SILVER BELL	HOMESTAK INDIAN	32-30- N	111-30- W	CU AG AU PB	S	18b
1062	SILVER BELL	MAGONIGAL MINE	32-25-32N	111-37-35W	CU	S	18a
1063	SILVER BELL	MAMMOTH MINE	32-24-52N	111-31-45W	CU AG	S	
1064	SILVER BELL	NEW HOPE MINE	32-18-16N	111-32-34W	CU	S	18b
1065	SILVER BELL	NORTH SILVER BELL	32-26-27N	111-31-57W	CU	S	
1066	SILVER BELL	OXIDE MINE	32-23-49N	111-30-07W	CU AG	M	18b or 18a
1067	SILVER BELL	RAMERO RANCH	32-19-39N	111-30-19W	CU AU	S	
1068	SILVER BELL	SCOTT CLAIMS	32-36-36N	111-31-55W	CU PB ZN W F	-	
1069	SILVER BELL	SILVER BELL PROSPECT	32-25-13N	111-32-25W	CU	L	21a
1070	SILVER BELL	SILVER LEAD MINE	32-26-16N	111-32-18W	PB ZN	S	
1071	SILVER BELL	SUNSET CLAIMS	32-25-43N	111-38-00W	CU MN	-	
1072	SILVER BELL	SUNSET GROUP	32-25-40N	111-37-55W	MN	S	
1073	SILVER BELL	UNNAMED PROSPECT	32-22-38N	111-30-37W	CU	-	
1074	SILVER BELL	UNNAMED PROSPECT	32-26-09N	111-31-47W	CU	-	
1075	SILVER BELL	UNNAMED PROSPECT	32-26-08N	111-31-55W	CU MO	-	
1076	SILVER BELL	UNNAMED PROSPECT	32-26-09N	111-32-09W	CU	S	
1077	SILVER BELL	UNNAMED PROSPECT	32-25-51N	111-31-43W	CU	-	
1078	SILVER BELL	UNNAMED PROSPECT	32-25-50N	111-32-02W	CU	-	
1079	SILVER BELL	UNNAMED PROSPECT	32-25-38N	111-31-49W	CU	-	
1080	SILVER BELL	UNNAMED PROSPECT	32-25-35N	111-31-53W	CU	-	
1081	SILVER BELL	UNNAMED PROSPECT	32-25-24N	111-32-32W	CU	-	
1082	SILVER BELL	UNNAMED PROSPECT	32-23-32N	111-31-37W	CU	-	
1083	SILVER BELL	UNNAMED PROSPECT	32-26-09N	111-32-46W	CU MO	-	
1084	SILVER BELL	UNNAMED PROSPECT	32-25-59N	111-32-38W	CU	-	
1085	SILVER BELL	UNNAMED PROSPECT	32-22-49N	111-31-01W	CU	-	
1086	SILVER BELL	UNNAMED PROSPECT	32-23-23N	111-31-09W	CU	-	
1087	SILVER BELL	UNNAMED PROSPECT	32-23-30N	111-31-42W	CU	-	
1088	SILVER BELL	UNNAMED PROSPECT	32-23-45N	111-32-22W	CU	-	
1089	SILVER BELL	UNNAMED PROSPECT	32-23-42N	111-32-14W	CU	-	
1090	SILVER BELL	UNNAMED PROSPECT	32-24-44N	111-33-19W	CU	-	
1091	SILVER BELL	UNNAMED PROSPECT	32-24-27N	111-33-23W	CU	-	18a
1092	SILVER BELL	UNNAMED PROSPECT	32-25-22N	111-33-13W	CU	-	
1093	SILVER BELL	UNNAMED PROSPECT	32-25-39N	111-32-57W	CU	-	
1094	SILVER BELL	UNNAMED PROSPECT	32-25-56N	111-34-18W	CU	-	
1095	SILVER BELL	UNNAMED PROSPECT	32-26-34N	111-36-00W	CU	-	
1096	SILVER BELL	UNNAMED PROSPECT	32-26-38N	111-35-56W	CU	-	
1097	SILVER BELL	UNNAMED PROSPECT	32-26-53N	111-35-55W	CU	-	
1098	SILVER BELL	UNNAMED PROSPECT	32-25-52N	111-30-56W	BA PB	-	
1099	SILVER BELL	UNNAMED PROSPECT	32-26-22N	111-30-55W	CU	-	
1100	SILVER BELL	UNNAMED PROSPECT	32-28-02N	111-30-34W	CU	-	
1101	SILVER BELL	UNNAMED PROSPECT	32-28-52N	111-30-17W	MN	-	
1102	SILVER BELL	UNNAMED PROSPECT	32-27-05N	111-32-02W	CU PB ZN	-	
1103	SILVER BELL	UNNAMED PROSPECT	32-26-60N	111-32-11W	CU	-	
1104	SILVER BELL	UNNAMED PROSPECT	32-22-46N	111-30-35W	CU	-	

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105	SILVER BELL	UNNAMED PROSPECT	32-23-09N	111-30-39W	AU	S	
106	SILVER BELL	UNNAMED PROSPECT	32-22-39N	111-30-19W	CU	-	
107	SILVER BELL	UNNAMED PROSPECT	32-25-49N	111-34-55W	CU	-	
108	SILVER BELL	UNNAMED PROSPECT	32-26-27N	111-35-10W		-	
109	SILVER BELL	UNNAMED PROSPECT	32-26-52N	111-30-40W	CU	-	
110	SILVER BELL	UNNAMED PROSPECT	32-26-52N	111-30-47W	CU	-	
111	SILVER BELL	UNNAMED PROSPECT	32-25-21N	111-30-26W	CU	-	
112	SILVER BELL	UNNAMED PROSPECT	32-26-22N	111-32-32W	CU MO	-	
113	SILVER BELL	UNNAMED PROSPECT	32-27-22N	111-33-10W	CU	-	
114	SILVER BELL	UNNAMED PROSPECT	32-28-25N	111-32-26W	PB CU ZN	-	22c
115	SILVER BELL	UNNAMED PROSPECT	32-27-20N	111-31-50W	PB CU ZN AG	-	
116	SILVER BELL	UNNAMED PROSPECT	32-27-38N	111-32-13W	W V	S	
117	SILVER BELL	UNNAMED PROSPECT	32-27-50N	111-30-44W	CU	-	
118	SILVER BELL	UNNAMED PROSPECT	32-27-38N	111-38-12W	CU	-	
119	SILVER BELL	UNNAMED PROSPECT	32-25-40N	111-37-55W	CU	-	21a
120	SILVER BELL	UNNAMED PROSPECT	32-25-52N	111-38-23W	CU	-	18b
121	SILVER REEF	COPPER STANDARD	32-42-29N	111-47-42W	CU	S	
122	SILVER REEF	M &M GROUP	32-39-57N	111-50-16W	PERLITE U	-	
123	SILVER REEF	OLD JONAH MINE	32-42-51N	111-47-53W	CU	S	
124	SILVER REEF	SILVER REEF MINE	32-40-05N	111-49-03W	AG	S	
125	SILVER REEF	UNNAMED PROSPECT	32-43-43N	111-47-05W	MN	-	
126	SLATE	CAMINO MINE	32-34-58N	111-54-30W	PB	S	19a
127	SLATE	DESERT QUEEN MINE	32-36-19N	111-53-37W	AG	S	19a
128	SLATE	JACKRABBIT MINE	32-36-23N	111-53-26W	AG	S	19a
129	SLATE	MAMMON MINE	32-32-38N	111-54-40W	AU	S	
130	SLATE	ORIZABA MINE	32-37-11N	111-54-42W	AG PB	S	
131	SLATE	PICO MINE	32-37-25N	111-54-51W	AG	S	
132	SLATE	TURNING POINT MINE	32-35-60N	111-53-45W	AG PB	S	19a
133	SUMMIT	GIBSON MINE	32-20-03N	110-56-30W	CU	S	
134	SUMMIT	SWEDE MINE	32-21-40N	110-59-30W	W	S	15a
135	SWINGLE	SWINGLE CLAIMS	32-48-28N	110-31-08W	MN FE	S	19b
136	TABLE MOUNTAIN	CLAYSHULTE MINE	32-50- N	110-30- W	MN	-	19b
137	TABLE MOUNTAIN	TABLE MOUNTAIN	32-49-01N	110-29-07W	CU AG A	S	26a
138	TOMBSTONE	71 MINERALS DUMP	31-42-10N	110-03-34W	AG AU	S	
139	TOMBSTONE	ALKIE MINE	31-37-52N	110-09-04W	PB CU	S	
140	TOMBSTONE	ANCHOR MINE	31-41-39N	110-04-19W	MN AG	S	
141	TOMBSTONE	ARGENTA MINE	31-41-47N	110-06-32W	CU PB	S	
142	TOMBSTONE	ARIZONA QUEEN MINE	31-42-03N	110-03-45W	AG PB	S	
143	TOMBSTONE	ARLINGTON MINE	31-38-44N	110-06-57W	PB CU	S	
144	TOMBSTONE	BALD EAGLE MINE	31-39-30N	110-08-49W	PB AG	S	
145	TOMBSTONE	BLACKTAIL MINE	31-41-17N	110-03-53W	MN AG	S	
146	TOMBSTONE	BONANZA MINE GROUP	31-41-58N	110-06-26W	AG PB	S	
147	TOMBSTONE	BUNKER HILL MINE	31-41-27N	110-03-47W	AG PB MN	S	19a
148	TOMBSTONE	CARPER SHAFT	31-41-49N	110-02-46W	PB	S	22c
149	TOMBSTONE	CHANCE MINE	31-41-40N	110-05-48W	AG AU	S	
150	TOMBSTONE	CHARLESTON LEAD	31-39-26N	110-09-16W	PB ZN	S	22c

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151	TOMBSTONE	COMET AND BLACK EAGLE	31-41-06N	110-03-43W	MN AG PB	S	19b
152	TOMBSTONE	CONTACT MINE	31-41-29N	110-05-11W	MN	S	
153	TOMBSTONE	CONTENTION MINE	31-42-05N	110-03-47W	AG PB	M	19a/22c
154	TOMBSTONE	DEFENSE MINE	31-42-28N	110-04-05W	AG PB	S	
155	TOMBSTONE	DRY HILL MINE	31-41-30N	110-05-20W	AG MN	S	
156	TOMBSTONE	EAGLE ROOST MINE	31-41-01N	110-04-23W	MN AG	S	
157	TOMBSTONE	EAST SIDE MINE	31-41-58N	110-04-30W	AG MN	S	
158	TOMBSTONE	EMERALD MINE	31-41-20N	110-04-08W	AG PB ZN CU	M	19a
159	TOMBSTONE	EMPIRE MINE	31-42-27N	110-03-40W	AG PB CU ZN	S	19a
160	TOMBSTONE	FLORIDA MINE GROUP	31-39-08N	110-07-10W	MN	S	
161	TOMBSTONE	FREE COINAGE MINE	31-42-04N	110-06-12W	AG AU	S	
162	TOMBSTONE	GALLAGHER VANADIUM	31-35- N	110-11- W	V PB ZN CU	S	
163	TOMBSTONE	GALVEZ MINE	31-40-27N	110-05-26W	PB CU AG AU	S	19a
164	TOMBSTONE	GOODENOUGH MINE	31-42-38N	110-04-06W	AG PB AU	S	19a
165	TOMBSTONE	GRAND CENTRAL MINE	31-42-09N	110-03-44W	AG AU PB CU	L	19a/Au skarn?
166	TOMBSTONE	GROUND HOG MINE	31-40-27N	110-05-26W	AG	S	
167	TOMBSTONE	HAWK EYE MINE	31-42-29N	110-04-09W	AG PB AU	S	19a
168	TOMBSTONE	HERSCHEL MINE	31-42-17N	110-04-21W	AG PB AU CU	S	19a
169	TOMBSTONE	INGERSOL MINE	31-42-16N	110-04-16W	PB AG	-	
170	TOMBSTONE	INTERVENER MINE	31-42-27N	110-04-08W	AG PB AU	S	19a
171	TOMBSTONE	LUCK SURE MINE	31-41-49N	110-04-30W	AG MN AU PB	S	19b
172	TOMBSTONE	LUCKY CUSS, ESCONDIDO	31-42-04N	110-04-27W	AG MN AU PB	S	19b
173	TOMBSTONE	MAMIE MINE	31-41-47N	110-06-24W	AG	S	22c
174	TOMBSTONE	MANGANESE SILVER	31-41-11N	110-04-14W	CU AG AU MN	S	19a
175	TOMBSTONE	MANILA MINE	31-38-43N	110-08-50W	PB AU	S	
176	TOMBSTONE	MERRIMAC MINE	31-42-17N	110-06-14W	AG AU	S	
177	TOMBSTONE	MILDRED ET AL CLAIMS	31-44- N	110-05- W	AU AG	-	
178	TOMBSTONE	MONTEZUMA MINE	31-41-28N	110-06-53W	AG AU	S	22c
179	TOMBSTONE	MORNING STAR MINE	31-41-36N	110-03-09W	PB AG AU CU	S	19a
180	TOMBSTONE	MUSTANG MINE	31-39-55N	110-08-32W	PB AG	S	
181	TOMBSTONE	OLD GUARD MINE	31-42-11N	110-04-25W	AG AU	S	19a/Au skarn?
182	TOMBSTONE	OREGON-PROMPTER	31-41-34N	110-04-43W	AG MN AU	S	19b
183	TOMBSTONE	OWL'S NEST MINE	31-42-04N	110-04-27W	AG PB	S	19a
184	TOMBSTONE	PLAIN VIEW MINE	31-41-20N	110-04-08W	MN AG	S	19b
185	TOMBSTONE	QUARTZITE MINE	31-40-29N	110-04-46W	AU AG	S	
186	TOMBSTONE	RANDOLPH MINE	31-41-26N	110-06-42W	AG	S	
187	TOMBSTONE	ROCKY BAR MINE	31-41-15N	110-05-23W	MN AG CU AU	S	19b/18b
188	TOMBSTONE	SAILOR MINE	31-41-39N	110-05-47W	AG	S	
189	TOMBSTONE	SAN DIEGO MINE	31-41-41N	110-02-43W	PB	S	
190	TOMBSTONE	SAN PEDRO MINE	31-42-13N	110-06-49W	AG AU MN CU	S	
191	TOMBSTONE	SIDEWHEEL MINE	31-41-02N	110-04-18W	MN AG	S	
192	TOMBSTONE	SILVER PLUME MINE	31-41-11N	110-04-13W	PB AG	S	19a
193	TOMBSTONE	SILVER THREAD	31-42-29N	110-03-33W	PB AG	S	19a
194	TOMBSTONE	STATE OF MAINE	31-41-57N	110-06-54W	AG AU MN CU	M	19a
195	TOMBSTONE	SULPHURET MINE	31-42-28N	110-04-15W	AG PB	S	
196	TOMBSTONE	SUNSET MINE	31-41-15N	110-05-10W	AG PB MN CU	S	

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197	TOMBSTONE	TELEPHONE MINE	31-41-35N	110-04-09W	AG MN	S	
198	TOMBSTONE	TOMBSTONE EXTENSION	31-41-49N	110-02-48W	PB AG AU V	M	19a
199	TOMBSTONE	TOUGHNUT MINE	31-42- N	110-04- W	AG CU PB ZN	S	
200	TOMBSTONE	TRANQUILITY SHAFT	31-42-28N	110-03-44W	AG PB	S	22c
201	TOMBSTONE	TRIBUTE MINE	31-42-09N	110-04-09W	PB AG	S	22c
202	TOMBSTONE	VIZINA LODE	31-42-42N	110-04-01W	AG PB	-	19a
203	TOMBSTONE	WAY UP MINE	31-42-34N	110-03-53W	AG PB AU	S	
204	TOMBSTONE	WEST SIDE MINE	31-42-25N	110-03-60W	PB AG	S	
205	TUSCON MOUNTAIN	OLD YUMA	32-14- N	111-07- W	V PB ZN CU	-	
206	TYNDALL	BLUE LEAD MINE	31-33-44N	110-48-52W	PB AG	S	
207	TYNDALL	BOWLING GREEN MINE	31-35-38N	110-50-27W	PB AG	S	22c
208	TYNDALL	ELEPHANT HEAD GROUP	31-42-36N	110-55-26W	CU PB MO AG	S	
209	TYNDALL	ELLEN DELLA MINE	31-33-46N	110-47-40W	CU	-	
210	TYNDALL	FLORIDA MINE	31-36-45N	110-51-47W	CU PB	S	22c
211	TYNDALL	GLOVE MINE GROUP	31-39-35N	110-56-47W	PB ZN	S	19a
212	TYNDALL	GOOD LUCK MINE	31-41-28N	110-55-34W	PB AU	S	
213	TYNDALL	JESUIT MINE	31-36-35N	110-52-06W	AG PB	S	
214	TYNDALL	LEE MINE	31-36-19N	110-50-33W	CU PB	S	
215	TYNDALL	SAN RAMON MINE	31-37-01N	110-51-28W	PB AG	S	
216	TYNDALL	TIAJUANA PROSPE	31-40-07N	110-52-23W	ZN PB CU AG	S	
217	UNKNOWN	DUTCHESS CLAIM	32-07-30N	111-02-12W	U	-	
218	UNKNOWN	UNION PLASTER CLAIM	32-55- N	110-43- W	GYP	-	
219	UNKNOWN	UNNAMED PROSPECT	32-37- N	111-45- W	MN	-	
220	UNKNOWN	UNNAMED PROSPECT	31-37-24N	111-08-55W	CU	-	
221	UNKNOWN	UNNAMED PROSPECT	32-14-58N	110-22-24W	MO W	-	
222	UNKNOWN	UNNAMED PROSPECT	32-22-33N	110-17-44W	CU	-	
223	UNKNOWN	UNNAMED SHAFT	31-41-54N	111-07-24W	FE	-	
224	UNKNOWN	VENTURA	31-27- N	110-46- W	MO CU	-	
225	WASHINGTON CAMP	BELMONT MINE	31-22-05N	110-41-44W	ZN PB	S	18c
226	WASHINGTON CAMP	BONANZA MINE	31-22-23N	110-41-11W	CU ZN PB AG	S	18b
227	WASHINGTON CAMP	HOLLAND MINE	31-22-14N	110-41-44W	ZN PB AG CU	S	19a
228	WASHINGTON CAMP	ILLINOIS MINE	31-22-14N	110-41-14W	ZN CU	S	18c
229	WASHINGTON CAMP	LANGLEY MINE	31-23-02N	110-41-17	PB	S	
230	WASHINGTON CAMP	MAINE MINE	31-23-03N	110-42-02W	ZN CU	S	18c
231	WASHINGTON CAMP	MARY JANE MINE	31-22-10N	110-41-38W	PB ZN	S	
232	WASHINGTON CAMP	NEW YORK MINE	31-22-54N	110-41-38W	PB ZN	S	19a
233	WASHINGTON CAMP	O'CONNOR PROSPECT	31-22-08N	110-42-10W	PB CU	-	
234	WASHINGTON CAMP	SIMPLOT MINE	31-23-09N	110-41-55W	ZN CU PB AG	-	19a
235	WATERMAN	CARLO & ECLIPSE	32-19-37N	111-29-35W	CU AG	S	22c
236	WATERMAN	INDIANA-ARIZONA	32-21-21N	111-28-42W	PB ZN	S	18b
237	WATERMAN	PENNY AND PENNY	32-18-47N	111-26-33W	CU	S	
238	WATERMAN	SILVER HILL MINE	32-20-52N	111-28-19W	CU AG	S	22c
239	WATERMAN	UNNAMED PROSPECT	32-21-37N	111-33-55W	CU	-	
240	WATERMAN	UNNAMED PROSPECT	32-18-00N	111-31-05W	CU	-	
241	WATERMAN	UNNAMED PROSPECT	32-17-39N	111-30-50W	CU	-	
242	WATERMAN	UNNAMED PROSPECT	32-17-31N	111-30-50W	MN	-	

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243	WATERMAN	UNNAMED PROSPECT	32-17-58N	111-30-39W	CU ZN	-	
244	WATERMAN	UNNAMED PROSPECT	32-19-50N	111-30-22W	CU	-	
245	WATERMAN	UNNAMED PROSPECT	32-19-42N	111-30-18W	CU	-	
246	WATERMAN	UNNAMED PROSPECT	32-19-55N	111-30-19W	CU	-	
247	WATERMAN	UNNAMED PROSPECT	32-19-55N	111-30-07W	CU	-	
248	WATERMAN	UNNAMED PROSPECT	32-20-03N	111-30-06W	CU PB	-	
249	WATERMAN	UNNAMED PROSPECT	32-20-48N	111-30-10W	CU	-	
250	WHETSTONE	CHADWICK(CONLIG)	31-50-08N	110-22-10W	W	S	15a
251	WHETSTONE	EVENING STAR MINE	31-50-15N	110-22-16W	W	S	15a
252	WHETSTONE	JAMES MINE	31-50-23N	110-23-03W	W	S	15a
253	WHETSTONE	LONE STAR FLUOR	31-51- N	110-21- W	F	S	CaF vein
254	WHETSTONE	SAN JUAN MINE	31-50- N	110-23- W	W	S	15a
255	WHETSTONE	STAR NO. 1 MINE	31-47- N	110-25- W	U	S	U veins
256	WINCHESTER	HEARST GROUP	32-14-55N	110-01-14W	CU AG	-	26a?
257	WINCHESTER	UNNAMED PROSPECT	32-17-06N	110-02-35W	AG PB	-	
258	WINCHESTER	UNNAMED PROSPECT	32-15-56N	110-02-00W	CU	-	
259	WOOLEY	UNNAMED PROSPECT	32-59-49N	111-06-53W	CU	-	
260	WOOLEY	UNNAMED PROSPECT	32-58-35N	111-08-44W	CU	-	
261	WRIGHTSON	CONNECTICUT MINE	31-39-37N	110-52-05W	CU PB	S	
262	YELLOW JACKET	LITTLE DOE MINE	31-30-01N	111-20-23W	PB AG CU	S	25c
263	YELLOW JACKET	OSTRICH MINE	31-29-30N	111-18-29W	AU AG	S	
264	YELLOW JACKET	YELLOW JACKET MINE	31-29-49N	111-18-53W	AU	S	
265	YELLOWSTONE	AMERICAN MINE	32-12-53N	110-14-53W	PB CU	S	
266	YELLOWSTONE	SAN JOSE PROSPECT	32-08-35N	110-14-38W	CU PB	S	
267	YELLOWSTONE	TIP TOP #1 PROSPECT	32-06-49N	110-12-45W	CU	-	18b
268	YELLOWSTONE	UNNAMED PROSPECT	32-06-48N	110-11-10W	CU	-	
269	YELLOWSTONE	UNNAMED PROSPECT	32-14-58N	110-15-24W	CU	S	
270	ZIG ZAG	UNNAMED PROSPECT	32-57-49N	111-14-23W	CU	-	
271	ZIG ZAG	ZIG ZAG GROUP	32-54-41N	111-15-13W	MN	S	