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DOME ROCK DISTRICT

Location:

This district is located in La Paz County west of the community of Quartzite. We have arbitrarily designated the area to be that between the Colorado Indian Reservation on the north and the Yuma Proving Grounds on the south. Our boundaries take in the La Paz, Middle Camp, Oro Fino and La Cholla districts of Keith (1978). Most of these mineralized areas fall within the Dome Rock Mountains located in T3, 4 and 5N and R20, 21W. U.S. Interstate 10 from Quartzite to Blythe passes east-west through the central part of the district.

Geology and History:

The geologic setting of the district can be summarized briefly as consisting of Mesozoic sedimentary and metamorphic rocks that are intruded by one large Jurassic pluton and a number of smaller Laramide or mid-Tertiary intrusive bodies. Although not shown on the Yuma County geologic map (Wilson, 1960), there are small outcrops of probable Paleozoic rocks such as in the Boyer Gap area northwest of Quartzite (Rehrig, unpubl. field notes). Generally, these rocks have been so tectonized, attenuated and metamorphosed that their age designations are most difficult to determine.

The Mesozoic rocks are mainly metamorphosed, poorly sorted, lithic-rich sandstones, siltstones and conglomerates correlated tentatively to the McCoy Mountains Formation of eastern California and the Livington Hills Formation of the southern Plomosa Mountains, Arizona (Tosdel, 1982). This terrigenous section rests depositionally (?) and is partially interstratified with siliceous to intermediate metavolcanic rocks common to the northern part of the Dome Rock Mountains (Crowl, 1979). These volcanics have been dated as early to middle Jurassic age (L. Silver <u>in</u> Crowl, 1979).

The largest pluton in the district is the Middle Camp quartz monzonite, a 160 m.y. old, coarse-grained, porphyritic body with leucogranite phases. This body makes highly irregular, complex and metasomatic contacts with metamorphic host rocks.

All rocks older than the undeformed Diablo quartz monzonite plutons are deformed tectonically (Crowl, 1979). There is a rumored 85 m.y. date on this pluton. A pervasive cleavage or structural foliation is discordantly developed to varying degrees through the Jurassic sediments, volcanics and plutons. It trends WNW and dips shallowly northward. Although details are lacking because of insufficient mapping, it is suspected that major internal thrusts and isoclinal folds exist in the range and that a picture as complex as that mapped by Miller (1970) in the neighboring Plomosa range will emerge in the Dome Rocks as well.

A variety of mineral occurrences have been prospected in the Dome Rock district. These include numerous, small gold-quartz showings; extensive shallow placer gold deposits, a large advanced argillic alteration area containing shows of molybdenum, tin and tungsten, a porphyry copper prospect, small scattered copper prospects, and occurrences of mercury, lead, magnetite and specular hematite. The overall distribution of gold mineralization and placer gold deposits to be crudely marginal to the large Middle Camp quartz monzonite suggests a possible genetic tie to Jurassic plutonism. Additionally, early reports by Jones (1916) mention a predominance of gold-quartz veining in the La Paz subdistrict restricted to the lower, metavolcanic rocks (i.e. the quartz-albite schist of Crowl, 1979). Veining is concordant with metamorphic foliation (EW to WNW strikes) and is also cross cutting (~N-S strike). The concordant veins are the largest and most persistent. Even exotic, non-metallic occurrences such as kyanite, dumortierite, andalucite and sillimanite are reported from Mesozoic sediments at several localities. These characteristics suggest to us a strong influence of lithologic control or stratibound effects on metallization. All in all the geologic setting characterized by Jurassic plutonism, stratibound-like gold and alumino-silicate alteration appears much like that in the Cargo Muchacho Mtns. of southeastern California where three large gold discoveries have been developed.

The two major placer gold operations, the Farrar Gulch (T4N, R21W, Sec. 36) and La Paz Wash workings (T4N, R20W, Sec. 26), together produced over 100,000 oz gold; largely prior to 1900. This large placer production plus the numerous smaller workings throughout the district emphasize the overall favorability of the area. The interesting mercury-bearing prospects around a locality called Cinnabar at the southern end of the Dome Rock range is also described with this district.

Mines of Interest:

Apache mine (T6N, R21W, Sec. 35, Colorado River Indian Reservation) Gold-silver in lensing quartz vein cutting Mesozoic metasediments intruded by rhyolite plug. Produced very high grade gold (330 tons of 2.4 opt), but probably low tonnage potential. Added negative factor is location on reservation ground.

Darling mine (T5N, R20W, Sec. 33) Weak copper and pockets of scheelite associated with contact metamorphism (?)(epidote, calcite, biotite, quartz) along a sheared contact between carbonate and dark, micaceous schist. Mineralization may also be of the stratiform type. Gold is mentioned as occurring with the mineralization but no assays or production are mentioned. The Tungsten Hill mine nearby (T5N, R20W, Sec. 27) also produced scheelite (4000+ tons of 0.4% WO_3) from a garnetized, epidote-bearing tactite zone along a schist-limestone contact. Numerous quartz veins cut the mineralized zone.

The Goodman mine group (T4N, R21W, Secs. 23-25) Reported as the richest gold deposit in the Dome Rock region, the Goodman workings span 2 to 3 miles along a WNW strike. Production was from a long, lensing, massive (1 to 40 ft thick) quartz vein in a north-dipping shear zone cutting mylonitized Middle Camp quartz monzonite. Mineralization is spotty free gold, auriferous pyrite and minor copper-lead. Strong epidote is mentioned as well as rare earths. The occurrence is said to be the source for the large placer deposits in La Paz Wash (T4N, R20W, Sec. 26) and Farrar Gulch (T4N, R21W, Sec. 36). The Goodman workings produced some 11,000 tons of ore that averaged 0.33 opt Au and 0.02 opt Ag. Copper was not recovered.

Maraquitta mine (T4N, R20W, Sec. 22) Gold and silver with minor base metals occurs in a lensing quartz vein (N20°W, 20° NE dip) cutting considerably altered Middle Camp and Diablo quartz monzonite plutons. Host of mineralization at the mine is quartz mica schist.

Strong chlorite, epidote and sericitization are mentioned in the mineralized area. Where the productive quartz zone is hosted by metasediments, it fills a possible thrust that is fault nearly conformable to bedding foliation. The mine produced some 180 tons of one averaging about 0.6 opt Au and 0.3 opt Ag. Scheelite was reported.

Note that the Oro Fino placers just south of the mine (T4N, R20W, Sec. 27) produced about 6,000 oz Au. The adjacent Middle Camp placers (T4N, R20W, Secs. 21 & 28) also produced about 6,000 oz Au. The source of the placer gold is said to be numerous small gold-bearing veins and stringers on Middle Camp Mountain.

Julian mine group (T4N, R19W, Sec. 30) Gold-silver and minor base metals in multiple veins and stringers along fracture zones in Jurassic granite with pegmatite dikes. Produced about 350 tons of 0.55 opt Au material.

Sugarloaf Peak area (T3N, R20W, Sec. 3) Centered over several square miles surrounding Sugarloaf Peak is an area of intense hydrothermal alteration (sericite, argillization, alunite). The altered zone appears to be suddenly faulted off to the south and southwest of the peak; and to the north and northwest, it extends nearly to the interstate highway. The property has attracted much modern exploration interest starting as a moly porphyry play by Congdon and Carey in the 1960's. Most recently the property is under option from Westworld Resources of Houston to Amselco. Although numerous high-level geochemical anomalies (Pb, Mo, Bi, W, Tl) are reported over the altered area, drilling and trenching have thus far failed to delineate any economic mineralization. Anomalous geochemistry at the surface typically disappears within 50 ft of depth suggesting mechanical or chemical enrichment in oxidized rocks. On Sugarloaf Peak and adjacent hills where the alteration is most intense, a silicified felsic rock occurs which looks like either erosional remnants of a rhyolite flow or shallow intrusive plugs. Although the felsite occurs within an overall area of bleached, argillized and pyritic Mesozoic metasediments and could be interstratified with them, it is possible that the felsite represents a shallow Tertiary subvolcanic hot springs system having little to do with the gold-dominated Mesozoic mineralization elsewhere in the district (Rehrig, unpubl. field notes).

In Section 4, T3N, R20W, a property called the Leadville (Hartsif) is described as an 80 by 150 ft elliptical gossan containing disseminated galena and rhyolite. Ore running 6% to 17% Pb, about 5% Bi and .18% tin. Deposits believed hosted in felsic breccia or tuffaceous pipe.

Copper Bottom, Yellow Dog, and Yum Yum mine area (T3N, R20W, Secs. 23, 28, 14 & 15) The mines and prospects occur in the La Cholla mining district of Keith, 1978, in which he describes numerous quartz veins and stringers carrying gold, copper and silver. Crowl (1979) notes a syngenetic character at least for the copper, which is apparently restricted to the noses of folds within certain stratigraphic horizons of the Mesozoic metasedimentary sequence. Bedding plane quartz-copper-gold veinlets are mentioned at the Yum Yum deposit. The Copper Bottom produced about 100 tons of 19% Cu, 1.6 opt Au and 27 opt Ag ore. The Yum Yum property yielded 176 tons of 1 opt Au and 0.2 opt Ag.

Note that in this area the La Cholla placer deposits produced some 9,500 oz Au and 900 oz Ag.

Cinnabar mine area (T2N, R20W, Sec. 3) Although this area, located in the southern Dome Rock Mountains about 8 miles southwest of Quartzite, is within the Yuma Proving Grounds, it is of sufficient interest to describe as part of the Dome Rock district. The old Cinnabar mine worked a N47°-55°W near vertical fault zone in highly brecciated Mesozoic metavolcanic rocks. Parallel fault strands widen the main vein from about a foot to several feet. In addition to disseminated cinnabar, copper carbonates are conspicuous within the gangue of silica, calcite and siderite. The mineralization is reported to contain gold and silver. The appearance of magnetite near the vein was noted by Bancroft (1911). A Hg production of 540 flasks is reported for 1916.

Approximately 1½ miles west of the Cinnabar mine, old prospects in T2N, R20W, Secs. 4 or 5 (up a steep narrow gulch at about 1,600 ft elevation) explore quartz, sericite, tourmaline, copper and free gold which as described by Bancroft (1911) occurs in a zone striking N55°W with a flat dip (15°) to the southeast. Siderite and cinnabar is reported to also be in the shallow-dipping structure. The fine-grained, quartz-sericite schist and impure carbonate beds which host the mineralized zone are described as being extensively tourmalinized and silicified.

In this general area (S.Cen. Sec. 9, T2N, R20W), an antimony occurrence of stibnite has been noted in Arizona Dept Mineral file data. A reference source for this prospect is Arizona Bur. Mines Bull. 122.

References:

Bancroft, 1911; Jones, 1916; Keith, 1978; Crowl; 1979; Arizona Dept Mineral Resources, file data; Rehrig, unpubl. field notes; Tosdel, 1982; Wilson, 1960.

Mike Broch to Kirk Kinort 20 Dec 84

Mod-dipping, tabular bx zone modified by high angle structures. Bx appears to or related or controlled by to the high angle structures. One zone is generally 50-60' thick, may be thinner based on well drilling.

There is a zone up to 800' thick in HW of pervasive & frac-controlled hem (spec ⇒ ~~ear~~ earlier hem). Bx consists of clasts of ~~un~~ unmineralized volc frags in matrix of qtz & fn-gr spec. Crse-gr spec tends not to run Au.

Alt'n sequence.

propyllitic — pervasive spec — qtz + spec veins — qtz-amethyst, last two are auriferous.

There are numerous directions of fracturing in the min'zd zone. Complicated structure & mineralizing events.

Mineralized zone 2000-3000 along strike. Down-dip ?

Mike believes inhomogeneity of volc rx (foliation etc) important in providing good structural preparation.

Dan and Maria Patch - Cyprus Mines - May 1, 1980

T6N R19W Sec. 6, 7, 18, 19, 20, 21, 22
6N R20W Sec. 1, 2, 10, 11, 12, 13, 14, 22, 23, 24

Copperstone 1 thru 315
Iron Reef 1-10
Claims staked Oct., 1979

Phone conversation w/ Mike Broch 18 Dec 84

Confirmed Amoco is redrilling Copperstone to tighten up grade & tonnage control. Apparently the rotary drilling did misrepresent both grade & tonnage as Stan said. He mentioned that Amoco may have hit another zone.

Copperstone is in a higher angle (listric fault) above the D.F. The D.F. is exposed to the south in the range where it has local mineralized zones which are low grade. Amoco drilled the D.F. between Copperstone and the range but it was barren.

"Ore" is in (Mesozoic?) meta-volcanic rocks. The nature of these rocks is questionable. They have been considered to be cataclastically deformed. Sid Williams examined some samples and said the "cataclasis" was welding. Therefore they may be welded tuffs which are only weakly deformed, if at all. Mike says these volcanic rocks are very similar in appearance to rocks in the Buckskins which are dated as mid-Tertiary.

The carbonate rocks appear to be intercalated with the volcanic rocks - since the drilling was rotary, there is no structural data. The question is are the carbonates lacustrine or Paleozoic limestones? Similar appearing carbonates ~~do~~ intercalated with volcanic rocks do occur in the Whipples, so Copperstone may be in a mid-Tertiary volcanic-lacustrine section.

Conversation w/ (415) 323 - 8111

- Kyanite - Dick Tosdal

5/20/85 - Livingston Hills - is upper part of McCoy Mtns. Fm.

- Copper Bottom Pass South - mostly

- Trigo

- Eagle

Livingston Hills - Knows of no areas in here w/ aluminosilicates

Diablo Qtz. Mon. - prob. is Jurassic.

Kitt Pk. gd. - 165 m.y. - U-Pb

Baboquivari Mtns. - see Jurassic granites

Jurassic ⇒ intrusion - Jurassic rocks.

Aluminous gneisses + qtz felds schist.

white granite - qtz porphyry -

Vitrefax Hill

granite - schist - Kyanite - Tumco

look at Dillon's thesis - demonstrates is metamorphic reaction, not protolith.

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mu - metamorphic undiff on Crowl's map.

would be unit to look at for Kyanite

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rocks of 'Slumgullion' - or KJWUR

= basal part of McCoy Mtns Fm

= Winterhaven Fm.

in here see aluminosilicate altered areas - but all in KJWUR

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the areas S. of Granite Peak probably project west to main Dome Rocks but not specific deposits and continued with complete domination of the basin by volcanic /pyroclastic deposition including an ash deposit resembling the Peach Springs Tuff.

The conglomerates, sandstone and shale of the UPC represent alluvial fan deposition. The presence of Stepladder Mountain pluton clasts imply a south-southwest source area. Average grain sizes are unusually large and suggest additional north-eastward displacement of the UPC allochthon relative to the Stepladder allochthon after deposition of the sediments. Comparison of Sacramento Mountains stratigraphic and structural data with that of nearby ranges shows general similarities in the pattern of Tertiary volcanism and sedimentation and invites chronostratigraphic correlation between the ranges.

EVIDENCE FOR CARBONIFEROUS (?) RIFTING ALONG A CONTINENTAL MARGIN FROM THE SIERRA LAS PINTA, BAJA CALIFORNIA NORTE, MEXICO

№ 103009

LEIR-ENGELHARDT, Paula and GASTIL, Gordon, Department of Geological Sciences, San Diego State University, San Diego, CA 92182

The Sierra las Pinta is located 112 km south of Mexicali, Baja California Norte. On the north end of the range are, in succession, yellowish brown siltstone and calcareous sandy siltstone; dark grey siltstone interbedded with calcareous siltstones; graded sandy crinoidal grainstone; normally graded beds of coarse sandstone and clast supported granule to cobble conglomerate; basalt conglomerate and massive lava flows; and bedded chert and calcareous argillite in thrust contact with underlying units.

In the south end of the range, the basal unit is a bedded chert and argillite; followed by a sequence of flysch and granule conglomerate debris flows; a deformed limestone and shale sequence; and massive basalt flows and pillow basalts.

Lophophyllid corals from the northern area are Late Paleozoic in age, and one conodont fragment from the southern area has been identified as medial Paleozoic.

Detailed thin section analysis suggests the second unit in the northern sequence and the second unit in the southern sequence were derived from a cratonal terrane. Minor and trace element analysis of basalts from both areas indicate a back-arc rifting, or rifting along a continental margin. This is consistent with the provenance data and the probable slope depositional environment of both areas.

COINCIDENT RADIATION OF CAMBRIAN PROTISTA AND METAZOA

№ 87700

LIPPS, Jere H., Department of Geology, University of California, Davis, CA 95616

Foraminifera and radiolaria are known from Lower Cambrian through Ordovician rocks in North America, Europe and Asia. These occurrences span the time of the initial radiation of Metazoa, and indicate that the Cambrian radiation took place at several grades of biological organization. The single-celled heterotroph diversification at the same time as that of Metazoa puts constraints on hyptheses for the early stage evolution of animals.

Like Metazoa, these early heterotrophic Protista were morphologically simple. The foraminifera are simple, straight or coiled agglutinated tubes, and the radiolaria are latticed spheres or discs. In the Middle Cambrian, the foraminifera include coiled chambered forms; total known genera number at least six. Among the radiolaria, at least five genera are known in the Cambrian. During the Ordovician, both protistan groups underwent considerable diversification, as did the Metazoa.

The protistan heterotroph and metazoan radiation indicates that metazoan-based or metazoan-unique hypotheses for the "Cambrian explosion of animals" can be eliminated. The coincident radiation indicates that the explanation for diversification in such structurally and ecologically different organisms lay in ecosystem dynamics, most likely trophic interactions.

PALEOCENE-EOCENE SEDIMENTATION AND WRENCH TECTONICS ALONG THE BORDER RANGES FAULT SYSTEM, NORTH-CENTRAL CHUGACH MOUNTAINS, ALASKA.

№ 103079

LITTLE, Timothy, A., Alaska Div. Geol. and Geophys. Surveys, 794 Univ. Ave., Fairbanks, AK 99701; BLOME, C.D., and WOLFE, J.A., U.S. Geol. Survey, M.S. 919, Box 25046, Federal Center, Denver, CO 80225.

About 170 km east of Anchorage, AK, a ~ 1 km thick conglomeratic section of the Chickaloon Formation (Tch), part of the Cook Inlet forearc basin, is uplifted along the N. flank of the Chugach Mts. and cut by the Border Ranges fault system (BRFS). Here, the BRFS is a zone of high-angle faults between (and within) Jurassic arc rocks of the Peninsular terrane (PT) to the north and Cretaceous subduction complex rocks of the Chugach terrane (CT) to the south.

The Tch in the Chugach Mts. contains plant fossils of Paleocene age and unconformably overlies several different Jurassic and Cretaceous units of the PT and locally both the McHugh complex and Valdez Group of the CT. Clasts of CT lithologies, including Mesozoic radiolarian chert, are more abundant in the Tch than are clasts of Peninsular terrane lithologies. The Tch records the following latest Cretaceous-Paleocene events occuring in the forearc basin: 1) cessation of marine conditions; 2) south-side-up, extensional(?) block-faulting; and, 3) uplift of the CT forming a positive area to the south. Latest(?) Cretaceous turbidites of the Valdez Group were deposited, accreted to the continental margin, metamorphosed in the lower greenschist facies, penetratively deformed twice, and subaerially exposed in less than 15 m.y. prior to deposition of the Tch. Facies and paleocurrent data suggest that during the Paleocene a humid alluvial fan system onlapped fault scarps of CT to the south and prograded northward across fault blocks in the PT.

Following this latest Cretaceous-Paleocene orogeny, and prior to intrusion of ~ 37 m.y. old silicic plutons in both the PT and CT, the BRFS became a zone of en echelon folding and dextral wrench faulting. Oblique-slip faults with large components of reverse and normal displacement probably developed synchronously with wrench faults. Local cross-folding about steeply-plunging axes within N or NE-striking axial planes records a late component of E-W compression. The largest such fold warps the entire BRFS and can be related to ~ 13km of dextral displacement along a nonplanar wrench fault with associated fault-bend folding of McHugh complex and PT rocks as they rode over a left-stepping bend.

Any plate tectonic model calling for significant displacement along the BRFS in post-Eocene time is viewed untenable in the light of these geologic data.

THE BOYER GAP: A RECORD OF JURASSIC INTRA-ARC FOLD AND NAPPE TECTONICS IN THE NORTHERN DOME ROCK MOUNTAINS OF SOUTHWESTERN ARIZONA

№ 95058

LOGAN, Robert E., and FROST, Eric G., Dept. of Geological Sciences, San Diego State Univ., San Diego, CA 92182

Complex structural relations principally related to fold and nappe development within the Jurassic magmatic arc of the SW Cordillera are present in the Boyer Gap region of the northern Dome Rock Mountains. A basal thrust, here termed the Boyer Gap Thrust (BGT), places Grand Canyon-correlative Paleozoic metasedimentary rocks above metaclastic rocks of presumed early to middle Mesozoic age. A synkinematic suite of mid-Jurassic plutonic rocks are intruded as sill-like concordant bodies into the thrust as well as lower- and upper-plate structures where their involvement appears to have facilitated large-amplitude (ca. 1km) fold formation. The fold nappe above the BGT as exposed in the N. Dome Rock and S. Moon Mountains contains a WNW-trending, S- to SW-overturned syncline/anticline fold pair which implies S to SW tectonic transport. Post-Jurassic deformational elements can be identified in the Boyer Gap, but do not significantly disrupt the major Jurassic structure. This affords the unique opportunity to view Jurassic deformation in a manner which is rarely possible in the Mojave-Sonoran region.

The preceding relationships suggest a tectonic scenario, whereby oblique northward subduction of Pacific Plate precursors beneath western North America formed intra-arc, transtensional basins (ie., McCoy Basin and Orocopia Schist) which were subsequently overthrust by S-verging intra-arc transpressional tectonics during the mid-Jurassic. An outboard shift of arc magmatism in the late Mesozoic placed the region in an arc-rear position which favored NE-verging structures such as the Mule and Chocolate Mountain Thrusts.

PHYSICAL PROPERTIES OF DEEP CRUSTAL REFLECTORS IN SOUTHEASTERN CALIFORNIA

№ 99280

LOUIE, John N., and CLAYTON, Robert W., Caltech 252-21, Pasadena, CA 91125

Seismic reflection data exhibiting strong mid- and deep-crustal reflections on the multi-offset records are available from 3 areas of the Mojave Desert of southeastern California. In 1962 Hewitt Dix recorded a common-shot gather showing such reflections at offsets from 1.5 to 13 km in the central Mojave just north of the San Bernardino Mts. The COCORP Mojave survey in 1982 obtained numerous exceptional records of deep reflections at offsets from 0.4 to 10 km in the western Mojave. The May-June 1985 CALCRUST Mojave-Sonoran experiment recorded 100 km of seismic reflection data in the Ward, Rice, and Vidal Valleys of the eastern Mojave near the Colorado River. The CALCRUST data include recordings made by stationary arrays at offsets up to 20 km in addition to the main high-resolution profiling survey. All 3 of the above datasets show reflections at a wide enough range of offsets to yield at least 20° of incident-angle coverage on reflectors as deep as the base of the crust. The prominent reflections are examined in detail at different offsets to yield information on the physical nature of the deep-crustal reflectors. Two approaches are used. First, changes in the power spectrum of a reflection with offset can reveal whether the reflector is a step discontinuity, a thin layer, or a gradient, of the physical properties such as P or S velocity or density. For the thin-layer model, simple interference relations allow the thickness and P velocity of the layer to be derived solely from the change in peak frequency with offset. Second, the variation of reflection amplitude with offset yields information on the relative changes in the velocities and density. The reflection characteristics of various models at different offsets are constrained by 2-d acoustic and elastic finite-difference synthetics. Such an evaluation of the changes in physical properties of a particular reflector can help to evaluate differing lithologic models. The spectra of several reflections from the CALCRUST dataset at many midpoints in the Ward Valley show agreement with the predictions of the thin-layer model. The change in peak frequency with offset of these events indicates that the velocities of these 100 to 400 m thick layers are at least 10% higher than the velocity of the surrounding country rock. The higher velocity indicates that the layers may include higher-grade metamorphic minerals or be of more mafic composition.

GSA 1986

FORM 61 - 159 (3)

DUVAL CORPORATION

INTER-OFFICE MEMORANDUM

To: R. A. Metz

Subject: Colorado River Area

From: W. H. Wilkinson

Copy: J. I. Sharpe
P. O. Tyree

Date: January 30, 1984

Pat Wotruba provided the following information in a telephone conversation late Friday. The information is from a friend of his, Mike Brock, who works for AMOCO. AMOCO's project in the Moon Mountains, AZ, called Green Creek (?), is said to contain 16 to 18 million tons of .075 oz/t Au mineralization. It is a low sulfide system with Au occurring on fractures with hematite and local specularite, distinct characteristics of the detachment association. The deposit has a 6:1 stripping ratio and indicated recoveries are 70% but should exceed 80%. AMOCO has projected a $140 million profit over the life of the mine. However, at AMOCO's latest budget meeting, it was decided to sell the property.

This discovery fits the objective stated in the Colorado River Project Proposal of finding a deposit containing one million ounces of Au. They do exist and the relative proximity to Kingman makes the northern part of the area from the proposal particularly attractive.

The above information was proprietary to Pat Wotruba and should be kept Company Confidential.

W. H. Wilkinson

WHW:hdh

LITHOLOGIC ASSOCIATIONS OF GOLD DEPOSITS, SOUTHEASTERN CALIFORNIA AND SOUTHWESTERN ARIZONA | № 61296

TOSDAL, R.M., HAXEL, G.B., U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA, 94025, and DILLON, J.T., Alaska Division of Geological and Geophysical Surveys, College, AK 99708

Disseminated gold deposits in the Chocolate and Cargo Muchacho Mountains, southeastern California, and other historically important lode and related placer districts in the Dome Rock Mountains, southwestern Arizona, share several lithologic associations. All are hosted largely or entirely by gneiss. For most of these deposits, the protolith of the gneiss was one or both of two regionally extensive lithologic units of known or probable Jurassic age. These are 1) silicic volcanic and volcaniclastic rocks and hypabyssal quartz porphyry, intruded by 2) dioritic, granodioritic, and granitic plutonic rocks(the slightly different gneiss at the Picacho Mine could be a higher grade equivalent of the metamorphosed Jurassic granitoids or an older gneiss).

Metasomatic rocks, now kyanite-quartz-white mica gneiss, are commonly, but not invariably, spatially associated with mineralization. These rocks are exposed along contacts between and derived from both the metavolcanic rocks and the granodioritic to granitic plutons. Field and mineralogic evidence indicates metasomatism was related to granitic plutonism and probably synchronous with amphibolite facies regional metamorphism.

These observations suggest that the gold deposits are, at least in part, genetically related to Jurassic igneous rocks. Although gold may well have been remobilized or further concentrated during late Mesozoic and(or) Tertiary deformations and magmatism, it probably was initially introduced or concentrated during Jurassic plutonism and regional metamorphism.

PROVENANCE OF THE LATE PRECAMBRIAN KINGSTON PEAK FORMATION, SOUTHEASTERN DEATH VALLEY REGION, CALIFORNIA | № 65623

TROXEL, B. W., Dept. of Geology, University of California, Davis, CA 95616; WRIGHT, L. A., WILLIAMS, E. G., and MCMACKIN, M. R., Dept. of Geosciences, Pennsylvania State University, University Park, PA 16802

The Kingston Peak Formation, in southeastern Death Valley, was deposited in a rapidly-subsiding WNW-trending basin accompanied by faulting along the NNE margin of the basin. The source area was to the north. The facies of the formation deposited along the NNE margin consists of a lower siltstone, a middle diamictite, and an upper mixed member. The upper member contains conglomerate, siltstone, sandstone, diamictite, and megabreccia.

In general, all members are thickest in the central trough of the basin and thin or wedge out northward. The lower and middle members are each about 300 m thick in the trough and taper out or buttress on the margin. Both are moderately uniform in grain and clast size. The upper member consists, in the trough, of distal parts of turbidite beds, sandstone, siltstone, diamictite, and breccia beds. It is as much as 3,000 m thick within a few km of the basin margin. At the margin, it is generally 100 to 200 m thick and contains coarse fanglomerate, proximal turbidite beds, siltstone, sandstone, diamictite, and very coarse breccia beds. The breccia beds are about 1,500 m thick within about 3 km of the margin and contain gigantic clasts one being about 1 km long and 300 m in stratigraphic thickness. The breccia beds show a progressive denudation of the source region.

Precambrian faults were active along the basin margin before, during, and briefly following deposition of the Kingston Peak Formation. Volcanism accompanied deposition of the upper member. Bedrock irregularities existed near shore.

A LATE DEVONIAN STRATIFORM PB-ZN AND STRATIFORM BARITE METALLOGENIC EVENT IN THE NORTH AMERICAN CORDILLERA: MARGIN-LONG EXTENSION AND IMPLICATIONS FOR THE ANTLER OROGENY. | № 63914

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Over 100 stratiform barite and 20 stratiform Pb-Zn deposits of syn-diagenetic origin occur from the Yukon to Mexico within late Devonian age carbonaceous shale +/- chert, turbidite basinal marine rocks. These deposits define a single genetically related metallogenic event and a major Pb-Zn-Ag-Ba province, distinctive for the high ratio of stratiform barite/stratiform Pb-Zn deposits. Sedimentological evidence for late Devonian submarine extension (synsedimentary faults, locally derived debris flow and turbidite deposits, rapid lateral facies change) has been documented on a regional scale in the Selwyn Basin area. Stratiform Pb-Zn and stratiform barite deposits in the Selwyn Basin area occur together as clusters associated with loci of submarine synsedimentary faulting. By analogy, the presence of similar coeval stratiform deposits in the U.S. and Mexico within equivalent but more deformed strata is interpreted to reflect exhalative activity related to centers of extensional faulting. From Yukon to Nevada there is a fining of the coarsest clastics within the late Devonian sediments concurrent with a decrease in the ratio of sulphide to barite deposits. This may reflect a decreasing amount of extension southwards. Biostratigraphic control indicates this late Devonian extensional event occurred along 4500 km of Cordilleran continental margin within a time interval of less than 14 m.y. This event reflects either a margin-parallel rift, transform or transtensional enviroment. In Nevada and Idaho, this event immediately preceded movement on the Roberts Mountains thrust. The occurence of time-equivalent late Devonian age stratiform deposits in both autochthonous miogeoclinal rocks (Yukon, B.C., Washington) and the Roberts Mountains allochthon (Nevada, Idaho) suggest the latter is a displaced fragment of the edge of the continent and not an exotic terrane.

CHARACTER AND EVOLUTION OF STRATIFORM PB-ZN-BARITE MINERALIZATION, SOUTH ZONE, JASON PROPERTY, YUKON. | № 64078

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The South zone contains two stratigraphically distinct, stratiform Pb-Zn -barite bodies hosted in late Devonian siltstone turbidite, organic shale and debris flow deposits adjacent to a synsedimentary normal fault. Both stratiform bodies are mineralogically and texturally zoned away from a breccia body above the fault. Stratiform mineralization is divided into the following mineral/textural facies: (1)massive py; (2) banded py-po; (3) massive ankerite-gl; (4) banded siderite-po; (5) banded sl-gl; (6) disseminated ankerite-sl-gl; (7)laminated qtz-sl; (8) laminated barite-qtz-sl-gl; (9) qtz-celsian laminae and (10) silicification. Zoning of these facies from proximal to distal is: upper body (1-3-5-7-8-9-10); lower body (2-4-6-8-9-10). Textural evidence suggests the stratiform bodies are composites of several processes: sedimentation with minor diagenetic recrystallization (1,5,7,8); sedimentation (?) with major diagenetic change (9,10); lateral hydrothermal infiltration of uncompacted sediment (2,4,6); and fracture controlled mineralization/ alteration of earlier stratiform mineralization (1,2,3,4). The breccia body is composed of silicified fragments in a siderite-po matrix at depth grading upwards to py-po. The interpreted evolution of the South zone is: (a) venting of hydrothermal fluid to form the distal facies (8, ?9,?10)of the lower stratiform body; (b) formation of a fault scarp debris flow apron; (c)brecciation; lateral infiltration by hydrothermal fluids forming the proximal part of the lower stratiform body (2,4,6); venting of hydrothermal fluids forming the upper stratiform body (1,5,7,8,?9?10) and fracture controlled mineralization/alteration of early formed hydrothermal sediments of the upper stratiform body (1,3); (d) renewed fault scarp debris flows and (e) diagenetic recrystallization of the hydrothermal sediments.

MAGMA MIXING AND FRACTIONAL CRYSTALLIZATION OF MIOCENE VOLCANIC ROCKS IN THE CASTLE MOUNTAINS NORTHEASTERN MOJAVE DESERT | № 71221

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Three compositionally distinct groups of Miocene volcanic rocks in the Castle Mountains display evidence for both fractional crystallization and magma mixing or assimilation. From oldest to youngest this section contains: I) 100-150m of hbl-cpx-plag andesite flows and flow breccias with minor rhyolite ash-flow tuffs; II) 250-350m of mafic and silicic volcanic and hypabyssal intrusive rocks including basalt flows, rhyolite pyroclastic rocks and flows, and both diabase and rhyolite intrusions; III) voluminous andesitic flows and flow breccias in the adjacent Piute Range. K-Ar ages constrain eruption of group I and II rocks to between 18.0 and 12.8 Ma. Group III rocks are inferred to be younger based on field relations.

Major and trace element, Sr isotope, and petrographic data provide convincing evidence for magma mixing or assimilation in group II rocks, and fractional crystallization of group II basalt to produce group III andesites. Evidence for magma mixing or bulk assimilation includes: 1) mixing lines connecting end-member compositions on element-element and ratio-element plots; 2) resorbed quartz mantled by clinopyroxene in andesites; 3) Sr 87/86 values which correlate positively with silica. The geochemistry of group III rocks is consistent with evolution by fractional crystallization of ol+plag$\pm$cpx from group II basalt.

TEMPORAL TRENDS IN THE CHEMICAL EVOLUTION OF MEGACRYST-BEARING, SUBALKALINE-ALKALINE BASALTIC LAVAS FROM THE LUNAR CRATER VOLCANIC FIELD, NYE COUNTY, NEVADA | № 64254

TURRIN, Brent D., U. S. Geological Survey, Menlo Park, CA 94025; RENNE, Paul R., Dept. of Geology and Geophysics, University of California, Berkeley, CA 94720; and DOHRENWEND, John C., U. S. Geological Survey, Menlo Park, CA 94025

New studies, including 19 whole-rock K-Ar dates and supporting paleomagnetic polarity measurements, on chemically analyzed samples permit a quantitative evaluation of chemical evolution in the Lunar Crater volcanic field (LCVF), a subalkaline-alkaline mafic magmatic system. The LCVF, approximately 65 km long by 15 km wide, extends northeastward across the Pancake and Reveille Ranges in Nye County, Nevada. Previous studies indicate spatial and temporal trends in the composition of LCVF basaltic lavas: older, more silica-rich lavas occur in the southern part of the field, and younger, relatively undersaturated lavas dominate the northern part. A detailed chronology for the LCVF indicates that the field has been active from at least 5.8 Ma to less than 0.13 Ma. During this period, a regular and continuous compositional evolution has occurred from subalkaline basalt containing approximately 8% normative hypersthene to basanite containing as much as 13% normative nepheline. In addition, the following components also increase through time: MgO (4 to 9%), CaO (8 to 10.5%), Cr (75 to 150 ppm), and Ni (30 to 160 ppm). Components that decrease with time are SiO_2 (48.5 to 44.5%), Al_2O_3 (17 to 14.5%), and Zr (260 to 160 ppm). K_2O, MnO, Na_2O, and P_2O_5 show no systematic variations throughout the eruptive history of the field. FeO^* appears to reach a maximum (13.5 %) in lavas that are intermediate in age (3-4 Ma). These compositional variations demonstrate a continuity of petrogenetic processes in the LCVF magmatic system over the past 6 Ma.

GSA Cordill

THE MINING RECORD

THE VOICE OF THE MINING INDUSTRY

19 WEDNESDAY, MAY 8, 1985, DENVER, COLORADO 80206 $24 pe

[redacted]

Stan Keith 18 Dec 84

Initial drilling straight rotary

core drilling doubled grades, but decreased thickness by 50%.

~~New drill~~

Redrilling now w/ core (50 holes).

Tonnage significantly less than thought, but contained Au is the same.

THE MULE MOUNTAINS THRUST IN THE MULE MOUNTAINS CALIFORNIA AND ITS PROBABLE EXTENSION IN THE SOUTHERN DOME ROCK MOUNTAINS, ARIZONA; A PRELIMINARY REPORT

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ABSTRACT

The Mule Mountains thrust in the Mule Mountains, Calif., and its probable extension in the southern Dome Rock Mountains, Ariz., is a southward dipping thrust fault that superposes Precambrian(?) or Mesozoic(?) granitic rocks and a Precambrian gneiss complex over Early and (or) Middle Jurassic(?) metavolcanic and volcaniclastic rocks. Mylonitic rocks and fabrics are present along the thrust fault, and synkinematic crystalloblastic fabrics in the metamorphic rocks of the lower plate. In the southern Dome Rock Mountains, a gradational stratigraphic contact between Early and (or) Middle Jurassic(?) metavolcanic and volcaniclastic rocks and structurally lower but younger upper Mesozoic metasedimentary rocks indicate these rocks, part of the McCoy Mountains Formation and equivalent Livingston Hills Formation, may be as old as Middle Jurassic(?) and not of Late Cretaceous(?) or younger age. The age of movement along the thrust fault is constrained to be post-Middle Jurassic(?) and pre-middle Tertiary, and probably of late Cretaceous to early Tertiary age.

INTRODUCTION

Thrust faulting, regional metamorphism, nappe formation, and intrusion of synkinematic granite are important elements of the late Mesozoic to early Tertiary tectonics of the eastern Mojave Desert, Calif., and northern Sonoran Desert, Ariz. (Hamilton, 1971; Pelka, 1973; Haxel and Dillon, 1978; Howard and others; 1980; Reynolds and others, 1980; Anderson and Rowley, 1981; Crowell, 1981; Miller and others, 1981; May and others, 1981). Throughout this region, crustal shortening of uncertain magnitude is recorded by the thrust faults; Reynolds and others (1980, p. 50) suggest some tens of kilometers of tectonic transport on thrust faults in the area of Salome, Ariz. Varying structural thicknesses of mylonitic rocks are present along the thrusts. Prograde metamorphism of lower plate rocks accompanied translation along the thrust faults; whereas retrograde metamorphism occurred synkinematically at the base of the upper plate. These thrust faults comprise two systems (Fig. 1): the outboard Vincent thrust, and a recently recognized but incompletely studied inboard system (e.g. Crowell, 1981; Tosdal and Haxel 1982).

The inboard system of thrust faults occurs within a northwest-trending belt that extends at least from northernmost Sonora and south-central Arizona (May and others, 1981) to the Salome-Quartzsite-Blythe area of Arizona and California (Reynolds and others, 1980). The Mule Mountains thrust that superposes Precambrian(?) or Mesozoic(?) plutonic rocks atop varyingly metamorphosed Jurassic(?) volcanic and volcaniclastic rocks in the Mule Mountains, southeastern California (Pelka, 1973; Crowell, 1981) and in the southern Dome Rock Mountains, southwestern Arizona (this paper), is part of the inboard system of thrust faults (Fig. 1). The brief description of these rocks and structures presented are preliminary observations, and will be greatly expanded by further studies of the kinematics and regional relationships of the Mule Mountain thrust.

MULE MOUNTAINS

Along the Mule Mountains thrust (Figs. 1, 2A), a zone of mylonitic rocks separates Precambrian(?) or Mesozoic(?) porphyritic granodiorite and Precambrian gneiss of the upper plate, from the weakly to moderately metamorphosed Early and (or) Middle Jurassic(?) rhyolitic to dacitic volcanic and volcaniclastic rocks of the lower plate. The thrust fault strikes northwesterly and dips about 30° to 50° SW.

Penetrative foliation that developed in both the lower-plate metavolcanic rocks and upper-plate blastomylonitic granodioritic gneiss parallels that the in the mylonitic rocks along the fault. The width of the zone of blastomylonitic granodioritic gneiss at the base of the upper-plate varies dramatically in thickness along the thrust fault, with foliation rapidly diminishing in intensity structurally upward. All macroscopic trace of the foliation has disappeared 300 m above the thrust, although localized zones of blastomylonitic gneiss occur sporadically throughout the porphyritic granodiorite. Quartz rods and trails of broken micas and feldspars present throughout the metamorphic rocks define a penetrative lineation within the plane of the foliation that plunges to the south-southwest. A late stage northwest-trending crenulation lineation slightly folds the primary lineation.

The porphyritic granodiorite, a tabular body extending across the entire width of the mountain range (Fig. 2A), is bounded on the northeast by the Mule Mountains thrust, and on the south by the gneiss complex. With the exception of the narrow zone adjacent to the Mule Mountain thrust, scattered zones of blastomylonitic rock that parallel the thrust, and a structurally disturbed portion of the otherwise intrusive contact with the gneiss complex, the porphyritic granodiorite has igneous textures and mineralogy. Cream colored, commonly with a pinkish tint, potassium feldspar phenocrysts are the distinctive feature of the porphyritic granodiorite. These phenocrysts range from 1 cm to 6 cm in size, and are variable both in their habit and distribution, occurring as subparallel tabular crystals, blocky crystals that compose much of the granodiorite or as scattered, randomly oriented crystals, usually of smaller size. The age of the porphyritic granodiorite is unknown, but petrologic resemblances to other dated plutonic rocks of southeastern California suggest one of several Precambrian ages (Silver, 1968, 1971; L. T. Silver, in Powell, 1981). However, elsewhere in the southwest, porphyritic granodiorite and monzogranite plutons are also of Mesozoic age (Silver, 1971; L. T. Silver in Powell, 1981); hence, a Mesozoic age for the

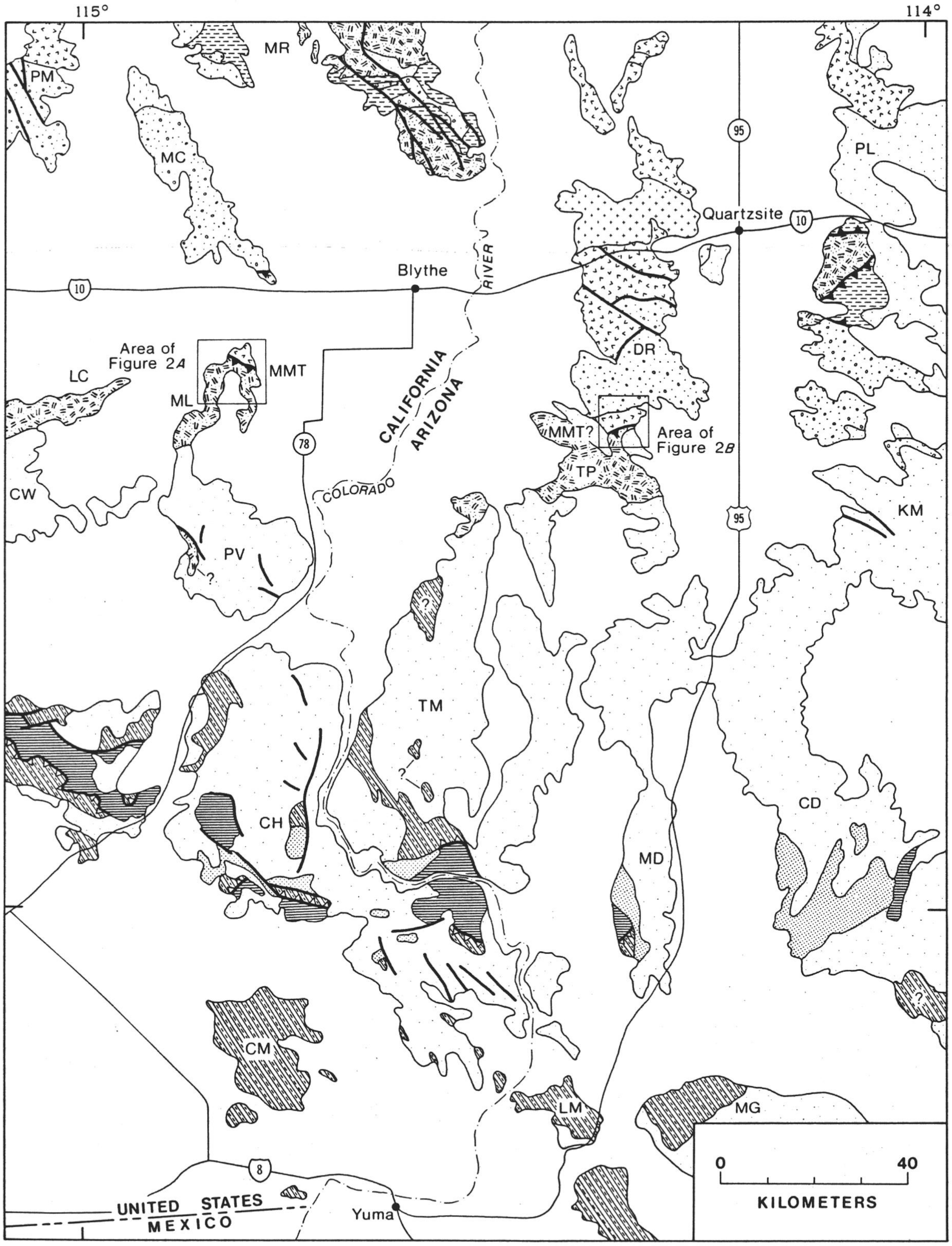

Figure 1. General geologic map of the lower part of Colorado River, California and Arizona, showing distribution of inboard thrust system and associated rocks, and outboard Vincent thrust system. Modified from Strand, (1962); Jenning (1967); Wilson and others, (1969); Miller (1970); Pelka, (1973); Dillon (1975); Haxel, (1977); Crowl, (1979); W. Hamilton (oral commun., 1981); CD, Castle Dome Mountains; CH, Chocolate Mountains; CM, Cargo Muchacho Mountains; CW, Chuckwalla Mountains; DR, Dome Rock Mountains; LC, Little Chuckwalla Mountains; LM, Laguna Mountains; KM, Kofa Mountains; MC, McCoy Mountains; MD, Middle Mountains; MG, Muggins Mountains; ML, Mule Mountains; MMT, Mule Mountains thrust; MR, Maria Mountains (includes both Big and Little Maria Mountains); PL, Palomas Mountains; PM, Palen Mountains; PV, Palo Verde Mountains; TM, Trigo Mountains; TP, Trigo Peaks.

EXPLANATION

Volcanic and sedimentary rocks (Tertiary)

Granitic and sedimentary rocks (late Mesozoic and (or) early Tertiary)

INBOARD THRUST SYSTEM

UPPER PLATE

Sedimentary rocks (Paleozoic)

Gneiss and granite (Precambrian; may include rocks of Mesozoic age)

THRUST FAULTS

LOWER PLATE

Sedimentary and metasedimentary rocks (late Mesozoic)

Granitic rocks (Mesozoic)

Volcanic and metavolcanic rocks (Jurassic)

VINCENT THRUST SYSTEM

UPPER PLATE

Gneiss and granite (Precambrian and Mesozoic)

CHOCOLATE MOUNTAINS THRUST

LOWER PLATE

Orocopia Schist (Late Cretaceous and (or) early Tertiary)

CONTACT

FAULT

porphyritic granodiorite cannot be discounted.

Polymetamorphic melanocratic to leucocratic gneiss derived from granitic to granodioritic, gabbroic, and ultramafic plutonic rocks, and subordinate amounts of sedimentary(?) and (or) volcanic(?) protoliths form the majority of the rocks comprising the upper plate. Crystalloblastic fabrics formed under amphibolite facies conditions are characteristic of the gneiss complex; although, extensive areas of mylonitic fabrics, unrelated to the Mule Mountains thrust, are present. A Precambrian(?) age is inferred for the gneiss complex.

Certain rock types, and their relative age relations within the gneiss complex of the Mule Mountains are similar to those characteristic of the Precambrian San Gabriel terrane (Silver, 1971; L. T. Silver in Powell, 1981). The San Gabriel terrane is widely distributed in the eastern Transverse Ranges, southeast California, as far east as the Little Chuckwalla Mountains (Powell, 1981), located some 10 km west of the Mule Mountains (Fig. 1). Correlation of the gneiss complex of the Mule Mountains to the gneiss composing the San Gabriel terrane has previously been suggested by Crowell (1981), but confirmation of this correlation must await further work. It is interesting to note that in the Orocopia Mountains, 70 km west of the Mule Mountains, the San Gabriel terrane forms the upper plate of the Vincent thrust (Crowell, 1981; Powell, 1981).

A conjugate system of gabbroic to granodioritic dikes are the youngest rocks of the upper plate. These rocks are converted to greenschists and blastomylonite near and within the deformation zone at the base of the upper plate. The age of these dikes are unknown, but are provisionally assigned a Mesozoic age.

The rhyolitic to dacitic metavolcanic and volcaniclastic rocks of the lower plate (Fig. 2A) consist of varying amounts of relict embayed quartz, broken plagioclase phenocrysts, and recrystallized pumice lapilli surrounded by a groundmass composed of quartz, albite, white mica, epidote, chlorite, and tourmaline. Several white quartzite and quartzite-clast metaconglomerate beds are interstratified with the volcaniclastic strata. An Early and (or) Middle Jurassic(?) age is assigned to the metavolcanic rock sequence on the basis of their similarity in appearance and petrology to volcanic rocks of known Early to Middle Jurassic age elsewhere in southeastern California (Daniel Krummenacher, in Pelka, 1973), in south-central Arizona (Wright and others, 1981), and northern Sonora, Mexico (Anderson and Silver, 1978). Crowell (1981) tentatively has correlated these metavolcanic rocks to weakly metamorphosed dacitic and andesitic volcanic rocks in the southernmost McCoy Mountains, located some 12 km north of the Mule Mountains; there, the metamorphosed dacitic and andesitic volcanic rocks structurally overlie the McCoy Mountains Formation of Miller (1944; Pelka, 1973). Alter-natively, in the northern McCoy Mountains weakly cleaved, rhyodacitic hypabyssal rocks of Early Jurassic age (Daniel Krummenacher, in Pelka, 1973), depositionally overlain by the McCoy Mountains Formation of Miller (1944) of late Cretaceous(?) or younger age, may prove to be a better stratigraphic correlation for the metavolcanic rocks in the Mule Mountains.

SOUTHERN DOME ROCK MOUNTAINS

The Dome Rock Mountains are composed of upper Mesozoic metasedimentary rocks, considered to be equivalent to the McCoy Mountains-Livingston Hills Formations as defined by Harding (1980), and Early to Middle Jurassic metavolcanic and granitic rocks (Wilson and others, 1969, L. T. Silver, in Crowl, 1979). Scattered investigations of these rocks (Crowl, 1979; Harding, 1980; Marshak, 1980;

Harding and others, 1982) have revealed highly complex and, as yet, incompletely understood geologic relations. A thrust fault in the southern Dome Rock Mountains (Figs., 1, 2B) is generally on strike with the Mule Mountains thrust (Fig. 1), superposes similar rocks (Fig. 2B), and is inferred to be an extension of the Mule Mountains thrust. The thrust strikes east-northeast and dips moderately south-southeast. The mylonitic foliation along the thrust parallels the crystalloblastic foliation in the lower-plate rocks, and contains a penetrative quartz-rodding and mica-streaking lineation that plunges southwest. The bearing of this lineation is similar, but not identical, to the quartz-rodding and broken mica and feldspar lineation noted in the Mule Mountains (Fig. 2A).

The majority of the rocks comprising the Dome Rock Mountains are weakly to moderately metamorphosed sandstone, siltstone, and conglomerate (Crowl, 1979; Marshak, 1980) of the 7,000-m-thick McCoy Mountains-Livingston Hills Formations (Harding, 1980; Harding and others, 1982). In the McCoy Mountain, Calif., the central and southern Dome Rock Mountains, Plomosa Mountains, and the Livingston Hills, Ariz. (Fig. 1), the sedimentary or metasedimentary rocks of the McCoy Mountains-Livingston Hills Formations rest depositionally on or are interstratified with siliceous volcanic and metavolcanic rocks of known or inferred Early and (or) Middle Jurassic age (figs. 1, 2B, Miller, 1970; Pelka, 1973; Crowl, 1979; Harding, 1980). In the southern Dome Rock Mountains (Fig. 2B), the sequence is overturned, and the Early and (or) Middle Jurassic(?) metavolcanic rocks grade structurally downward into the metasedimentary rocks. This gradational contact between these metavolcanic rocks and upper Mesozoic metasedimentary rocks strongly implies the depositional age of the McCoy Mountains-Livingston Hills Formations may be as old as Middle and (or) Late Jurassic (Harding, 1980) and not late Cretaceous(?) or younger (Miller, 1970; Pelka, 1973). Recognition of a probable Jurassic depositional age for all, or at least the basal part, of the McCoy Mountains-Livingston Hill Formations has several important implications for the stratigraphic relation of these sedimentary rocks to the Jurassic volcanic arc, and to the Jurassic tectonics of the region.

TIMING OF MOVEMENT

The youngest rocks involved in thrusting and metamorphism are the weakly to moderately metamorphosed McCoy Mountains-Livingston Hills Formations of late Cretaceous(?) or younger age (Miller, 1970; Pelka, 1973), although, a Middle and (or) Late Jurassic(?) age now seems more likely for these rocks. Middle Tertiary volcanic and sedimentary rocks, prior to limited and local movement along detachment faults (Frost and others, 1981; D. Sherrod and R. M Tosdal, unpub. data, 1982) depositionally overlay the Precambrian and Mesozoic crystalline rocks. Therefore, existing data broadly constrains the movement of the Mule Mountains thrust to late Mesozoic (late Jurassic(?)) and (or) early Tertiary times.

Throughout western Arizona, crystalline thrusts of the inboard thrust system have been demonstrated to be late Cretaceous and (or) early Tertiary in age (Reynolds and others, 1980; Haxel and others, 1981). The similarity between the Mule Mountains thrust and thrusts of the inboard thrust system suggests movement along the Mule Mountains thrust may also be late Cretaceous and (or) early Tertiary in age.

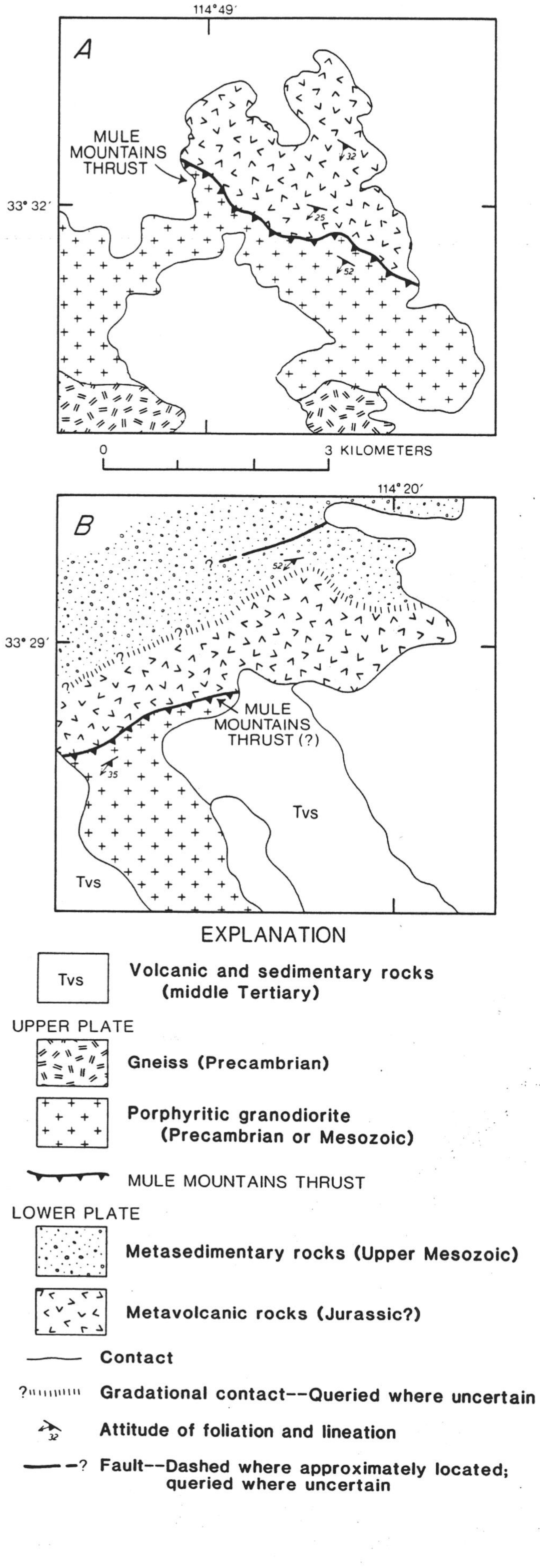

Figure 2a. Generalized geologic maps of the Mule Mountains thrust; A, northern Mule Mountains, Calif., B, southern Dome Rock Mountains, Ariz. See figure 1 for locations of these maps.

SOME REGIONAL QUESTIONS

Some 40 km south of the last outcrops of the southward-dipping Mule Mountains thrust is a similar, but distinct, mylonitic thrust fault, the Chocolate Mountains thrust of the Vincent thrust system. The Chocolate Mountains thrust places Precambrian granite and gneiss and Mesozoic granitic rocks over the ensimatic Orocopia Schist, which consists of dominantly quartzofeldspathic schist and minor ferromanganiferous metachert, metabasite, siliceous marble, and meta-ultramafic rock (Dillon, 1975; Haxel, 1977). In its northernmost outcrops in the Chocolate and Trigo Mountains (Fig. 1), the Chocolate Mountain thrust dips varyingly north. Movement along the Chocolate Mountains thrust is also inferred to be late Cretaceous and (or) early Tertiary in age (Haxel and Dillon, 1978).

Despite the effects of middle Tertiary large-scale folding of the different Precambrian and Mesozoic crystalline rocks and the two thrusts (Cameron and Frost, 1981), some important questions are raised by their close geographic proximity (Fig. 1), the northward dip of the Chocolate Mountains thrust and the southward dip of the Mule Mountains thrust and the inferred late Cretaceous and (or) early Tertiary age for thrust movements. What is the relation between these two thrust faults? Does the Mule Mountains thrust represent a sympathetic, intracontinental thrust related to movement along the Chocolate Mountains thrust (Crowell, 1981); or, does the Mule Mountains thrust represent a shallower exposure of the Chocolate Mountains thrust (Dillon, 1975); or do these two thrust faults share no tectonic relationship except formation by similar geologic processes? If the Mule Mountains thrust is continuous with the Chocolate Mountains thrust, what is the relation between the lower plate rocks, the Orocopia Schist and the Early and (or) Middle Jurassic(?) volcanic rocks? If the rocks of the two lower plates are related, could the protolith of the Orocopia Schist be sedimentary rocks originally deposited in the accretionary wedge of an Early Jurassic(?) subduction zone, and subsequently, during the late Cretaceous and (or) early Tertiary, overridden by an allochthon that may have been exotic to North America (Vedder and others, 1982), or part of the continental margin (Crowell, 1981)? The answers to these questions which remain unresolved, may yet be found in the discontinuous erosional windows of Precambrian and Mesozoic metamorphic and granitic rocks exposed between the Mule-Dome Rock Mountains and the Chocolate-Trigo Mountains (Fig. 1).

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REFERENCES

Anderson, J. L., and Rowley, M. C., 1981, Synkinematic intrusion of peraluminous and associated metaluminous granitic magmas, Whipple Mountains, California: Canadian Mineralogist, v. 19, pt. 1, p. 83-101.

Anderson, T. H., and Silver, L. T., 1978, Jurassic magmatism in Sonora, Mexico [abs.]: Geological Society of America Abstracts with Programs, v. 10, no. 7, p. 359.

Cameron, T. E., and Frost, E. G., 1981, Regional development of major antiforms and synforms coincident with detachment faulting in California, Arizona, Nevada, and Sonora, [Mexico] [abs.]: Geological Society of America Abstracts with Programs, v. 13, no. 7, p. 421-422.

Crowell, J. C., 1981, An outline of the tectonic history of southeastern California, in Ernst, W. G., ed., The geotectonic development of California (W. W. Rubey Volume No. 1): Englewood Cliffs, N. J., Prentice Hall, p. 583-600.

Crowl, W. J., 1979, Geology of the central Dome Rock Mountains: Tucson, University of Arizona, M.S. thesis, 76 p.

Dillon, J. T., 1975, Geology of the Chocolate and Cargo Muchacho Mountains, southeasternmost California: Santa Barbara, University of California, Ph. D. thesis, 405 p.

Frost, E. G., Cameron, T. E., Krummenacher, Daniel, and Martin, D. L., 1981, Possible regional interaction of mid-Tertiary detachment faulting with the San Andreas fault and the Vincent-Orocopia thrust system, Arizona and California [abs.]: Geological Society of America Abstracts with Programs, v. 13, no. 7, p. 455.

Hamilton, Warren, 1971, Tectonic framework of southeastern California [abs.]: Geological Society of America Abstracts with Programs, v. 3, no. 2, p. 130-131.

Harding, L. E., 1980, Petrology and tectonic setting of the Livingston Hills Formation, in Jenney, J. P., and Stone, Claudia, eds., Studies in western Arizona: Arizona Geological Society Digest, v. 12, p. 135-145.

Harding, L. E., Coney, P. J., and Butler, R. F., 1982, Stratigraphy, sedimentary petrology, structure, and paleomagnetism of the McCoy Mountains--Livingston Hills Formations, southeastern California and southwestern Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 14, [in press].

Haxel, G. B., 1977, The Orocopia Schist and the Chocolate Mountain thrust, Picacho-Peter Kane Mountain area, southeasternmost California: Santa Barbara, University of California, Ph. D. thesis, 277 p.

Haxel, Gordon, and Dillon, John, 1978, The Pelona-Orocopia Schist and Vincent-Chocolate Mountain thrust system, southern California, in Howell, D. G., and McDougall, K. A., 1978, eds., Mesozoic paleogeography of the western United States: Los Angeles, Society of Economic Paleontologists and Mineralogists, Pacific Section, Pacific Coast Paleogeography Symposium 2, p. 453-469.

Haxel, Gordon, Tosdal, R. M., May, D. J., and Wright, J. E., 1981, Latest Cretaceous and early Tertiary thrust faulting, regional metamorphism, and granitic plutonism, south-central Arizona [abs.], in Howard, K. A., Carr, M. D., and Miller, D. M., eds., Tectonic framework of the Mojave and Sonoran Deserts, California and Arizona: U.S. Geological Survey Open-File Report 81-503, p. 42-44.

Howard, K. A., Miller, C. F., and Stone, Paul, 1980, Mesozoic thrusting in the eastern Mojave Desert, California [abs.]: Geological Society of America Abstracts with Programs, v. 12, p. 112.

Jennings, C. W., Compiler, 1967, Salton Sea sheet of Geologic map of California: Division of Mines and Geology, State of California, scale 1:250,000.

Marshak, Stephen, 1980, A preliminary study of Mesozoic geology in the southern Dome Rock Mountains, southwestern Arizona, in Jenney, J. P., and Stone, Claudia, eds., Studies in western Arizona: Arizona Geological Society Digest, v. 12, p. 123-133.

May, D. J., Tosdal, R. M., and Haxel, Gordon, 1981, Imbricate thrust faulting of Late Cretaceous or early Tertiary age, Organ Pipe Cactus National Monument, southwestern Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 13, no. 2, p. 95.

Miller, D. M., Howard, K. A., and Anderson, J. L., 1981, Mylonitic gneiss related to emplacement of a Cretaceous batholith, Iron Mountains, southern California, in Howard, K. A., Carr, M. D., and Miller, eds., Tectonic framework of the Mojave and Sonoran

Deserts, California and Arizona: U.S. Geological Survey Open-File Report 81-503, p. 73-75.

Miller, F. K., 1970, Geologic map of the Quartzsite quadrangle, Yuma County, Arizona: U.S. Geological Survey Geologic Quadrangle Map GQ-841, 3 p., scale 1:62,500.

Miller, W. J., 1944, Geology of the Palen Springs-Blythe strip, Riverside County, California: California Journal of Mines and Geology, v. 40, p. 11-72.

Pelka, G. J., 1973, Geology of the McCoy and Palen Mountains, southeastern California: Santa Barbara, University of California, Ph. D. thesis, 162 p.

Powell, R. E., 1981, Geology of the crystalline basement complex, eastern Transverse Ranges, southern California: constraints on regional tectonics interpretations: Pasadena, California Institute of Technology, Ph. D. thesis, 441 p.

Reynolds, S. J., Keith, S. B., and Coney, P. J., 1980, Stacked overthrusts of Precambrian crystalline basement and inverted Paleozoic sections emplaced over Mesozoic strata, west-central Arizona: Arizona Geological Society Digest, v. 12, p. 45-50.

Silver, L. T., 1968, Precambrian batholiths of Arizona [abs.]: Geological Society of America, Cordilleran Section, Programs, 64th Annual Meeting, Tucson, Ariz., 1968, Programs, p. 109-110.

___1971, Problems of crystalline rocks of the Transverse Ranges [abs.]: Geological Society of America Abstracts with Programs, v. 3, no. 2, p. 193-194.

Strand, R. G., Compiler, 1962, San Diego-El Centro sheet of Geologic map of California: California Division of Mines and Geology, scale 1:250,000.

Tosdal, R. M., and Haxel, Gordon, 1982, Two belts of late Cretaceous to early Tertiary crystalline thrust faults in southwest Arizona and southeast California [abs.]: Geological Society of America Abstracts with Programs, v. 14 [in press].

Vedder, J. G. Howell, D. G., and McLean, Hugh, 1982, Stratigraphy, sedimentation, and tectonic accretion of exotic terranes, southern Coast ranges, California: (Paper presented at Hedberg Conference on Continental Margins, 1980).

Wilson, E. D., Moore, R. T., and Cooper, J. R., 1969, Geologic map of Arizona: Arizona Bureau of Mines and U.S. Geological Survey, scale 1:500,000.

Wright, J. E., Haxel, Gordon, and May, D. J., 1981, Early Jurassic uranium-lead isotopic ages for Mesozoic supracrustal sequences, Papago Indian Reservation, southern Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 13, no. 2, p. 115.

FORM 61 - 159 (3)

DUVAL CORPORATION
INTER-OFFICE MEMORANDUM

To: R. A. Metz

Subject: Colorado River Area

From: W. H. Wilkinson

Copy: J. I. Sharpe
P. O. Tyree

Date: January 30, 1984

Pat Wotruba provided the following information in a telephone conversation late Friday. The information is from a friend of his, Mike Brock, who works for AMOCO. AMOCO's project in the Moon Mountains, AZ, called Green Creek (?), is said to contain 16 to 18 million tons of .075 oz/t Au mineralization. It is a low sulfide system with Au occurring on fractures with hematite and local specularite, distinct characteristics of the detachment association. The deposit has a 6:1 stripping ratio and indicated recoveries are 70% but should exceed 80%. AMOCO has projected a $140 million profit over the life of the mine. However, at AMOCO's latest budget meeting, it was decided to sell the property.

This discovery fits the objective stated in the Colorado River Project Proposal of finding a deposit containing one million ounces of Au. They do exist and the relative proximity to Kingman makes the northern part of the area from the proposal particularly attractive.

The above information was proprietary to Pat Wotruba and should be kept Company Confidential.

W. H. Wilkinson

WHW:hdh

1 Feb 84 Conversation w/ Ned Butler
Located in Dome Rock Mtns
18 m.t geologic
12.6 m.t. mineable @ .068 oz/t - 4.5:1 stripping ratio
286.00 / oz production costs
In volcanic rocks (dacite flows ?)

VICEROY RESOURCE CORPORATION(VOY-V,T)

AGGRESSIVE EXPLORATION SEEKS TO INCREASE ORE RESERVES

During the quarter ended 30Jun87, Viceroy Resource Corporation increased its working capital to $18,037,000 as a result of a private placement of 900,000 common shares at $16.78 per share to Hemlo Gold Mines Inc. and James Capel of London. In addition to the private placement, Hemlo will advance $10,000,000 for production financing convertible into 595,948 common shares at $16.78 per share.

The feasibility study on the Castle Mountain gold property in San Bernadino county, California, was submitted in July and concluded that the Project is a higher than average grade open pit heap leach gold mine with favourable operating conditions and low production cost estimates. Projections indicate a highly profitable project at present gold prices.

Extensive metallurgical testing is underway to optimize operating efficiencies. Drilling on all deposits has increased reserves and new reserve calculations will be completed by October. As of May, reserve estimates were 24,000,000 tons grading .060 oz. gold/ton.

The Waste Discharge Permit draft order has been prepared by the Regional Water Quality Control Board and the Plan of Operations has been submitted to the Bureau of Land Management and the State of California agencies for enviromental approval.

Pre-production stripping & construction will begin in Sept. upon approval of the Plan of Operations. Production is planned for 8,000 tons of ore per day, producing approximately 100,000 ounces gold per year.

Upon completion of current condemnation drilling on proposed plant and waste dump locations, an aggressive exploration program will test ten more drill targets identified on Viceroy's exclusive ten square mile area.

Hemlo Gold Mines Ltd. has started its exploration program. Under a joint exploration agreement, Hemlo is required to spend $5,000,000 to earn a 50% interest on the remaining 38 square miles of claims presently 100% owned by Viceroy.

Wade N. Ellet has been appointed vice president of operations of the Castle Mountain project. He has 14 years experience managing mining operations including the Freeport Gold Jerritt Canyon open pit gold mine. E.S.Holt has been appointed vice president, engineering & development. J. Christopher Mitchell has been appointed executive vice president. Mr. Mitchell was the vice president and chief financial officer of CoCa Mines Inc., of Denver. Jack Miller has been appointed senior engineer. Until recently, Mr. Miller was the senior planning engineer at Equity Silver Mines. Gerald Fabbro and John Ivany have joined the Viceroy board of directors.

MUSTO EXPLORATIONS LTD.(MUX-V,T)

MINE SHUT DOWN ANNOUNCED - Musto Explorations Ltd. has shutdown its mining operation in St. George, Utah.

A weakness has developed in the gallium market to the extent that Musto has been unable to sell the gallium production at acceptable prices in July and August, 1987. This has contributed to the shortage of working capital. The longer term outlook for gallium does, however, remain promising.

A carryover of fluorides from the leach into the downstream operations has caused corrosion of the glassware in the germanium refinery. This has forced a shutdown of the refinery.

The company will continue with a number of capital projects designed to increase overall recoveries of both gallium & germanium & to further reduce operating costs. It is estimated that these will take approximately four months to complete. Every effort will be made to raise funds to improve working capital and to reopen the plant.

KAABA RESOURCES INC.(KBR-V)

TEST HEAP LEACH PADS TO BE BUILT - Kaaba Resources Inc., in equal partnership with Alawas Gold Corporation (ALW-V), have contracted a California company under the management of Fred Dotterrer to construct two heap leaching pads on their Picacho Peak gold property in south east California, 20 miles north of Yuma, Arizona. The Picacho Peak gold property is surrounded by Glamis Gold, Eastmaque Gold Mines, and Consolidated Goldfields heap leaching gold operations.

Mr. Dotterrer specializes in heap leaching operations and was recommended by principals of Glamis Gold Ltd. In addition to the construction of heap leaching pads, he will supervise the construction of collections ponds, the processing plant and supply all the equipment necessary for open pit mining. Mr. Dotterrer has previously worked for Beaver Resources

Negotiations are also progressing toward an acquisition of a potential heap leaching, open pit gold property in Arizona. A geochemical survey revealed a large anomalous zone of about 3000 by 7000 feet. Reported drilling results showed an average of 0.02 oz.gold/ton in 28 drill widely spaced drill holes on the property. (See GCNL NO.113(87), P.2 for interest in the Pichacho Peak gold property). Sugarloaf PK.

KILLICK GOLD COMPANY LTD.(KLK-V)

ASSAYS EXPECTED SOON FROM HIGH GRADE SURFACE SHOWING - Killick Gold Company Ltd. has started mining an area where surface sampling assayed 0.152 and 0.27 oz.gold/t. The property is on Adams Plateau, 60 miles east of Kamloops, B.C. The mining encountered tetrahedrite in lime gangue. The silver mineralization is expected to be quite strong. Samples are in for assay. The mining is along 40 feet and the mineral is 12 feet thick. Lateral development of the zone will continue. Mining the central portion of the zone will begin. Killick proposes to continue mining until weather forces a stop approximately Oct.15/87. Then the crew will process the ore in the 50 ton portable lead-zinc-silver-gold flotation concentrator. A crew of 4 is presently mining and hauling ore to the millsite at about sixty tons a day. A report dated 19Jun87 by J.J.McDougall, P.Eng., recommends a $527,000 diamond drilling program of 18,000 feet to test all areas of the claims. The company is considering a joint venture in the diamond drilling and/or flow-through share placement.

GALACTIC RESOURCES LTD.(GLC-V)
NEWMONT MINING CORPORATION
IVANHOE PARTNERS

TAKEOVER PROPOSED - T. Boone Pickens, Jr., has reported Ivanhoe Partners have offered to acquire all of the equity interest in Newmont Mining Corporation in a negotiated transaction for a price of $95 per share in cash.

Ivanhoe Partners currently owns 6,650,000 Newmont shares, representing 9.95% of the total outstanding shares. Ivanhoe Partners is comprised of affiliates of Mesa Limited Partnership, Harbert Corporation, NRM Energy Company, L.P., and Galactic Resources Ltd.

This price represents a significant premium to recent market prices and more than 200% of the price Newmont sold its own shares to the public two months ago.

He said, "We have confidence in the operating and technical expertise of Newmont's existing management and would want that team to remain in place after the acquisition."

With respect to Consolidated Gold Field's 26% stock interest in Newmont, Ivanhoe Partners are willing to discuss a broad range of alternatives to Consolidated's sale of its interest, such as an exchange of its stock interest for direct ownership interests in one or more assets of Newmont or continued ownership by Consolidated of a minority interest in the company.

NICOR MINERAL VENTURES

One of the NICOR basic energy companies

MEMORANDUM

To: Clancy Wendt

From: Gary Parkison

Date: April 1, 1986

Subject: Sugarloaf Peak Submittal - Norm Dausinger

INTRODUCTION

Norm Dausinger, agent for Westworld Oil and Gas, submitted the Sugarloaf Peak gold property to us for joint venture consideration in late February, 1986. The property consists of 84 SP claims and 48 Lizard Lip claims (total 132 claims) covering a contiguous 2640 acres on BLM ground (T4NR20W Secs 33, 34, 35; T3NR20W Secs 2, 3, 4). The area is located just south of I-10 about seven miles west of Quartzsite, La Paz County, Arizona. The topography is quite subdued with low hills except for conical-shaped Sugarloaf Peak.

Westworld originally located the SP claims in November, 1981 over an area previously evaluated for porphyry copper-moly potential. Following extensive surface sampling by Westworld and many other companies examining the property for joint venture participation Westworld drilled ten shallow (250') rotary holes in April, 1983 with interesting results. In 1984 AMSELCO entered into a joint venture on the property which was subsequently terminated in September, 1985 due to company wide cutbacks. AMSELCO drilled eighteen shallow to moderate depth holes with results comparable to Westworlds.

GEOLOGY

The Sugarloaf Peak property is underlain by extensively altered and weakly metamorphosed Mesozoic (Jurassic?) volcanic sandstones (graywackes), lithic tuffs and quartz porphyry intrusives and flows. The general lack of good exposures and the effects of superimposed metamorphic and alteration have hindered the generation of a useable geology map and no map of distribution of rock types is available. Foliation of the generally stratified rocks have shallow to moderate dips to the northwest, north and northeast. Large faults are inferred beneath alluvium whereas some exposed low-angle structures may also be faults of unknown displacement.

Petrographic descriptions of numerous rock samples by Sid Williams has led him to conclude that probable regional metamorphism was superimposed upon an earlier alteration episode, timing similar to that of the Carolina state belt. An alteration map prepared by AMSELCO shows a general increase in alteration intensity from west to east, towards Sugarloaf Peak. The alteration is assumed to have been generally independent of rock type and progresses from propylitic, through sericitic with or without quartz to argillic, including advanced argillic assemblages with alunite, and culminates in quartz-flooded silicified rock. The western half of the prospect area is underlain by the sericitically altered rock with argillically altered rock in the eastern part enclosing local areas of quartz flooded rock. The affects of later metamorphism are difficult to distinguish from the earlier alteration effects, but may have been of greenschist facies with attendent development of some schistosity and foliation.

GEOCHEMISTRY

A fairly comprehensive geochemical data base covers most of the prospect area as well as adjacent areas to the west. AMSELCO in particular took several hundred surface samples in a general E-W trending swath astride Sugarloaf Peak. Geochemical maps have been prepared for Au, Ag, As, Sb, Hg, Te, Tl, Bi, Cu, Pb, Zn and Mo. Au and Ag anomalies are coincident but do not generally relate to anomalies for any other elements. Where Au and Ag anomalies are present they often have associated, elevated As, Sb, Hg and Te values but within a more restricted area than the Au and Ag. Hence, anomalies for Au and Ag do themselves appear to be their own best "pathfinders". Other areas with coincident As, Sb, Hg and Te values but with no associated Au or Ag have been drilled and shown to be barren of Au and Ag at depth as well. For this discussion, anomalous values are Au, >.010 opt, Ag; >.06 opt; As, >30 ppm; Sb, >7 ppm; Hg, >.06 ppm and Te, >.10 ppm.

Anomalous Au and Ag values are commonly restricted to areas underlain by sericitically altered rocks, generally to the west and north of Sugarloaf Peak, and are generally absent in areas of argillic alteration and quartz-flooded rock, although these latter areas host significant enrichments in As, Sb, Hg and Te.

MINERALIZATION

Very little is known about the habit, mode of occurrence or origin of gold mineralization. Based on petrographic descriptions and associated gold values there does not appear to be a general coincidence between gold and any particular rock type.

Nor does there appear to be a positive correlation with pyrite (oxidized and unoxidized) content or silicification. All mineralized samples (>.01 opt gold) do have quartz veinlets, however, suggesting some epigenetic component to the mineralization.

Some gold mineralization appears to be restricted or localized by shallowly-dipping quartz veins with base-metal sulfides, whereas most mineralization may be related to irregular quartz veins. At least locally some gold does appear to be found in very porous, siliceous rocks resembling siliceous sinter material. Much more work obviously needs to be done to define the controls and origin of the mineralization and in particular to decipher the relationship between mineralization and alteration events and the effects of later(?) metamorphism.

A working model for gold mineralization based on little factual data may include:

1. Deposition in a shallow submarine environment of the siliceous volcanic flows and interbedded sediments with contemporaneous subvolcanic intrusions providing a heat source for generation of subaerial and submarine hot springs with related deposition of siliceous sinter.

2. Alteration associated with the hot springs produced the present alteration pattern and is genetically related to gold-silver mineralization. Quartz-flooded zones could represent throats or vents of hot springs with spatially related trace element anomalies.

3. The fairly long lived alteration-mineralization hydrothermal event produced cross-cutting quartz veins and veinlets and redistributed some of the earlier deposited gold.

4. Cessation of the hydrothermal system was followed by regional greenschist facies metamorphism which could have also acted to remobilize gold and other elements to some degree.

5. Weathering and supergene effects have oxidized pyrite, and produced both allophane and alunite veinlets.

DRILLING RESULTS

Drilling results are tabulated in Table 1. Drilling has been fairly widespread and many holes have intersected interesting thicknesses and grades of mineralization, typically aggregating 75-150' of .015-.020 opt gold with .2-.4 opt silver. The mineralized zones are often scattered throughout the hole, however, and no consistent mineralized zone or trend has been defined. An assay log of one of the better holes, SWR-2, is presented as Table 2. Drill holes and associated aggregate grades and thicknesses are shown in Figure 1.

As shown on Figure 1 the most intensely drilled area is west of Sugarloaf Peak with 15 of the total 28 holes drilled in an area about 1200' N-S by 2500' E-S. This area also closely follows the area of consistently high gold values in surface sampling by AMSELCO.

METALLURGY AND ASSAYING

Preliminary metallurgical studies have been performed on composite drill hole cuttings by Dawson Labs and Heinen-Lindstrom. Bottle roll leach tests conducted on both oxide and sulfide zone material at sizes from 1/4 inch to -200 mesh gave gold recoveries from 68 to 72% in 48 hours with fairly low cyanide and lime consumption.

All gold and silver assaying done on the project has been by fire assay performed by AMSELCO, Jacobs and Skyline. Checks between Skyline and Jacobs often show some divergence but with no consistent pattern, suggesting a possible free gold problem. Silver assays also vary from lab to lab and could indicate a matrix problem. The Jacobs numbers agree more closely with results from metallurgical samples. Any further sampling should be large in size (50 lbs) as well as large assay charges, i.e., 5 assay ton.

SUMMARY AND CONCLUSIONS

The Sugarloaf Peak prospect near Quartzsite in western Arizona hosts probable epithermal, hot-springs type gold mineralization in altered and metamorphosed Jurassic(?) volcanic sediments, flows and intrusive rocks. Surface sample results have indicated widespread, high level gold values over that part of the property unerlain by sericitically altered rocks whereas As, Sb, and Te anomalies are more consistently found in peripheral argillically altered rocks. Drilling of 28 holes in both anomalous areas has shown gold values at depth only in areas with anomalous surface gold values. Mineralized holes typically have intercepted scattered zones from 25' to 75' thick averaging from .015 - .020 gold. No "ore grade" intercepts or "ore holes" have been intersected. No distinct mineralized horizon or trend has emerged from work to date.

The widespread and high level gold values and the intriguing geologic setting as well as drill results to date suggest that additional drilling may be warranted in areas not adequately tested to date. One such area is northwest of Sugarloaf Peak in a permissive area about 2000' N-S by 2500' E-W. This area has consistently high gold values somewhat higher and more widespread than the area drilled extensively by AMSELCO. No more than 10 holes of 300' depth should adequately test the potential of this area. Unfortunately, this area is bisected by buried telephone cables, and oil and gas pipelines and a portion of the area is in claims not controlled by Westworld (Figure 2). Information gained through drilling in this area will certainly help in generating a geologic and mineralization model for the entire area. This model will stimulate and guide efforts toward evaluating and/or defining other permissive areas for possible drill testing.

While it is probable that drilling in permissive areas will return values similar to those already known from previous drilling in the area, a doubling of the grade (.04 opt gold) or the discovery of a high grade zone to blend with lower grade mineralization is certainly possible. I recommend that we approach Mr. Dausinger with a proposal to joint venture the property with the provision that we are obligated only to perform 1986-1987 assessment work on the 132 claims via drilling and assaying expenses totaling over $13,200.00. A 3000' drilling program is anticipated with a total budget of about $35,000 or less.

Table 1.

Sugarloaf Peak - Drill Hole Intervals Greater Than 0.01 oz Au/Ton

HOLE NO.	TD	INTERVAL /.01	GRADE	COMMENTS
SWR - 5	340'	85'	.026	Inclined 60°
SWR - 2	400'	185'	.021	Inclined 70°
WW - 2	250'	105'	.020	Vertical
WW - 9	250'	145'	.020	Vertical
SWR - 1	400'	135'	.018	Inclined 70°
SWR - 4	400'	140'	.018	Inclined 70°
SWR - 7	400'	150'	.018	Inclined 60°
SWR - 6	395'	100'	.017	Inclined 60°
SWR - 8	300'	25'	.017	Inclined 45°
WW - 8	250'	205'	.016	Vertical
WW - 1	250'	105'	.015	Vertical
SWR - 3	400'	110'	.014	Vertical
SWR - 9	400'	35'	.014	Inclined 70°
SWR - 11	400'	95'	.013	Inclined 70°
SWR - 13	300'	65'	.013	Inclined 70°
WW - 4	250'	60'	.013	Vertical
WW - 5	250'	130'	.013	Vertical-increase w/dept
SWR - 10	400'	50'	.012	Inclined 70°
WW - 7	250'	40'	.011	Vertical
WW - 3	250'	30'	.011	Vertical
WW - 10	250'	75'	.011	Vertical
SWR - 12	300'	5'	.010	Inclined 70°
WW - 6	250'	NIL	<.010	Increased values w/depth
SWR - 14	740'	NIL	<.010	Inclined 40°
SWR - 17	250'	15'	.010	Inclined 50
SWR - 15	250'	NIL	.010	Inclined 50
SWR - 16	250'	NIL	.010	Inclined 50
Swr - 18	250	NIL	.010	Vertical

Table 2.

SUGARLOAF PEAK PROJECT — assay results from reverse circulation drilling

Hole: SWR-2
Bearing: 0°
Inclination: -70°
Completed: 11-15-84

Interval	Au (oz/t)	Interval	Au (oz/t)	Interval	Au (oz/t)
0- 5	no sample	150-155	.016	300-305	.013
5- 10	.014	155-160	.008	305-310	.023
10- 15	.033	160-165	.019	310-315	.033
15- 20	.009	165-170	.005	315-320	.052
20- 25	.016	170-175	.018	320-325	.008
25- 30	.006	175-180	.034	325-330	.008
30- 35	.002	180-185	.005	330-335	.007
35- 40	.013	185-190	.027	335-340	.005
40- 45	.022 (.023)**	190-195	.006	340-345	.014
45- 50	.018	195-200	.008	345-350	.018
50- 55	.021	200-205	.014 (.013)**	350-355	.006
55- 60	.011	205-210	.011	355-360	.005 (.007)*
60- 65	.008	210-215	.006	360-365	.004
65- 70	.007	215-220	.017	365-370	.010
70- 75	.009 (.011)**	220-225	.006	370-375	.006
75- 80	.003	225-230	.008	375-380	.006 (.006)**
80- 85	.031	230-235	.003	380-385	.022
85- 90	.005	235-240	.008 (.006)**	385-390	.003
90- 95	.034 (.033)*	240-245	.003	390-395	.001
95-100	.020	245-250	.004 (.006)*	395-400 TD	.003
100-105	.020	250-255	.005		
105-110	.009	255-260	.002		
110-115	.004	260-265	.006		
115-120	.005	265-270	.007		
120-125	.034	270-275	.009		
125-130	.014	275-280	.014		
130-135	.011	280-285	.010		
135-140	.015 (.02[redacted]	285-290	.015		
140-145	.008	290-295	.011 (.015)**		
145-150	.058	295-300	.007		

(assay repeat) * Amselco Lab
** Monitor Lab

Intervals >.010 opt gold

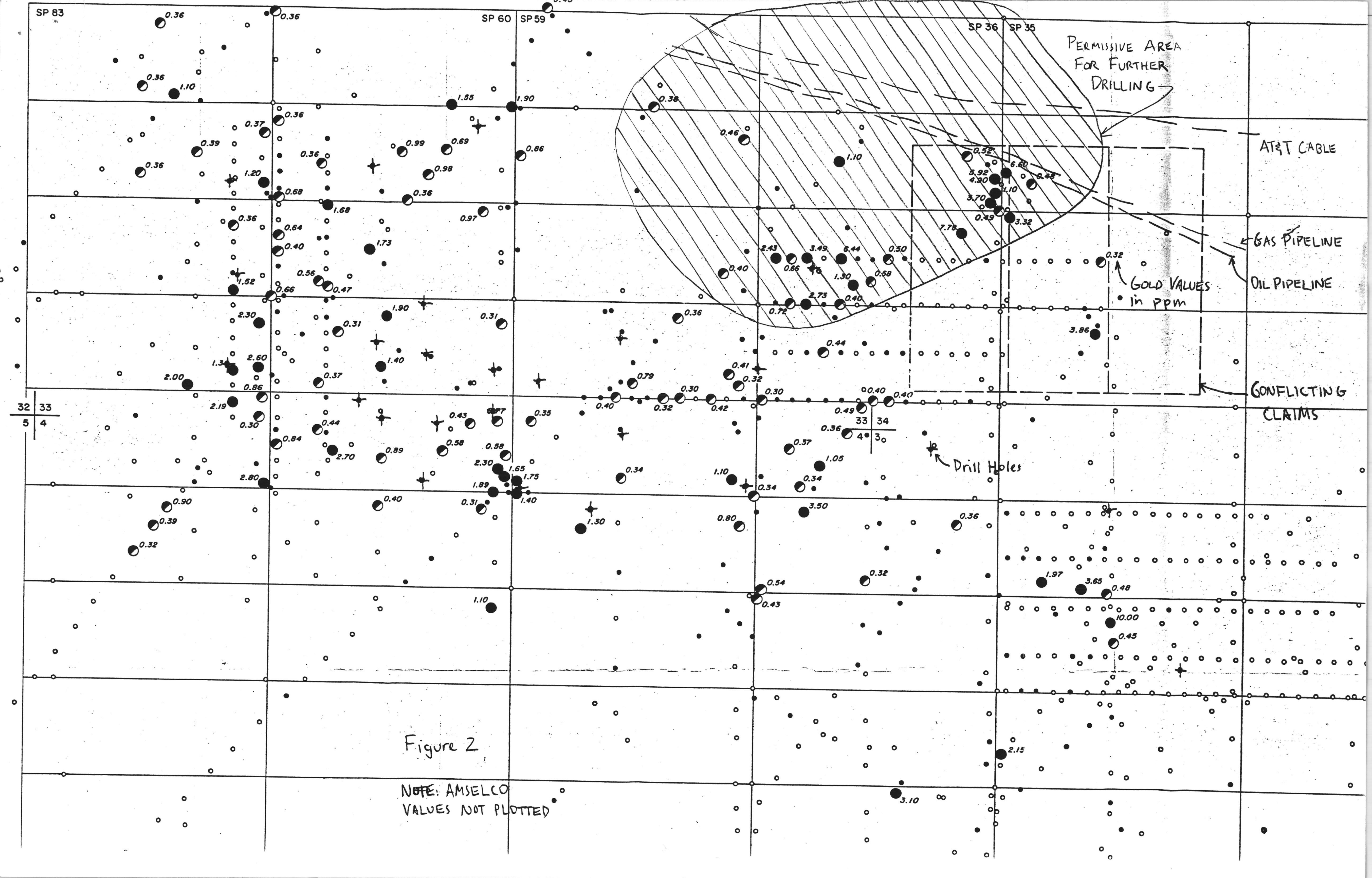
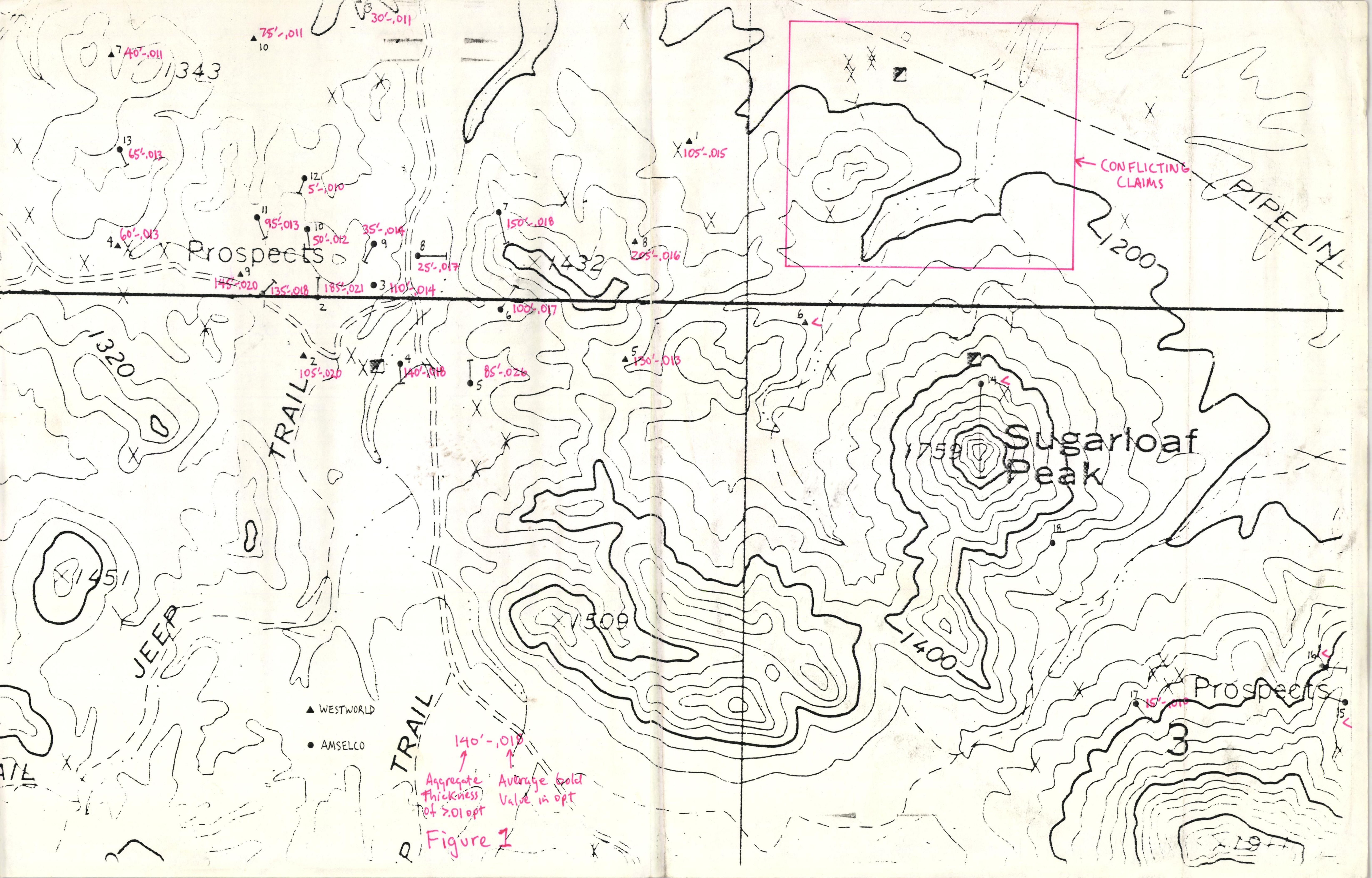


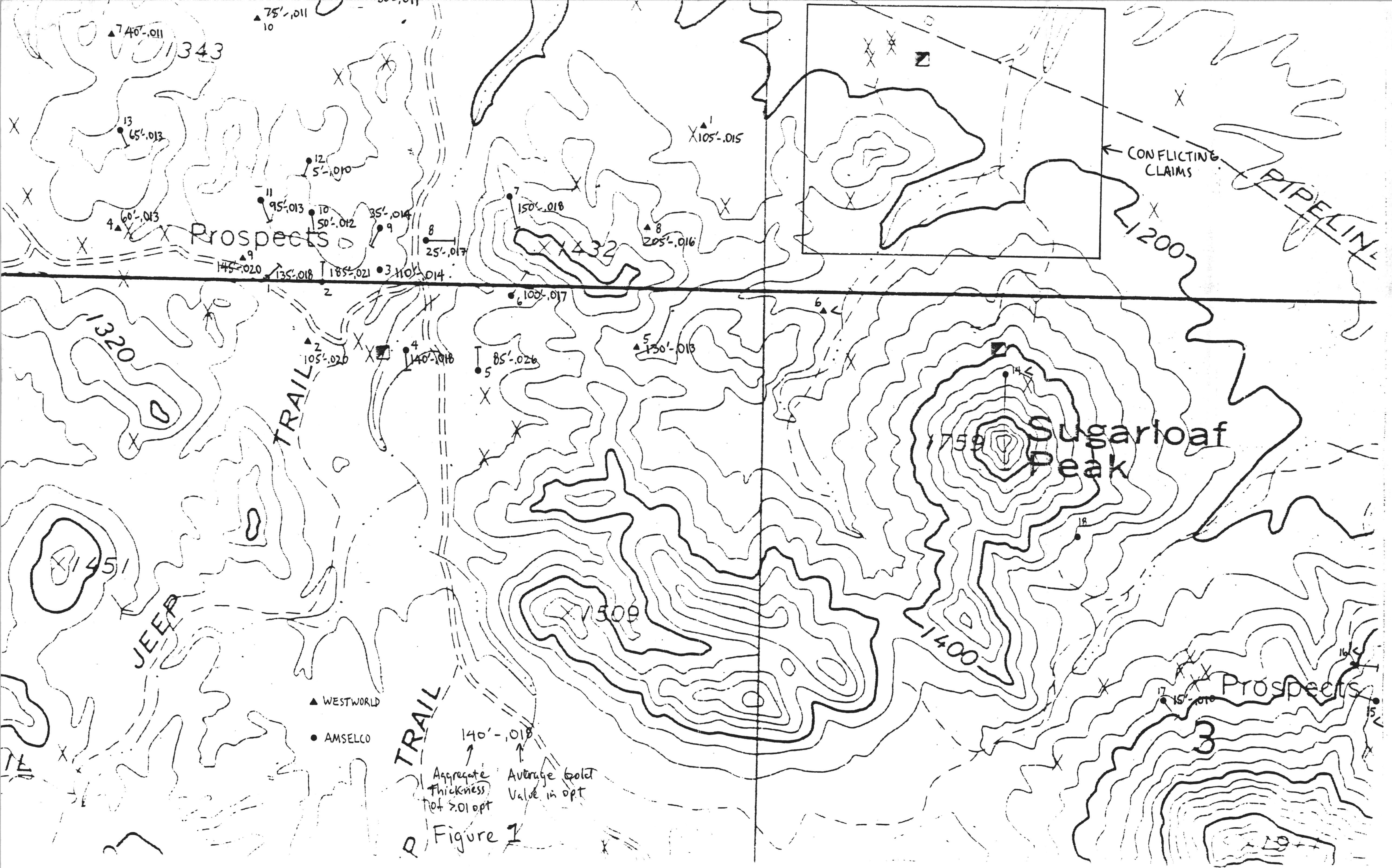
Figure 2

NOTE: AMSELCO VALUES NOT PLOTTED



1343
Prospects
1432
1320
TRAIL
1451
JEEP
TRAIL
1509
1759
Sugarloaf Peak
1400
1200
PIPELINE
CONFLICTING CLAIMS
Prospects
3
WESTWORLD
AMSELCO
75'-.011
30'-.011
40'-.011
65'-.013
5'-.010
95'-.013
60'-.013
50'-.012
35'-.014
150'-.018
205'-.016
105'-.015
25'-.017
145'-.020
135'-.018
185'-.021
110'-.014
100'-.017
105'-.020
140'-.018
85'-.026
130'-.013
15'-.010
140'-.018
Aggregate Thickness of ≥.01 opt
Average Gold Value in opt

Figure 1



Sugarloaf Peak
1759
1509
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1432
1400
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1320
1200
Prospects
Prospects
3
CONFLICTING CLAIMS
PIPELINE
TRAIL
TRAIL
JEEP
WESTWORLD
AMSELCO
140'-.018
Aggregate Thickness of >.01 opt
Average Gold Value in opt
75'-.011
40'-.011
65'-.013
5'-.010
95'-.013
50'-.012
35'-.014
60'-.013
145'-.020
135'-.018
185'-.021
110'-.014
25'-.017
150'-.018
205'-.016
105'-.015
100'-.017
105'-.020
140'-.018
85'-.026
130'-.013
15'-.010

Figure 1

CAMBIOR USA, INC.

FAX ☎ 1-303-773-0733
Facsimile Transmittal Sheet

TRANSMISSION TYPE (✓ One)

☐ NORMAL
☐ PRIORITY
☐ CONFIDENTIAL

NUMBER OF PAGES (Including Transmittal Sheet) 6

DATE May 4, 1993

TO Mike Gustin COMPANY Cambior

FAX №

FROM Gary Parkison

MESSAGE Here is the newer(?) info on Sugarloaf Pk I recently got from Norm Dausinger. Thanks for letting us store the copy machine, etc. in your space, I hope it won't be there too long. Did you get my fax re. the ~~pre~~ SME pre-prints?

Bye!

Gary

FILE:
Sugarloaf Peak,
La Paz Co, Az.

Please call (303) 694-4936 if any problems with this transmission and ask for

NORMAN E. DAUSINGER JR., E. GEOL.
9331 EAST MAGDALENA STREET • TUCSON, ARIZONA 85710 • (602) 296-5993

June 1988

SUGARLOAF PEAK PROJECT, Quartzsite, Arizona

General Comments

The region (SE California and SW Arizona) is of considerable current exploration interest and includes the Mesquite, Picacho, and Copperstone mines. Cyprus and INCO are presently drilling on adjoining claims to the west (SE group) and Breakwater Resources has been drilling to the north across Interstate-10.

Sugarloaf Peak is the largest known gold-silver target in Arizona and exhibits similar characteristics to Mesquite prior to Gold Fields entry at Mesquite in 1980. Gold Fields "model" for this type of disseminated precious metal deposit has been generally described as a "failed" porphyry copper system. Both Mesquite and Sugarloaf were considered as deep porphyry copper targets in the 1960's.

At Mesquite, by 1982, Gold Fields had drilled more than 300 holes (to depths of 500 feet, some to 1000 feet) in an area about 2000 feet long by 1000 feet wide. In contrast, recent drilling at Sugarloaf consists of 28 widespread holes distributed over an area (geochem anomaly) 9000 feet by 3500 feet to average depths of about 250 feet. While another Mesquite cannot be guarenteed, the potential certainly exists with additional exploration/development.

A 1987 computer analysis of the results from the 28 widespread drillholes indicates gold resources on the order of 1 MM ounces. Considering the erratic distribution of gold in nature, under bulk mining conditions, the present indicated grade of 0.02 ounces gold per ton over a sizeable surface area may improve by as much as a factor of 50 per cent. This is true (drill-indicated results versus process heads) even in porhyry coppers where mineralization is more homogeneous.

Four widespread holes in the eastern part of the project indicate a multi-million tonnage resource of pyrophyllite and sericite in separate zones of what is presently interpretated as the "upper clay cap".

NORMAN E. DAUSINGER JR., E. GEOL.
9331 EAST MAGDALENA STREET • TUCSON, ARIZONA 85710 • (602) 296-5993

May 1987

SUGARLOAF PEAK PROJECT
La Paz County, Arizona

General

Located approximately 6 miles west of Quartzsite, Arizona and 0.5 miles south of I-10. Holdings consist of 132 lode claims (2640 acres) controlled by N. E. Dausinger, Jr. and Westworld Inc. within the S½ of sections 33, 34, 35, T4N, R20W and sections 2, 3, 4, T3N, R20W (Middle Camp Mtn. Quadrangle, 7.5 minute series). During 1962-73, the area was unsuccessfully evaluated for deep porphyry copper potential by Congdon and Carey and Kerr McGee.

Recent test drilling (28 holes, 9075 total footage) within a broad surface gold anomaly (4000 by 6000 feet, 0.10 ppm-10.0 ppm), apparently diffused to the north and northwest from a suspected vent feature southwest of Sugarloaf Peak, indicates about 60 million tons, grade of 0.02 ounces gold, 0.30-0.50 ounces silver and possible lead/zinc credits. Accumulated data suggest that the grade, thickness and continuity of mineralization increases to the southeast as does the thickness of the upper clay zone.

Three inclined drill holes, drilled on a bismuth/lead anomaly southeast of Sugarloaf, spaced approximately 1500 feet apart, drilled to 250-foot depths, indicate a pyrophyllite resource zone of at least 50 million tons. This zone is interpreted as being within the thicker, overlying clay zone. These drill holes were essentially devoid of precious metal values (Figure 1 and 2).

The property is currently available on flexible terms.

Geologic Description

Regionally, the area is located within a structurally active zone reflecting plate tectonics, and includes the recently developed gold deposits at Mesquite, Picacho and American Girl in southeastern California and Copperstone in Arizona.

The project area is located within a metavolcanic complex with strong northwest trending structural fabrics. Host rocks are field classified as quartz porphyry schists, whose original characteristics are now masked by post-mineralization, low grade metamorphism, including regional shearing.

The large ovoid feature, interpreted from aerial photos and topography, may reflect broad doming with attendant ring/radial fracturing due to intrusive activity from the east or southeast along a major low angle structure at depth. Accumulated data suggest that the ovoid feature has a central zone of argillic

250

alteration (clay cap) that thickens to the east-southeast and thins to the northwest due to structure and recent erosion. The outer rim of the ovoid feature is a broad ring of propylitic alteration (Figure 1).

From the surface to depth, the area presents a reasonable interpretive model for a "porphyry" precious metal deposit (Figure 2):

1. Remnant metasilicic residue from original hot spring activity. Generally contains anomalous Hg, Au, Te and As. Several zones have been unsuccessfully drill tested for underlying roots.

2. A thick, upper clay zone with extensive bleaching, alunite stockwork/veining, pyrophyllite, sericite, jarosite and limonite derived from pyrite, specularite, "bull" quartz veins, generally anomalous Bi, Pb.

3. A thinning clay zone to the north-northwest from the vicinity of the suspected vent feature, with sericite, quartz-pyrite veinlets, alunite, limonite, jarosite and "bull" quartz veins and anomalous Au. In the northwest corner of the claim block, propylitic alteration was penetrated at shallow depths. The vent feature is considered to have been subject to deeper erosion, thus revealing the broad, diffused gold anomaly north-northwest of the vent.

4. The vent feature may be the plumbing system and principle host for precious metal deposition. A Kerr McGee log of a Congdon and Carey diamond drill hole, located in the northwest corner of section 3, drilled to 700 feet, describes open breccias and increasing silicification with depth. A recent hole, drilled at the same site, indicated increasing gold values (.001 to .01) with depth. A log of another Congdon and Carey hole, drilled to 790 feet depth, located just to the north of the 0.02 contour, Figure 1, indicates increasing silicification with depth. A recent hole located on the 0.02 contour, is bottomed at 250 feet in 0.05 O/T Au.

Future exploration, with an eye to higher grade gold values, should focus on the following:

1. Deeper drilling to the south and east of the trend developed by recent efforts. To the south, the northwest trending lineament may be an important structural control for localizing higher grade precious metal mineralization.

2. Due to thickening of the clay cap to the southeast, testing of the vent feature to at least 500 foot depths.

W. E. Dunn... [signature]

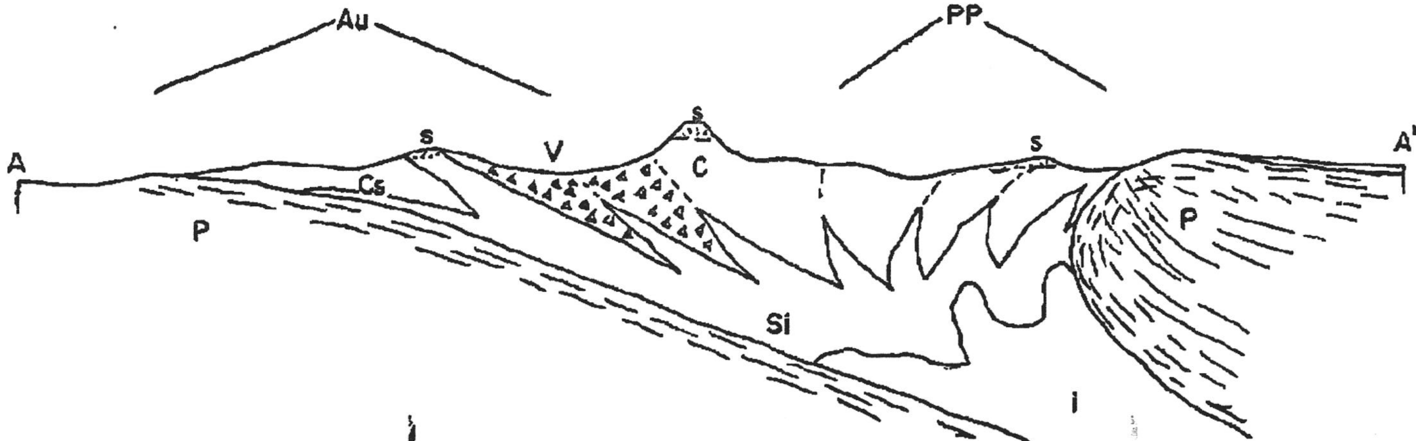


Figure 2.- Interpretive cross section through Sugarloaf Peak area. s- Metasilicic remnants of hot spring activity. C- Thick upper clay zone. Cs- Thinning clay zone. V- Vent feature. Si- Silicic zone, potentially higher grade precious metals. P- Propylitic zone. i- Hypothesized intrusive. Au- Extent of anomalous gold zone. PP- Pyrophyllite resource zone. Scale 1:24,000, vertical scale exaggerated.

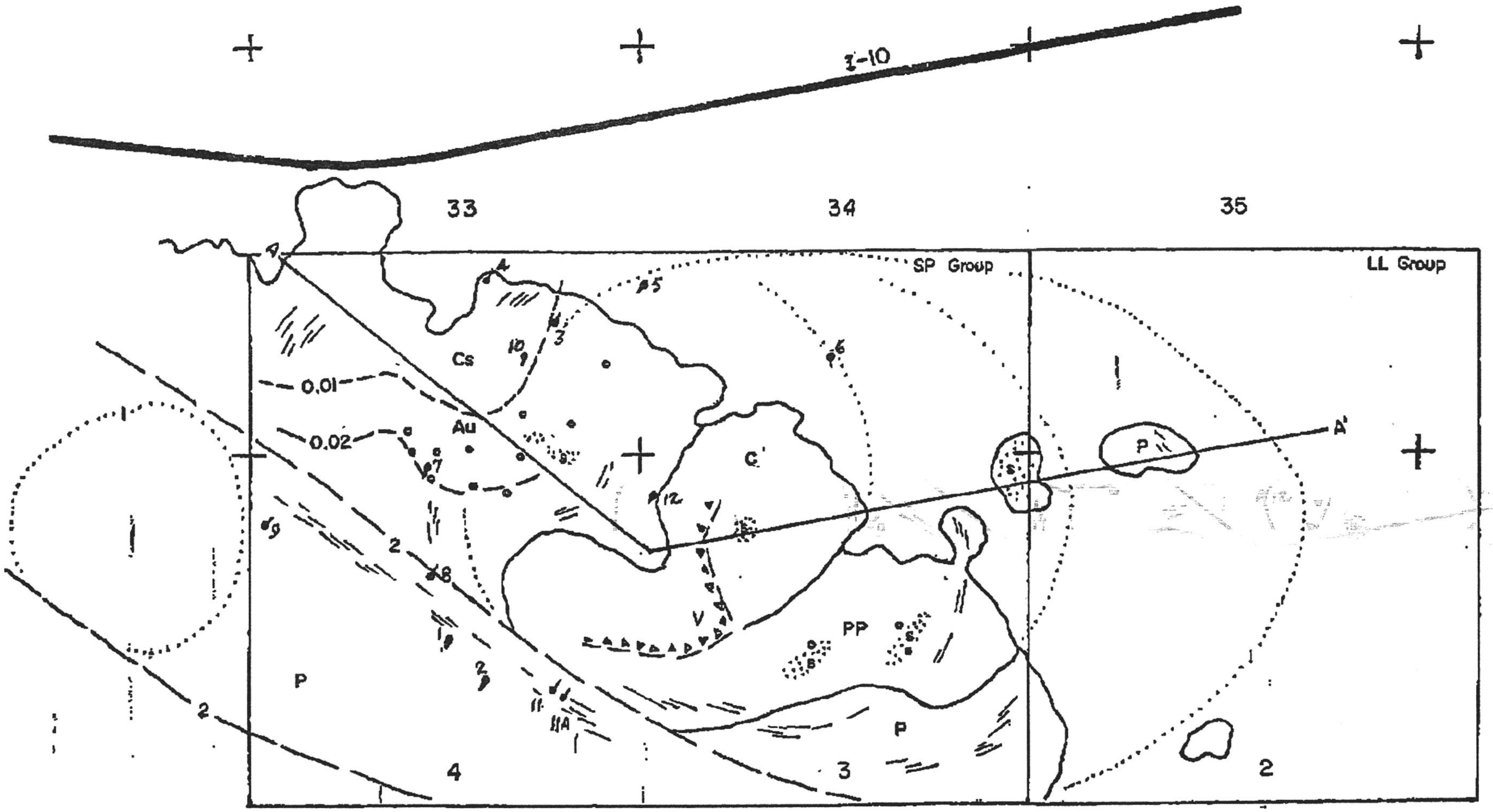
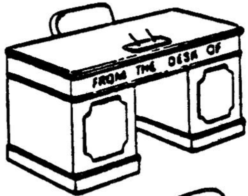


Figure 1.- Generalized plan of Sugarloaf Peak area. 1- Photo/topo ovoid features. 2 - Strong NW photo lineaments. s- Metasilicic remnants of hot spring activity. C- Thick upper clay zone. Cs- Thinning clay zone. V- Vent feature. P- Propylitic zone. Au- Partially drilled anomalous gold zone. Holes plotted have values between 0.015-0.026 O/T Au, cumulative drill intervals of 85 to 205 feet from surface to 250-300 foot depths as defined by contours. PP- Pyrophyllite zone. Holes plotted drilled almost entirely in pyrophyllite, gold values nil. Scale 1:24,000.



5/12/87

To: Hugo Dummett

N. E. [illegible] Jr.

Enclosed is recent summary re Sugarloaf Peak that you may find useful.

With recent increase in Au/Ag prices, there's been a flurry of activity/inquiries.

Saludos,

Norm

Please file

NORMAN E. DAUSINGER JR., E. GEOL.
9331 EAST MAGDALENA STREET • TUCSON, ARIZONA 85710 • (602) 296-5993

May 1987

SUGARLOAF PEAK PROJECT
La Paz County, Arizona

General

Located approximately 6 miles west of Quartzsite, Arizona and 0.5 miles south of I-10. Holdings consist of 132 lode claims (2640 acres) controlled by N. E. Dausinger, Jr. and Westworld Inc. within the S½ of sections 33, 34, 35, T4N, R20W and sections 2, 3, 4, T3N, R20W (Middle Camp Mtn. Quadrangle, 7.5 minute series). During 1962-73, the area was unsuccessfully evaluated for deep porphyry copper potential by Congdon and Carey and Kerr McGee.

Recent test drilling (28 holes, 9075 total footage) within a broad surface gold anomaly (4000 by 6000 feet, 0.10 ppm-10.0 ppm), apparently diffused to the north and northwest from a suspected vent feature southwest of Sugarloaf Peak, indicates about 60 million tons, grade of 0.02 ounces gold, 0.30-0.50 ounces silver and possible lead/zinc credits. Accumulated data suggest that the grade, thickness and continuity of mineralization increases to the southeast as does the thickness of the upper clay zone.

Three inclined drill holes, drilled on a bismuth/lead anomaly southeast of Sugarloaf, spaced approximately 1500 feet apart, drilled to 250-foot depths, indicate a pyrophyllite resource zone of at least 50 million tons. This zone is interpreted as being within the thicker, overlying clay zone. These drill holes were essentially devoid of precious metal values (Figure 1 and 2).

The property is currently available on flexible terms.

Geologic Description

Regionally, the area is located within a structurally active zone reflecting plate tectonics, and includes the recently developed gold deposits at Mesquite, Picacho and American Girl in southeastern California and Copperstone in Arizona.

The project area is located within a metavolcanic complex with strong northwest trending structural fabrics. Host rocks are field classified as quartz porphyry schists, whose original characteristics are now masked by post-mineralization, low grade metamorphism, including regional shearing.

The large ovoid feature, interpreted from aerial photos and topography, may reflect broad doming with attendant ring/radial fracturing due to intrusive activity from the east or southeast along a major low angle structure at depth. Accumulated data suggest that the ovoid feature has a central zone of argillic alteration (clay cap) that thickens to the east-southeast and thins to the northwest due to structure and recent erosion. The outer rim of the ovoid feature is a broad ring of propylitic alteration (Figure 1).

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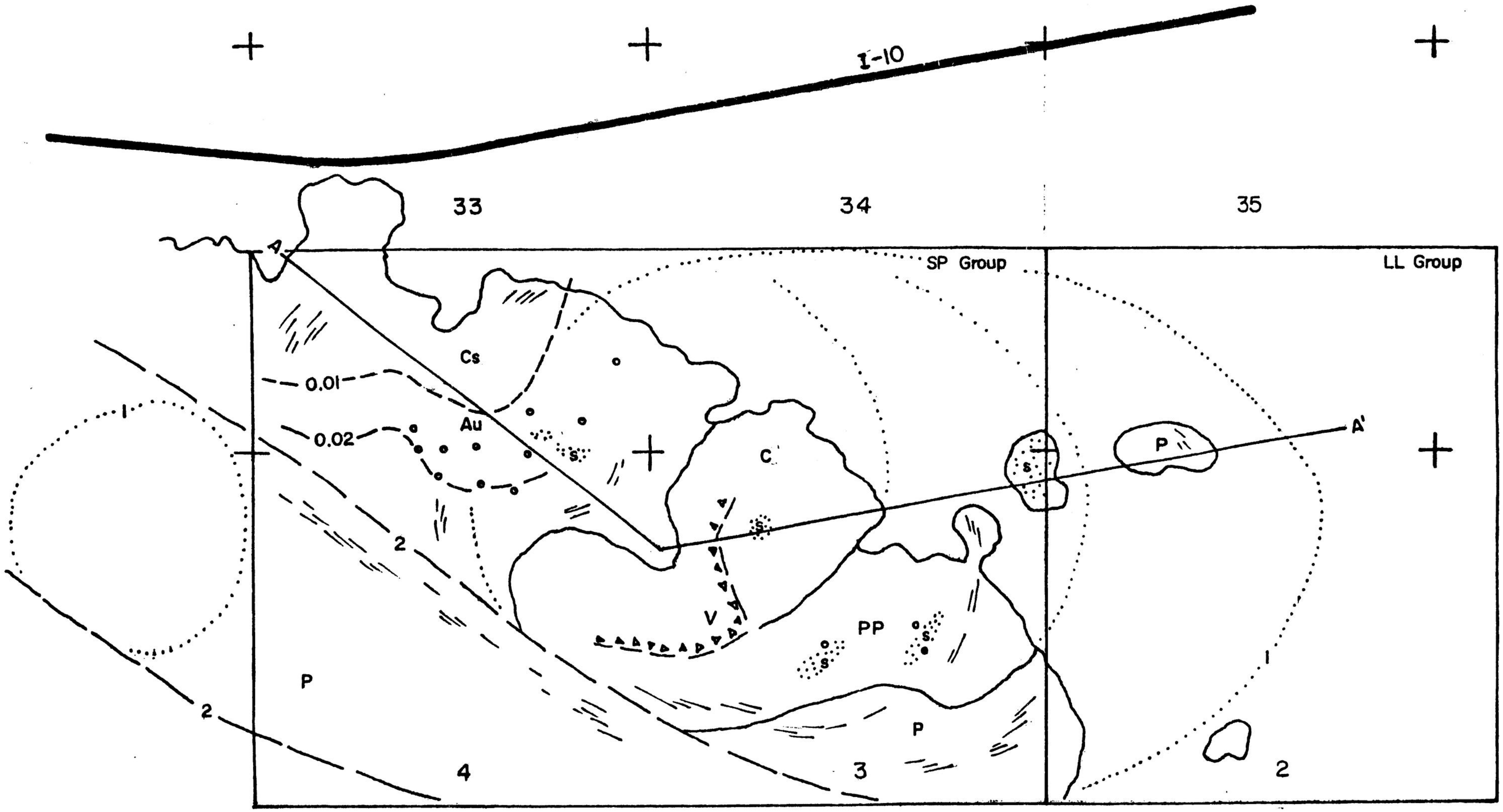


Figure 1.- Generalized plan of Sugarloaf Peak area. 1- Photo/topo ovoid features. 2 - Strong NW photo lineaments. s- Metasilicic remnants of hot spring activity. C- Thick upper clay zone. Cs- Thinning clay zone. V- Vent feature. P- Propylitic zone. Au- Partially drilled anomalous gold zone. Holes plotted have values between 0.015-0.026 O/T Au, cumulative drill intervals of 85 to 205 feet from surface to 250-300 foot depths as defined by contours. PP- Pyrophyllite zone. Holes plotted drilled almost entirely in pyrophyllite, gold values nil. Scale 1:24,000.

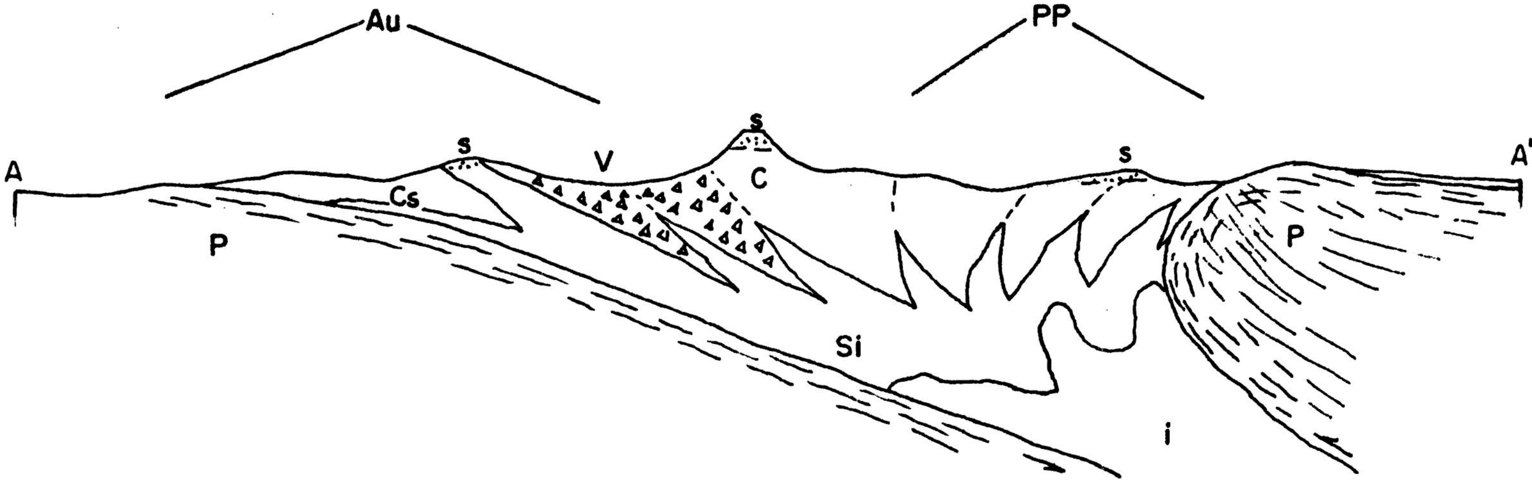
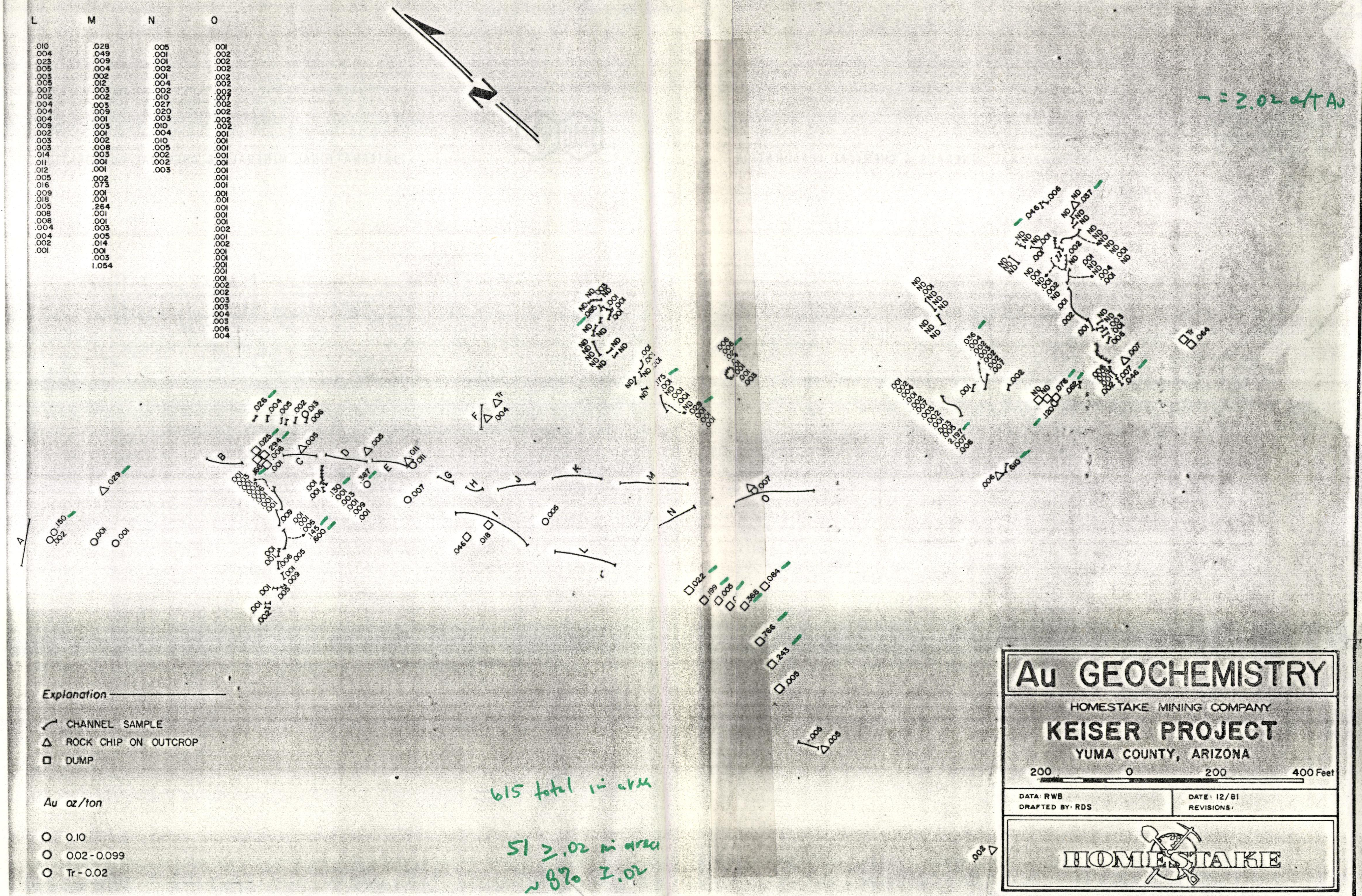


Figure 2.- Interpretive cross section through Sugarloaf Peak area. s- Metasilicic remnants of hot spring activity. C- Thick upper clay zone. Cs- Thinning clay zone. V- Vent feature. Si- Silicic zone, potentially higher grade precious metals. P- Propylitic zone. i- Hypothesized intrusive. Au- Extent of anomalous gold zone. PP- Pyrophyllite resource zone. Scale 1:24,000, vertical scale exaggerated.

L	M	N	O
.010	.028	.005	.001
.004	.049	.001	.002
.023	.009	.001	.002
.005	.004	.002	.002
.003	.002	.001	.002
.005	.012	.004	.002
.007	.003	.002	.002
.002	.002	.010	.007
.004	.003	.027	.002
.004	.009	.020	.002
.004	.001	.003	.002
.009	.003	.010	.002
.002	.001	.004	.001
.003	.002	.010	.001
.003	.008	.005	.001
.014	.003	.002	.001
.011	.001	.002	.001
.012	.001	.003	.001
.005	.002		.001
.016	.073		.001
.009	.001		.001
.018	.001		.001
.005	.264		.001
.008	.001		.001
.008	.001		.001
.004	.003		.002
.004	.005		.001
.002	.014		.002
.001	.001		.001
	.003		.001
	1.054		.001
			.001
			.001
			.002
			.002
			.003
			.003
			.004
			.003
			.006
			.004

— = ≥.02 o/T Au



615 total in area

51 ≥.02 in area

~8% ≥.02

Explanation

CHANNEL SAMPLE

△ ROCK CHIP ON OUTCROP

□ DUMP

Au oz/ton

○ 0.10

○ 0.02 - 0.099

○ Tr - 0.02

Au GEOCHEMISTRY

HOMESTAKE MINING COMPANY

KEISER PROJECT

YUMA COUNTY, ARIZONA

200 0 200 400 Feet

DATA: RWB
DRAFTED BY: RDS

DATE: 12/81
REVISIONS:

HOMESTAKE

390 FREEPORT BLVD., SUITE 12 • SPARKS, NEVADA 89431

INTERNATIONAL MINERALS & CHEMICAL CORPORATION

0 FREEPORT BLVD., SUITE 12 • SPARKS, NEVADA 89431

INTERNATIONAL MINERALS & CHEMICAL CORPORATION

Surface smpls.

RAA - NERCO smpl. results

≥ .02

18 - 4
18 - 7
18 - 6
18 - 5
18 - 3
18 - 0
18 - 8
18 - 3
18 - 0
18 - 0
11 - 0
95 - 22

286 - 54 = 19% smpls ≥ .02 opt Au

Nevestake

615 - 51 = 8% smpls ≥ .02 opt Au

Drill Holes, ≥ .02 opt Au

82-1 50-55 - .024
82-2 85-90 - .033 ; 100-105 - .020 ; 105- - .035 ; 125 - .072
82-3 55-60 - .020 ; 190 - .158 ; 195 - .043 ; 215 - .036 ; 240 - .036
82-4 140 - .047 ; 145 - .029 ;
82-5 none
82-6 5-10 - .021 ; 35 - .175 ;
82-7 none
82-8 240 - .042 ; 245 - .025 ; 255 - .028 ; 260 - .044 ;
265 - .030 ; 270 - .059
82-9 none
82-10 65-70 - .071 ; 100 - .020 ; 190 - .031 ; 195 - .028 ;
200 - .032 ; 240 - .022

A	B	C	D	E	F	G	H	I	J	K	L
.002	.006	.029	.003	.003	.001	.015	.002	.017	.002	.001	.010
.040	.001	.005	.001	.002	.003	.004	.008	.005	.002	.008	.004
.003	.002	.008	.002	.007	.014	.007	.001	.013	.006	.001	.023
.001	.002	.005	.001	.015	.031	.008	.002	.008	.002	.003	.005
.001	.025	.003	.002	.007	.002	.002	.001	.003	.010	.002	.003
.002	.153	.001	.001	.007	.009	.006	.004	.004	.005	.003	.005
.001	.016	.001	.002	.002	.004	.081	.001	.128	.005	.003	.007
.002	.003	.001	.002	.003	.002		.139	.009	.009	.002	.002
.035	.008	.001	.001	.003	.035			.002	.002	.002	.004
.001	.001	.001	.002	.002	.007			.075	.004	.001	.004
.003	.001	.003	.020	.002	.004			.001	.002	.002	.004
.001	.001	.003	.175	.001	.003			.013	.004	.001	.009
.001	.004	.002	.005	.002	.017			.116	.002	.002	.002
.018	.009	.002	.002	.002	.001			.053	.001	.001	.003
.029	.004	.002	.002	.093	.004			.003	.001	.002	.003
.001	.009	.004	.002	.001	.004			.005	.001	.002	.014
.001	.003	.002	.002	.003	.002			.005		.005	.011
.007		002	.001	.001	.002			.491		.001	.012
.006			.001	.003	.004			.023		.005	.005
.001				.007	.007			.105		.001	.016
								.001		.001	.009
								.003		.001	.018
								.002			.005
								.005			.008
								.002			.008
								.006			.004
								.004			.004
								.001			.002
								.002			.001
								.008			
								.007			
								.005			
								.013			
								.004			

Explan

CH

RO

DU

Au oz

0.1

0.0

Tr -

The geology of the McCoy Mountains Formation, southeastern California and southwestern Arizona

Geological Society of America Bulletin, v. 96, p. 755–769, 11 figs., 2 tables, June 1985.

unrecognized may be widely distributed through the rocks that make up the outer crust of the earth. The gases thus far examined have all been obtained at relatively high temperatures—360° to 850° C. In the presence of water vapor or hydrogen ammonia gas is developed from a nitride. It would be interesting to discover if possible whether similar gases are evolved from rocks in the slow processes of weathering and subaerial denudation and whether these conditions and the influence of bacteria might produce nitrates which would be carried in solution and concentrated at favorable places by evaporation.

USGS Bull 620, 1915

GOLD DEPOSITS NEAR QUARTZSITE, ARIZONA.

By Edward L. Jones, Jr.

INTRODUCTION.

This report is based on information obtained by the writer in April and May, 1914, while he was classifying the lands in the Colorado River Indian Reservation. The area considered includes the southern part of the reservation and the region extending eastward from the reservation to the Plomosa Mountains. The geology and ore deposits within the reservation were more particularly studied, the time allotted to the examination being too short to permit detailed work in the area farther east. For information concerning placers outside the reservation the writer is indebted to Mr. E. L. Dufourcq, who conducted the testing of placer ground near Quartzsite. Mr. W. W. McCoy, of San Bernardino, kindly furnished the early history of the La Paz district, and Mr. Edward Beggs, of Quartzsite, gave much useful information regarding the La Paz placers. In 1909 Howland Bancroft[1] made a geologic reconnaissance of northern Yuma County and much of the country around Quartzsite and farther west to the reservation line. In his report he mentions the La Paz district and briefly describes placers in the Plomosa Mountains and prospects on gold-bearing quartz veins in the vicinity of Quartzsite.

The map that accompanies the present report (Pl. IV) is compiled from the records of the General Land Office. The area within the reservation has been subdivided into sections; the land east of the reservation is unsurveyed. The mountainous areas in the reservation are indicated on this map by patterns showing the geologic rock formations; the mountains in the unsurveyed area are represented approximately by hachures.

GEOGRAPHY.

The topography of southwestern Arizona is characterized by small detached, generally northward-trending mountain ranges separated by broad aggraded desert plains. Quartzsite lies in the broad basin

[1] Bancroft, Howland, Reconnaissance of the ore deposits in northern Yuma County, Ariz.: U. S. Geol. Survey Bull. 451, 1911.

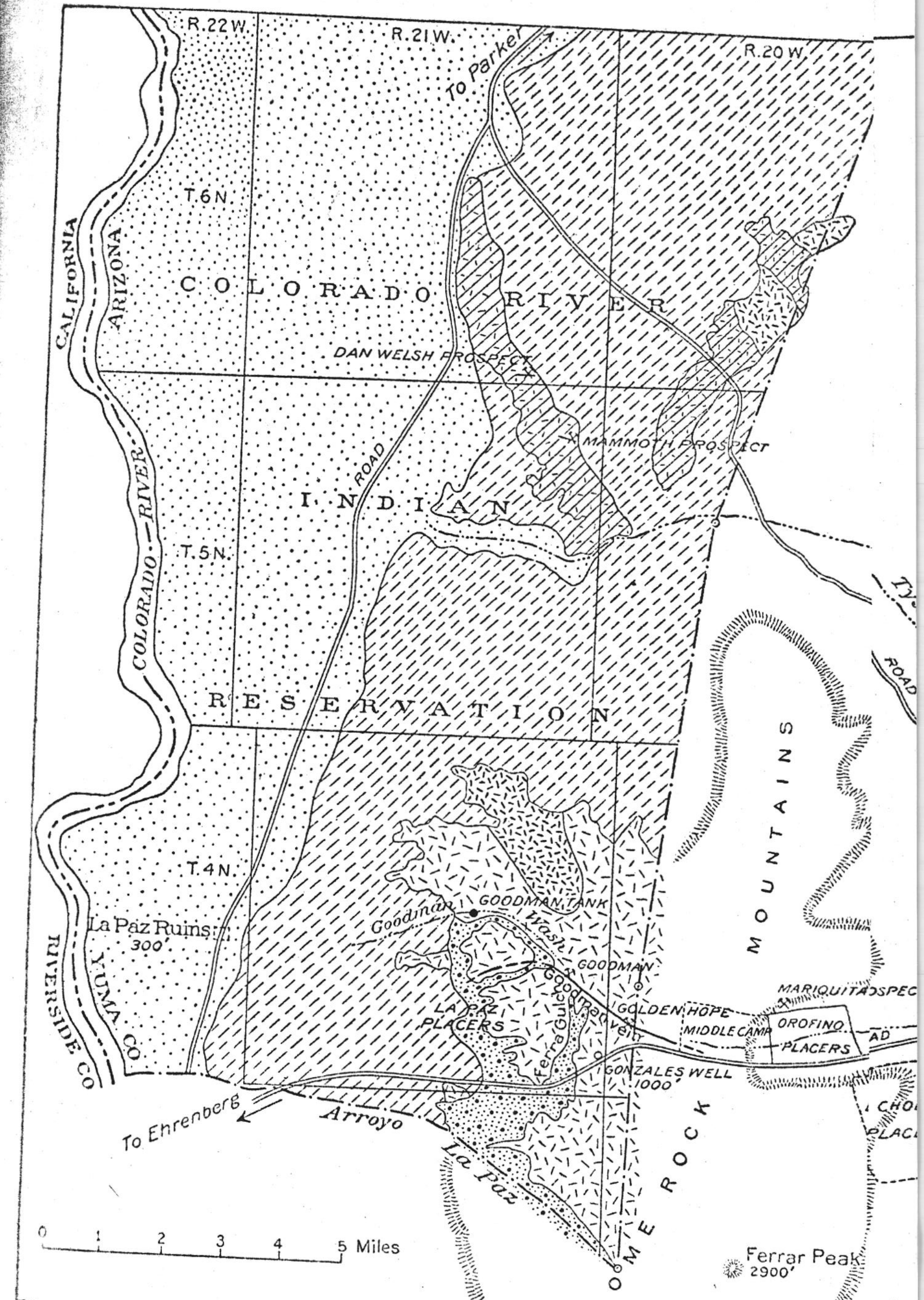
of Tyson Wash at the northern end of La Posa plain, in southwestern Arizona, between the Plomosa Mountains on the east and the Dome Rock Mountains on the west, at an elevation of about 850 feet. The distance between the Plomosa and Dome Rock mountains at the narrowest part of the plain is probably not less than 6 miles. Quartzsite is in the west-central part of Yuma County and is best reached by a daily automobile stage line, 25 miles long, from Bouse, Ariz., a station on the Arizona & California branch of the Atchison, Topeka & Santa Fe Railway. A road leading westward from Quartzsite traverses the southern end of the reservation and one leading southward traverses the broad stretch of desert to Yuma.

Most of the mountains in this region attain elevations not exceeding 2,000 feet above the surrounding desert. Ferrar Peak, 2,900 feet high, is the highest elevation near Quartzsite. The two small outlying ridges north of Tyson Wash rise not more than 800 feet above the surrounding bench lands, but the average relief is less than 500 feet. Gravel and wash covered bench lands slope gently westward from the Dome Rock Mountains nearly to Colorado River, where usually there is an abrupt descent of 100 feet to the river bottom lands.

Many shallow arroyos or washes drain to Colorado River, but none of them carries surface waters. Of these, Tyson Wash and Arroyo La Paz are the most prominent. Tyson Wash, with a length of 50 miles, heads south and west of Quartzsite in several branches which unite and drain northward to the north end of the Dome Rock Mountains, where the channel turns sharply westward and debouches on the Colorado River bottom lands. Tyson Wash carries an underground water flow at Quartzsite, where small tracts are irrigated from shallow wells operated by windmills or small gasoline pumps. Arroyo La Paz heads in the Dome Rock Mountains and for most of its course forms the southern boundary of the Colorado River Indian Reservation. The water supply in the vicinity of the placer camps is very scanty. Water of a rather inferior quality is furnished by Gonzales well, near the reservation line, and a small or uncertain supply is obtained from "tanks" or holes eroded in the bedrock of arroyos. Of these, Goodman tank is the best known and most accessible, but even this water must be piped from depths of several feet from the sands that fill the excavation. The placers in the Plomosa Mountains were supplied with water through pipe lines leading from the wells near Quartzsite.

The climate of the region is extremely arid. The mean annual precipitation at Parker,[1] near the north end of the reservation, is

[1] Bancroft, Howland, Reconnaissance of the ore deposits in northern Yuma County, Ariz.: U. S. Geol. Survey Bull. 451, p. 13, 1911.



MAP SHOWING GEOLOGY OF SOUTHERN PART OF COLORADO RIVER INDIAN NEAR QUARTZSITE, ARIZ.

plain, in southwestern
the east and the Dome
of about 850 feet. The
mountains at the nar-
than 6 miles. Quartz-
ty and is best reached
, from Bouse, Ariz., a
of the Atchison, To-
estward from Quartz-
ation and one leading
to Yuma.
elevations not exceed-
Ferrar Peak, 2,900 feet
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relief is less than 500
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Colorado River, but
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Wash, with a length
e in several branches,
nd of the Dome Rock
stward and debouches
Wash carries an under-
tracts are irrigated
mall gasoline pumps.
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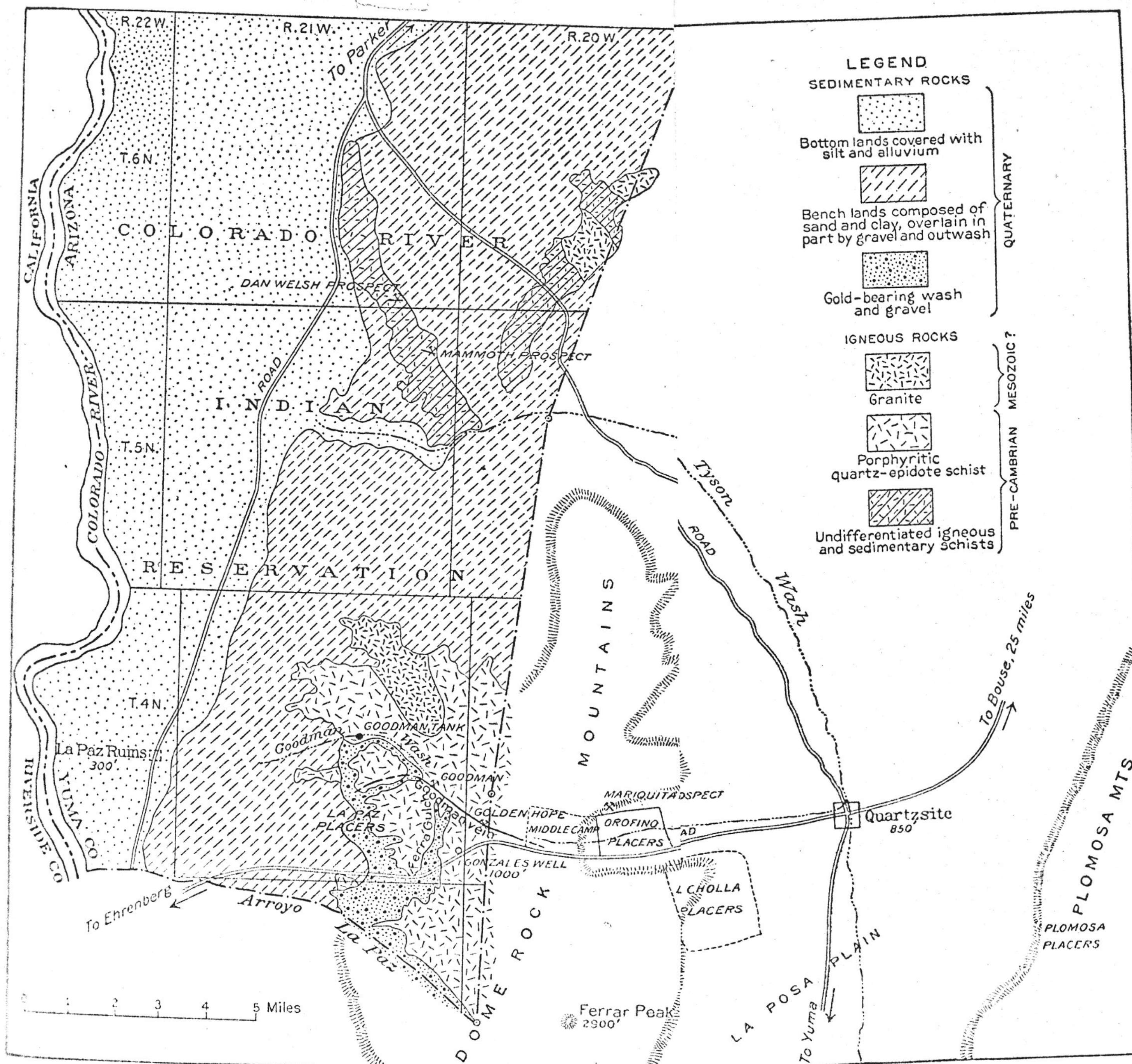

MAP SHOWING GEOLOGY OF SOUTHERN PART OF COLORADO RIVER INDIAN RESERVATION AND LOCATION OF PLACERS NEAR QUARTZSITE, ARIZ.

only 4.27 inches, and the mean annual temperature for a period of 12 years is 70.9° Fahrenheit. The summer is intensely hot, and work in the open is then almost impossible, but the winter is delightful. The vegetation of the region is scanty and includes no trees suitable for use as mining timber. The bottom lands of Colorado River support good growths of willow and mesquite and a few cottonwoods; in the larger arroyos there are sparser growths of thorny shrubs, including ironwood, ocotillo, palo verde, and mesquite; and on the bench lands and hill slopes there are several varieties of cactus and small shrubs.

GEOLOGY.

Character of the rocks.—In this investigation detailed geologic work was done only in the part of the Dome Rock Mountains that is included in the reservation, but the general geology of the Plomosa Mountains and the southern part of the Dome Rock Mountains is described by Bancroft.[1] Igneous and sedimentary rocks in complex association compose these mountains, and they range from pre-Cambrian schists and gneisses to Tertiary or Quaternary volcanic rocks. The placer areas specifically examined in the Dome Rock Mountains and in that part of the Plomosa Mountains here referred to are composed of intrusive igneous rocks, some of which are of schistose structure and others of holocrystalline granitic texture. The ages of these rocks could not be determined from the geologic evidence near by, although the schist is believed to be of pre-Cambrian age and the granite much younger and probably of Mesozoic age.

The ridges north of Tyson Wash are composed of intermixed schistose sedimentary and igneous rocks, into which are intruded narrow dikes of basic rocks, dikes and irregular masses of pegmatite and aplite, and an area of granite similar to that in the La Paz district. The metamorphosed sedimentary and igneous rocks are not differentiated on the map (Pl. IV). The rocks of sedimentary origin range from fine-grained silvery-white sericite schists to coarse-grained biotite schists with interbedded thin marble beds. Granite gneiss, amphibolite schist, quartz-epidote schist, and granite comprise the larger igneous masses in these ridges. Lava flows of Tertiary and Quaternary age occur throughout the eastern part of the Plomosa Mountains a short distance east of the area here considered.

Quartz-epidote schist.—A greenish-gray to black schistose porphyritic rock occupies the larger part of the Dome Rock Mountains within the reservation and probably much of the mountainous area east of the reservation. It forms relatively smaller areas of the ridges north of Tyson Wash. According to Bancroft it is the coun-

[1] Op. cit., pp. 22–36.

try rock in the vicinity of the New York-Plomosa placers east of Quartzsite. The rock is composed of quartz, orthoclase, and altered feldspars, some of calcic composition, more or less inclosed in an aggregate of epidote, sericite, chlorite, hornblende, and calcite. Locally magnetite is an important constituent. The rock exhibits varying degrees of schistosity, but large exposures show well-marked planes which trend from east-west to northwest-southeast and dip at an average of 30° to the north and northeast. The quartz-epidote schist is believed to have been derived from an intrusive igneous rock, probably a quartz monzonite or quartz diorite porphyry. This rock is of economic importance, for it contains the gold-bearing quartz veins in the La Paz district from which the placer deposits are derived.

Granite.—North of Goodman tank a light-colored granitic rock occupies a considerable area in the main Dome Rock Mountains and occurs in smaller masses in the ridges north of Tyson Wash. The rock is commonly of a medium-grained holocrystalline texture, but in places is coarsely granular, approaching a pegmatite. The crys- tals of quartz and feldspar are commonly intergrown. Orthoclase, oligoclase, and albite comprise the feldspars. Ferromagnesian min- erals are variable constituents of the granite; in some localities they are practically absent or consist of sparsely distributed biotite and chlorite; in other localities hornblende, biotite, and chlorite are fairly abundant. The granite intrudes the quartz diorite and other schistose rocks of the region, and, as shown by the absence of dynamic meta- morphism, is of much later age. The granite gneiss differs from the granite in composition by the arrangement of abundant biotite crys- tals in flow lines. Amphibolite and some of the biotite schists prob- ably are derived from diabase and diorite.

Quaternary deposits.—Between the Plomosa and the Dome Rock mountains lies the gravel and wash covered desert of Quaternary deposits. Flanking the mountainous areas within the reservation, with their eastern limits undetermined, are the bench lands com- posed of unconsolidated sands, clays, and gravels deposited by Colo- rado River in Quaternary time during periods of aggradation. This bench-lands formation is correlated with the Chemehuevis gravel, as described by Lee,[1] who noted it at many places along Colorado River. Rapid erosion of the mountainous areas under desert condi- tions has produced thick wash deposits in the gulches and alluvial fans that extend for short distances from the base of the mountain slopes over the bench-lands formation. This material is unassorted and consists of angular rock fragments and sand. In the reservation

[1] Lee, W. T., Geologic reconnaissance of a part of western Arizona: U. S. Geol. Survey Bull. 352, pp. 43–47, 1908.

this wash is unconsolidated, but placer operators report that on the eastern slopes of the Dome Rock Mountains a cemented wash is over- lain by incoherent material, and Bancroft reports that the placer workings in the Plomosa Mountains are in a conglomerate of the older rock fragments cemented by lime carbonate.

The bottom lands lying in the flood plain of Colorado River are deposits of river silt. During floods the plain is rapidly built up by fresh silt deposited from the heavily charged river waters.

PLACER MINES.

History.—Placer mining in this part of Arizona closely followed the discovery of the La Paz diggings. Part of the early history of these workings, in addition to that given by Mr. W. W. McCoy, was obtained from the report of J. Ross Browne in "Mineral resources of the States and Territories west of the Rocky Mountains," published in 1868. In January, 1862, Capt. Pauline Weaver was trapping along Colorado River, and at times would stray off into the mountains on prospecting trips for gold. The Indians, with whom he was on friendly terms, gave him some nuggets and, after Weaver had organized a party from Yuma, conducted him to the source of the gold. The party picked up $8,000 in nuggets within a short time, but had to return to Yuma, 150 miles distant, for pro- visions. A rush from southern California and Arizona points immediately started for these placers, and within a short time hundreds of miners were prospecting the country around the original location.

The town of La Paz was established at the base of the bench lands near the river, the houses being constructed of adobe bricks. La Paz soon became the supply point of the surrounding region, and maintained its population of about 1,500 until 1864, when, with the apparent exhaustion of the placers and the discovery of new diggings, large numbers left the district. From this time the popula- tion steadily decreased, until, with the creation of the additions to the Colorado River Indian Reservation in 1873, 1874, and 1876, which included much of the placer ground and greatly restricted mining, La Paz was practically deserted, and the site of the once flourishing town is now marked only by disintegrating adobe buildings.

The old placer workings are in the gulches and on the western hill slopes of the Dome Rock Mountains, from 6 to 8 miles from La Paz. Water at the diggings had either to be hauled from La Paz or a small supply obtained from the Goodman tank. Mr. McCoy states that water packed from La Paz to the placers brought $5 a gallon during the rush period. The gold was recovered entirely by dry washing in gold pans or wooden bowls called "bateas." Picks and shovels were used to break up and handle the gold-bearing material, these implements being supplemented by Mexican miners by a steel bar 2 feet long. With such crude methods, it is apparent that only the coarser gold could be saved and only ground extremely rich would be payable. Nevertheless, it is estimated[1] that $1,000,000 was recovered in the first year, and as much more in each following year until 1868. Since that time the production probably has been comparatively small. The gold particles or nuggets ranged in value from 5 cents to $10, although $20 and $40 pieces were not uncommon, and the largest piece, or "chispa," taken out, found by Juan Ferrar, was valued at $1,160. The production per man per day frequently exceeded $100. With the introduction of the "dry-washer" machine, a few years after the district was discovered, greater quantities of material could be handled and a large saving of the gold effected, although by that time the richer ground had largely been worked over.

Dry-washer machines.—The machines used in "dry washing" are of several types, but probably the most efficient is that of the "bellows" type. In capable hands 6 cubic yards of material can be handled by a machine of the largest type by one man in eight hours, and the capacity of those of the smaller types, more commonly used, is 2 yards a day. The machine consists of a wooden rramework, to which is attached a coarse screen, hopper, crank and gears, riffle board, and bellows. The material is passed through a screen having a quarter-inch mesh into a hopper having a capacity of 1 cubic foot, and then passes on to the inclined riffle board, 10 by 20 inches, which also is a screen surface with wooden riffles at right angles to its length. The pulsations of the bellows keeps the material in motion. Underneath the riffle board is a muslin cloth, stretched over the air chamber. The power for operating the bellows is a crank on geared wheels, and as the material passes over the riffle board the heavier particles are intercepted by the riffles and drop through the screen on to the cloth, while the waste material passes over the end of the board or is blown away by the air blast. The gold is obtained by panning the concentrates. It is apparent that the gold-bearing wash must run well above 50 cents per cubic yard in order that the operator may make miner's wages. Sporadic placer mining has been done with this machine by the miners at Quartzsite, but because of the variability of the gold content of the wash and the limitations of the machine no large areas have been thoroughly or continuously worked.

Areas of gold-bearing wash.—In the La Paz district the principal gulches or arroyos in which the gold-bearing wash occurs or to which

[1] Browne, J. R., Mineral resources of the States and Territories west of the Rocky Mountains, 1868.

the richest gulches are tributary are Goodman Arroyo and Arroyo La Paz, an arroyo at the southern boundary of the reservation. Ferrar Gulch, tributary to Arroyo La Paz, contained the richest and most productive placers of the district. Evidences of former work are seen in the old excavations and piles of bowlders and angular rock fragments, in exposures of bedrock where the wash was shallow, and in the deeper deposits by old shafts from which small drifts were driven in the hope of finding rich pockets. The thickness of the gold-bearing wash is variable, ranging from a few feet on the mountain slopes to an unknown measure in La Paz Arroyo and in the gulch traversed by the Quartzsite-Ehrenberg road. Shafts have been sunk in the wash to depths of 30 feet without reaching bedrock and it is reported that in places the wash is at least 60 feet deep. By far the greater part of the auriferous material is unworked, especially that in the lower courses of the arroyos, where the wash is deep. Ferrar Gulch for most of its course has been practically worked out. No estimate could be made of the probable gold content of the wash in the La Paz district because of lack of detailed data and of uncertainty as to the limits of the wash, but in one area the deposit, said to contain values of 50 to 75 cents per yard and much of it 30 feet or more deep, occupies at least 640 acres, and considerable areas extend into the smaller gulches.

Character of gold-bearing wash.—The gold-bearing material consists of sand and clay inclosing angular rock fragments of greatly variable size. Tests indicate that about 20 per cent of the wash will pass through a quarter-inch screen, and the largest bowlders weigh several hundred pounds. The material near the surface is unassorted and is unconsolidated, being readily worked with pick and shovel. That at depths of 15 or 20 feet is consolidated, but the cementing substance readily disintegrates on exposure to air. Deposits of wash below the depths of test pits may prove to be similar to the outwash on the east slope of the Dome Rock Mountains and in the Plomosa placers, where the material is firmly cemented with calcium carbonate and requires crushing in order to free the gold. In Goodman Wash below the Goodman tank a deposit of calcareous tufa several feet thick was noted. The ground stands sufficiently well to permit the sinking of shafts without the use of timber. The wash is readily worked in dry-washer machines, the only requirement being that the ground must be dry. The gold is said to be distributed throughout the wash, though in the early workings the richest yield was obtained near bedrock. The size of the gold now recovered from the deposits of the La Paz district probably averages only a few cents, but, as already stated, the gold recovered from the early workings was much coarser. The gold is rough and angular, and particles of iron cling to some of the nuggets. Magnetite is always found in the concentrates, and bowlders of magnetite, the largest weighing several pounds, are frequently found on the surface.

Present and contemplated operations in the La Paz district.—Occasional dry washing is done by miners within the La Paz district, and yearly assessments are maintained by parties who hope to gain title to placer tracts when the restrictions on mining within the reservation are removed. The most extensive preliminary work has been done by a California company, which, in addition to making tests, has leveled the top of a small hill for a reservoir site. This site, which stands at an elevation of 850 feet, is about 600 feet above the Colorado River bottom lands. Water for the reservoir could be obtained from wells near La Paz, which in an air line is but 4½ miles distant. It is said that the company intends to hydraulic the gold-bearing wash from the smaller gulches and hillsides into the larger arroyos, where a dredge will be installed and the entire deposit systematically worked.

Placers on the east slope of Dome Rock Mountains.—There are several placer tracts on the east side of the Dome Rock Mountains in the large branch of Tyson Wash, west of Quartzsite, and in low-lying ground traversed by gulches tributary to it. Of these the Middle Camp, Orofino, and La Cholla placers are outlined roughly on the accompanying map. These placers have been worked intermittently on a small scale since the La Paz placers were discovered, and several attempts have been made to handle the ground on a large scale, but thus far these efforts have proved unsuccessful. At the time the region was visited the Orofino tract, owned by the Catalina Gold Mining Co., was the only one on which work was being done, and this work consisted of testing the ground, partly to determine its gold content and partly to determine the advisability of working the wash with dry concentrating machines of large capacity. The following information was obtained on the ground, the data as to the gold content and like matters being supplied by Mr. E. L. Dufourcq, the engineer in charge. The placer ground owned by this company comprises 640 acres of land in which test holes were sunk every few hundred feet. The holes ranged in depth from a few feet to 30 feet. The material taken from each excavation was run through a small concentrator to determine its gold content, and the results showed that the gold content ranges from a few cents to over $1 per cubic yard, the average being 38 cents. The colors run from less than 1 cent to 24 cents each and the gold is fine, being worth about $19 an ounce. The gold-bearing material differs from that of the La Paz placers in that it consists of unconsolidated rock débris and an underlying cemented gravel. The loose material ranges in depth from a few feet to 12 feet, and the cement is of variable depth—at least 18 feet in places. The gold is said to be distributed through

both the unconsolidated and the cemented material. The machine used in making the tests was a Stebbins demonstration dry concentrator. This machine consists of a metal frame on which is a perforated steel table with riffles parallel to its length. Underneath the table is a fan which supplies an air blast that is conveyed in a tube to the table and passes out through the perforations. The dry wash is screened through a quarter-inch mesh at the head of the table, and as the material passes onto the table the lighter particles are blown away or worked over the lower side and the concentrates are collected at the end. The power is a small gasoline engine, which operates the fan and gives to the table a vibratory motion similar to that of a Wilfley table. Its capacity is about 1 cubic yard an hour.

The Middle Camp and La Cholla placer tracts were not visited, but their situation is similar to that of the Orofino tract, in the arroyos tributary to Tyson Wash. At the Middle Camp placer it is reported that a dry concentrating machine having bucket-dredge excavator and capacity of 1,000 yards per 10-hour day was installed, but proved a failure because of the moisture contained in the wash at depths of a few feet. In any dry concentrating process in order to attain maximum capacity and to make high saving of gold content it is essential that the material be absolutely dry, and even in this arid region some of the material holds sufficient moisture to greatly hamper the handling of large quantities of it. The bedrock of the La Cholla placer tract is reported to be schist derived from sedimentary rock. This schist is said to contain many small auriferous quartz veins, and the gold-bearing material is a hard siliceous cement that must be crushed before the gold can be recovered.

No survey was made of the placer ground on the east side of the Dome Rock Mountains, but the deposits are extensive enough to merit serious attention. It is believed that the deposits can be worked best by hydraulic methods, by means of storage reservoirs on one of the many small hills that overlook the placer ground. The water would have to be pumped from Colorado River with a lift of about 1,000 feet. The gold-bearing débris of the smaller gulches and mountain slopes could then be washed into the larger arroyos, where the entire deposit could be worked by dredge or by sluicing, although the slope of ground is rather low to permit easy disposal of the waste rock.

Deposits in the Plomosa Mountains.—Placer deposits on the southwestern slopes of the Dome Rock Mountains, 5 miles southeast of Quartzsite, have been worked intermittently on a small scale for many years. These placers were examined in 1909 by Howland Bancroft, and the following data are taken from his report.[1]

[1] Op. cit., pp. 87–88.

Of the companies that own placer tracts in this area, the New York-Plomosa Co.—

has installed large machinery, laid a 7-mile water-pipe line without any expansion joints, and has got all ready to work the placers. For some reason only one run had been made prior to May, 1909, the results of which were not available. * * *

There has been installed on the property the following machinery: Three 100-horsepower boilers, one 300-horsepower Corliss engine, two Williams mills, two Huntington mills, and various accessories. The pipe line which furnishes the water used on the property is approximately 7 miles long and is about 5 inches in diameter, the difference in elevation between the two terminals of the line being approximately 400 feet.

The ground has been prospected by a great many small tunnels with frequent openings to the surface and an occasional larger adit tunnel run along the bedrock. The vicinity had previously been prospected by "dry washers," and consequently the underground work resembles a network of small burrowings, some of which a man can scarcely drag himself through. * * *

In certain old drainage channels which led away from the southwestern part of the Plomosa Mountains is found an auriferous conglomerate of granite, schist, and quartz fragments cemented by lime carbonate. In thickness this conglomerate or "cement rock" varies from a few inches to a great many feet. * * * It was evidently the intention of the company to work the cemented material in mills.

A recent communication from Mr. Beggs states that these placers are again receiving attention, and that a dry concentrating plant, costing $60,000, is to be installed. Numerous tests have been made and a large area of ground has been blocked out, which is said to run 50 cents per cubic yard. Water in sufficient quantity for the needs of the camp was obtained in a well at a depth of 300 feet.

GOLD QUARTZ VEINS.

The auriferous quartz veins in the vicinity of the La Paz diggings were probably discovered at the same time as the placers, for in places they form conspicuous outcrops with abundant float. The decomposition of these veins has produced the placer gold for the largest areas of gold-bearing wash are found along the more persistent quartz veins on which mining has been done. These veins are generally distributed through the metamorphosed pre-Cambrian igneous and sedimentary rocks, although they are more numerous in the country rock of the La Paz placers than in the sedimentary schists. The veins are of two types—those that lie in the planes of schistosity and those that cut across them. In the La Paz district the veins of the first type are comparatively large and persistent, trending from east-west to northwest-southeast, and those of the second type consist of numerous north-south trending gash veins. On the west ridge north of Tyson Wash two large quartz veins of east-west trend cut across the schistosity of the inclosing rocks, and other smaller veins trend in various directions. The larger veins of east-west trend have been mined or prospected, but those of the gash vein type, although reported to be gold-bearing, are too small for exploitation. The failure to develop these veins more fully is due to their remote situation and the inability of the owners to acquire title under the mineral laws, for all the prospects here described except one are within the reservation.

MINES AND PROSPECTS.

Goodman mine.—The Goodman mine is on the Goodman vein, which trends from northwest-southeast to east-west and can be traced for 3 miles, its eastern limits of outcrop being the wash-filled arroyo traversed by the Quartzsite-Ehrenberg road, and the faulted portions of its westward extension being traceable to the bordering bench lands about a mile south of the Goodman tank. The vein varies greatly in width, ranging from a mere seam to a vein 40 feet wide and averaging in width probably 10 feet. It occupies a shear or fault zone in the quartz-epidote schist. It dips generally to the north at angles ranging from 30° almost to 90°. The development consists of several inclined shafts sunk on the vein and connecting tunnels. One incline is 120 feet deep with connecting tunnel 140 feet long and 120 feet of drifts; another tunnel is 240 feet long. The vein material is a massive iron-stained quartz containing small cavities resulting from the weathering of pyrite, which is distributed through the vein but is usually more abundant along the walls and for a short distance in the inclosing wall rocks than elsewhere. The gold is contained in the pyrite and can at many places be seen in the oxidized ores. About $40,000 was obtained from the Goodman mine prior to 1900, and since that time Mr. W. E. Scott, of Quartzsite, has mined ore to the value of $9,000, the average tenor of which was $65 per ton. The ore was hauled 15 miles to Quartzsite and there treated in a small amalgamation mill. The mine is not worked at present, although yearly assessments are maintained.

Golden Hope claims.—The Golden Hope claims are on the Goodman vein near the east reservation line. The workings consist of two shafts, each about 30 feet deep, and two tunnels, 30 and 70 feet long, respectively, which cut the vein at shallow depths. In a recent communication Mr. Beggs stated that a large shoot of milling ore running $30 per ton in gold had been opened in these workings and that the company owning the property was contemplating the erection of a mill to treat the ores.

The west end of the Goodman vein is covered by claims located by Mr. Beggs, who stated that he obtained an assay of $200 per ton in gold on ore taken from a small discovery hole sunk on the vein. The vein at the west end is of irregular shape; in places it is 40 feet wide but in a short distance pinches to a mere seam or is cut out by faults. The inclosing wall rocks are crumpled and folded quartz-epidote schists.

Mariquita prospect.—This property was not examined by the writer but is described as follows by Bancroft:[1]

> The Mariquita prospect is located about 6 miles west of Quartzsite, the road leading to it branching from the Ehrenberg stage line some 4 miles out of Quartzsite. It is situated 2 miles north of the stage road, at an elevation of 1,100 feet on the southeastern side of a saddle which occurs midway in the Dome Rock Mountains.
>
> Medium to fine grained quartz-mica schists, apparently intruded by much younger fine to medium grained granites or quartz monzonites, are the rocks in the immediate vicinity. The schists strike northwest-southeast and dip 20° NE., and they contain, besides the quartz and mica, much epidote and chlorite, with a large percentage of orthoclase feldspar and some unaltered but contorted biotite crystals.
>
> A fairly large vein of quartz, carrying a little copper and gold, which has been roughly prospected, is the source of the ore extracted from this property. The vein strikes S. 20° E. and dips 20° NE., and lies in a slip or fault between parallel schist strata. In width the vein varies from a few inches to several feet, is fairly persistent in length, and apparently is lenticular. As the workings on the property are old and not very extensive, little accurate data on the size of the ore body were obtained.

Dan Welsh prospect.—The Dan Welsh prospect is on the summit of a ridge near the south boundary of sec. 32, T. 6 N., R. 21 W. Little work has been done on it, and it was deserted at the time of the writer's visit. The development consists of a shaft 12 feet deep and several open cuts and short tunnels, which explore a quartz vein whose average width is 2 feet. The vein trends east-west, dips from 60° N. to vertical, and can be traced 1,000 feet, pinching to a mere seam on the west side of the ridge 400 feet from the shaft and disappearing beneath outwash deposits on the east side of the ridge. The inclosing wall rocks are a sandy mica schist of sedimentary origin and granite gneiss and amphibolite schist of igneous origin, all of pre-Cambrian age. The schists trend about north-south and dip 20° E., and the fracture filled by the quartz vein cuts squarely across the schistose structure. The vein matter is a massive vitreous, iron-stained quartz containing plentiful disseminated pyrite cubes from an eighth to a quarter of an inch square or crystal aggregates an inch or more in diameter. The oxidized portion of the vein, which extends to the bottom of the shaft, contains cavities from which pyrite has been weathered. The iron oxides contain here and there specks of gold and along the fracture planes in the quartz there are

[1] Op. cit., pp. 81–82.

dendritic flakes suggesting secondary deposition. The ore is apparently of high grade; its exact tenor is not known. A stack of 30 sacks of ore was found in the gulch leading down from the prospects on the west slope of the ridge, and another pile of 20 sacks, with several tons of unsacked ore, was found at the shaft. It was reported that the owners of this prospect packed the ore to Colorado River, 6 miles distant, and there treated the ore in an arrastre with mercury to recover the gold, but they were not allowed to continue operations.

Mammoth prospect.—The Mammoth prospect is in sec. 12, T. 5 N., R. 21 W., near the base of an eastward-trending ridge. An old incline, now inaccessible, but probably several hundred feet deep, is sunk on a faulted quartz vein of variable width, which trends about N. 70° E., and is traceable to the west for 1,000 feet, mainly by abundant float. At the shaft the vein is 10 feet wide. No work has been done here in recent years, but in 1914 the prospect was relocated and is now known as the Apache No. 2. The country rock is a dark schistose porphyry containing prominent feldspars inclosed by biotite, chlorite, and epidote. The vein matter is a massive white quartz slightly stained with iron and copper salts, with sparsely disseminated pyrite. The ore is said to be valuable only for its gold content, but its tenor is not known.

EMJ v.136 #3, 1935

Sugarloaf Butte Al

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1929, Amer. Min., v. 14, p. 373-381