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Lewis Mine & Surrounding

GEOLOGY

REGIONAL GEOLOGY: The oldest rocks in the vicinity of Sulphur are the Permian Happy Creek volcanic series, found mainly in the Jackson Mountains to the north. Smaller occurences of this series are found 20 miles to the west. A Triassic/Permian series of volcanic and sedimentary rocks have also been mapped in the Jackson Range. These are followed in time by extensive exposures of Triassic/Jurassic Auld Land Syne Group which consists of slates, phyllites, hornfels and quartzites. These older units have since been intruded by large masses of Cretaceous intermediate igneous rocks. Possibly overlying these earlier units and comprising almost entirely the Kamma Mountains, located immediately to the east of Sulphur, are thick sequences of Tertiary rhyolites and pyroclastics. These are reported by Stewart (1976) as ranging from 17 to 6 my in age. These volcanics are now flanked on the north, south and west by moderate thicknesses of Tertiary (Johnson 1977) or Tertiary-Quaternary conglomerates and sediments and later Quaternary lakeshore deposits and alluvium.

Faults mapped in this region as well as most pronounced topographic features, are oriented predominately in a north-south direction. This direction of tectonic pattern is consistant with this portion of Nevada resulting from a basin and range system. An interesting observation has been made by Rowan and Wetlaufer (1975) during a structural interpretation of Nevada using Landsat data. A large (11,000 sq. km.) circular area is situated over all of western and central Pershing County. Pyramid Lake is located along its western segment and Fallon is at its southern limit. The Sulphur area is located along the northern margin of this feature. Numerous small (15 sq. mi.) circular features, such as the unnamed small mountain immediately south of Rabbit Hole, are conspicious within this large circular feature. A possible theory for the formation of this large circular feature could be the presence of a large, immature, deep-seated caldera complex. Some research should be conducted on this idea to determine whether the remainder of the perimeter should be explored for precious metal deposits.

SPECIFIC GEOLOGY - Rock Description: Mapping within the area has resulted in defining two major rock types (see Plate 1). The older unit of Tertiary age (Willden, 1964) is an acidic to intermediate, thick section of pyroclastics, flows and volcaniclastics and an overlying sequence of Tertiary-Quaternary conglomerates, agglomerates, sandstones, sinter deposits and tuffaceous sediments. Names for these units will be the same as those used informally by Wallace (1980), the

Tertiary volcanic sequence being called the Kamma Mountains group and the Tertiary/Quaternary (?) clastics are the Sulphur group. Younger mapped units, Pleistocene gravels related to Lake Lahonton and later Holocene alluvium are found flanking the western part of the property.

The Kamma Mountains group crops out along the eastern margin of the area of interest. This area is currently being incorporated within another exploration program by T. Temkin. Included in this age group, but mapped as separate distinctive beds, is a sizeable diatomite/ash-fall sequence located in the north and several volcaniclastic beds of moderate thickness in the east.

The Kamma Mountains group is reported to be Tertiary in age (Johnson, 1977) and the diatoms within the diatomite/ash-fall beds have been placed in the Barstovian (Mio-Pliocene) range in a study by D. Giles (ver. comm., 1980). No age dating of the nearby volcanics has been reported, but 12 miles to the southeast K-Ar age dating of the Majuba Hill complex indicates that the intrusive and hydrothermal activity occurred in the Middle Tertiary, 24-25 my. (Silberman and Dockter, 1977). Information at present is too inconclusive to determine whether the diatomite/ash-fall beds are definately related to the top portion of the Kamma Mountains group or whether they represent an interface zone between the Kamma Mountains group and the Sulphur group. Until subsurface data is collected, they will be assigned to the upper portion of the Kamma Mountains group as an interbed.

Acidic flows and pyroclastics are the dominant rock types in the Kamma Mountains Group and, with the exception of the diatomite/ash beds, are found only on the east side of the easternmost north-south fault. These units are characterized by rapid rock changes with the most common type being a fine-to medium-grained, tannish colored, flow-banded rhyolite. Locally, it is highly crenulated and contorted. A rhyolite flow breccia containing a partly siliceous matrix may be intimately associated with this banded unit. Several dark colored vitrophyre flow (?) units, sometimes banded, occur sporadically within the area. Other minor occurrences include the previously described volcaniclastic interbeds, andesites and andesite flow breccias, located primarily in the northern map area. Wallace (1980) reports that the sedimentary members of the Kamma Mountains group are thickest in the Rosebud Canyon (several miles to the south) and thin towards the Sulphur area. He estimates that the Kamma Mountains group is at least 6,000 feet thick in the vicinity of Rosebud Canyon.

Several distinct volcaniclastics beds up to 200 feet in thickness have been mapped as a member of the Kamma Mountains group and are found in the northeastern part of the area. They appear to have been derived from a rhyolitic source, the clasts vary from rounded to angular and range from sand size to large pebbles. One thin bed resembled a well-worked quartzite. Individual beds are well defined, each indicating a rapidly changing mode of deposition. These beds appear conformable with the adjacent volcanic mud flow breccias.

The youngest unit in the Kamma Mountains group, as discussed above, is the Barstovian diatomite/ash beds. This member is generally thin-bedded with distinctive laminations, suggesting a lacustrine environment. Where exposed it is very poorly consolidated. Several thin (2 inches to 2 feet) ash beds have been opallized in the western exposed portion. Total thickness is not known, but a projected figure based on surface exposures and bedding dips indicated that it could range from 400 to 800 feet thick. The only other similar occurrence found to date is located at the southern end of the Jackson Mountains, 10 miles to the northeast.

The main rock unit of interest is the Sulphur group. It consists of a series of poorly sorted, coarse-to fine-grained clastic, tuffaceous, lacustrine sediments and a siliceous sinter which may contain fossil plant debris. Based on field observation and thin section studies (Honea, 1980), the majority of the Sulphur group is being classified as an agglomerate, but locally ranges from a breccia to a conglomerate. Clast sizes average 1 to 3 inches, but may range up to greater than 1 foot. They are composed primarily of igneous material, dominantly rhyolite and quartz latite with lesser amounts of andesite and basalt. Locally, sedimentary and/or metamorphic clasts were observed and may comprise the majority of a given bed. These clasts include greywackes (sometimes with organic debris), shales, siltstones, phyllites, quartzites, schists and milky quartz. Wallace (1980) reports seeing limestone fragments, but to date this has not been confirmed. The matrix material is composed of the fine-grained components of the clast material and, lithification due to silicification varies directly to the intensity of alteration which will be discussed further in the alteration section of this report.

The Sulphur group typically is poorly sorted. A crude bedding attitude is usually noticable from a distance but becomes indiscernible upon close inspection. Rapid erosion and deposition was interrupted occasionally by several periods of quiescence. Sources for these rocks are believed to have been located nearby, primarily the volcanic rocks in the Kamma Mountains bordering the property to the east and the metamorphics and sediments found further east of these volcanics. A somewhat subdued topography is envisioned during the Tertiary/Quaternary erosion, which stripped away the upper portion of the Kamma Mountains.

Opallized plant debris is found in several upper beds just south and east of Pulpit Rock. Reed columns, segmented and branched water plant stems, elongated leaves and possible root molds comprise most of the plant material observed. Cellular and external structures are usually well preserved. This area represents a hot springs center with numerous ponds containing marsh-type vegetation. Airborne ash falls blanketed these pond areas at various times burying the vegetation, some of which are still in a vertical position. Silica-rich solutions transported by the hot springs water combined with a silica-rich ash which probably cumultively formed the opal layers. These layers range from 1 foot to several 10's of feet thick, and vary in color from milky white, tan, light gray to blackish gray. A 1 1/2 foot thick, opallized, wafer-thin, crenualted, sinter bed caps much of the unit.

Johnson (1977) reports that the gravels in the southern portion of the Sulphur area are Tertiary/Quaternary in age and cover Mio-Pliocene sediments exposed further south at Barrel Springs. Willden (1964) has the sediments of the Sulphur group classified as Tertiary in age with Quaternary older alluvium cover. The fossil beds discussed previously have not been dated as yet and it is understood that these fossils can range from Tertiary to the present. No definite age information is reported on the entire Sulphur group. For the purposes of this report, a Tertiary/Quaternary (Late Pliocene to Early Pleistocene) age will be assigned.

Field evidence supports the theory that the unlithified gravels found adjacent to and within the lithified Sulphur group rocks are actually of the same age (Tertiary/Quaternary) and that lithification is actually a product of alteration. These gravels will be discussed in more detail in the alteration section.

Wallace (1980) reports that rhyolite dikes intrude the Sulphur group rocks and rhyolite flows can be found within. No rhyolite dikes have been found to date. A buff-colored indurated rhyolitic tuff was, however, observed in the central portion of the map. Depositional origin has not been ascertained as yet but it appear to have been formed from an ash fall. Wallace (1980) also reports finding a 6 inch thick lava flow. This was not substantiated. Some large basaltic fragments were found along a particular horizon in the unlithified gravel, however, and could possibly correlate to the reported lava flow.

Wallace (1980) believes that the Sulphur group has a thickness in excess of 2,000 feet. He based this estimate on the examination of a 2,000 foot core hole drilled by Duval Corporation in 1974.

A Pleistocene terrace and beach gravel series containing well-sorted and rounded sand and pebble fragments mark the high water line of ancient Lake Lahonton. Partly lithified wedges of this group are found in the western part of the mapped area lapping onto the Sulphur group just below the 4400 foot elevation.

Holocene-aged, poorly sorted alluvium is found within the existing drainages at higher elevations and have formed alluvial fans along the western edge of the Sulphur group outcrops.

Structure: Aerial photographs were used in conjunction with the field observations during mapping to delineate the structural patterns at the Sulphur area (see Plate 2). The most dominant direction visable is N20° - 35°E. These are well displayed at three separate localities and are being classified as the Western, Central and Eastern fault zones. They will be discussed in that order.

The Westerly fault zone bounds the Sulphur group with the valley alluvium to the west. This zone is obvious on aerial photos, but it is not as pronounced as the other two zones towards the east, and dies out at Pulpit Rock in the north. South of the mapped area, the westerly limits of the Tertiary/Quaternary gravels are well marked by a pronounced scarp. The valley side has been down dropped and is probably of moderate displacement with a steep westerly dip. An interesting double joint pattern occurs in the southwestern area near the Silver Camel area. The primary direction here is northerly with a westerly secondary alignment. Numerous pits have been dug along silica/limonite-filled fractures. This is interpreted as a zone of tensional fracturing with weak faulting along the dominant north-south trend which may have allowed mineralized vein material to form.

The Central fault zone separating the two prominent terraces appears to be numerous parallel, steeply west dipping, normal faults with moderate (100 feet to 300 feet aggregate) displacement. The northern extension of this zone splays into a broad fracture system. These tensional linear fractures are highly pronounced on aerial photographs. The availability of water along these fractures has allowed sagebrush and other shrubs to grow within this preferred orientation. Another highly visible feature is the numerous parallel faces on the outcrop blocks. The fractures appear to be tensional in nature, which locally are filled with opal and/or chalcedony.

The Eastern fault zone marks the boundary between the Sulphur group to the west and the Kamma Mountains volcanic group to the east. This fault appears to have a much greater vertical displacement than the Central and Western fault zones. Wallace (1980) estimates this displacement to exceed 4,000 feet. This estimate seems reasonable based on his examination of Duval's diamond drill hole #2 and in the thickness of the Kamma Mountains group exposed in the east. Strike along this fault is moderately sinuous with the westerly dip less steep than the other two zones. The dip averages 45° to 50°. This fault zone is also different in the fact that it contains sporadic thicknesses of up to several tens of feet of white quartz and chalcedony vein material. Several closely spaced parallel faults are found within this zone made obvious by a series of striated planes. Post sulfur faulting along this zone is evidenced by numerous striations within some of the massive sulfur. It is felt that sulfur near the surface is quite mobile and these fault striations would therefore indicate recent movements.

In addition to the above mentioned zones numerous vague east southeasterly linear zones are noticeable in two regions. The first area is at and slightly north of the Albert Pit and a second, somewhat wider zone is south of the Mercury Pit, north of Devil's Corral. These discontinuous patterns are characterized by linear drainage systems in the aerial photographs and are poorly illustrated in the field by weak fracturing. Near the Peterson Pit, the Eastern fault zone has been offset by several tens of feet of left lateral movement indicating that the east-west system was active after the north-south faulting component. South of the Peterson Pit, 3400 feet, the main northerly fault system appears to have been breached by an apparent right lateral fault with up to 600 feet of movement. Another possible explanation is a warping along the north-south direction with probable left lateral offset along the pronounced westerly drainage. Supportive field data is insufficient to make a definite statement.

Bedding throughout most of the Sulphur group is very consistent. The direction of strike varies throughout the area due to the very low dip angle which is generally less than 10°. The strike trend follows the primary north-south structural direction. An easterly dip is common throughout. The volcaniclastic units and diatomite/ash-fall tuff within the Kamma Mountains volcanic group also have an easterly dip, but with a steeper attitude. Jointing in the volcanics is believed to generally represent bedding planes in the more tuffaceous units and also conform to this strike and dip.

Alteration: Two major types of alteration have been mapped at Sulphur (see Plate 3). The main surface alteration is being termed 'solfataric' as it implies surface to near surface alteration by hot waters, gasses and acids with siliceous (primarily opaline), argillaceous and sulfatic products. The second major alteration type is termed 'silica-pyrite' which probably correlates with Hite's (1978) silica-alunite zone. This alteration differs from the solfataric alteration and is characterized by a dense siliceous (chalcedony, quartz and lesser opal) flooding usually accompanied with fine-grained sulfides (predominately pyrite) which has formed at moderate depth.

Large areas of the Sulphur group rocks have been totally altered to silica with moderate amounts of pyrite. Where exposed, these zones are found to have been flooded by silica, usually chalcedony and very fine-grained quartz with trace amount of opal. Replacement of the previously described clasts by this siliceous flooding is common, generally leaving the original textures intact. Often, this silicification is accompanied by two, to possibly three, stages of pyritization which will be discussed in the portion on mineralization. Very little silica veining is seen on a microscale. Instead, the veining occurs as occasional seams, fracture fillings and less often as veins several feet in width. Hypothetically, this type of alteration forms at a moderate depth, probably at and slightly below the ground water table (Shoen, et al, 1973). Thickness of this siliceous cap would depend on the amount of available silica from the ascending solutions. Self-sealing as well as a lowering of the water table, would force silica deposition at a greater depth. Uplift by faulting and erosion has subsequently exposed some of the silicified-pyritized areas. In addition, telescoping and overprinting of the silica-pyrite has probably occurred along many of the north-south structural zones, placing them much closer to the surface than they normally would form in a less fractured area. This resultant pervasive silicification, with thicknesses of up to several hundreds of feet, extends over an area of several square miles. The quantity of silica exposed throughout much of Sulphur is extremely impressive.

The solfataric altered zones are characterized on the surface by what Wallace (1980) calls the "White Breccia". These zones should not be classified as rock units as Wallace recommends. Instead, they illustrate a type of alteration where solfatara fields once existed. Here, similar alteration conditions extended from the surface down to the water table and/or boiling zone (Schoen, et al, 1973). This was a zone of intense downward sulfuric acid leaching which produced a porous, rubbly siliceous and argillized product. Probable maximum depth of this leaching extended 300 to 400 feet. Original clast textures are sometimes preserved by the intense pervasive silica flooding (opal, chalcedony and quartz), surrounded at times by a totally eroded and leached granular matrix. Thin sections of samples collected in the Mercury Pit show that the dominant alteration minerals are quartz and opal (Honea, 1980). Chalcedony, gypsum, kaolinite and sulfur are found in lesser amounts throughout various parts of these altered zones. A dull, earthy-white layered gypsum often accompanied by native sulfur, occurs in several of the more intensely altered zones generally located immediately below a thin siliceous cap. Formation of gypsum and/or sulfur is thought to have been controlled by the Eh-pH equilibrium at the time of deposition.

Alunite has been noted as occurring sporadically throughout portions of the area. The most obvious occurrences are along several of the fault zones and in several of the pits. Where found, it forms as veins up to 20 feet wide and also as matrix material. It is very likely that, due to the difficulty in identification of this mineral, a much greater amount of pervasive alunite is present than can be verified at present.

Sampling Method: Approximately 1000 samples have been taken over the mapped area. Almost all of these have been channel samples and, where practical, averaged 5 feet in length. Shorter channel samples were taken when certain narrow features were to be tested or when longer samples were unobtainable. The majority of these samples were prepared by the HMC Laboratory. Hunter Mining Laboratory (Reno, Nv.) analyzed most of the pulps. Bondar-Clegg (Vancouver, B. C.) and CMS (Salt Lake City, Utah) were used to a lesser extent, primarily in the early stages of the program. Rocky Mountain Geochemical Corp. (Reno, Nv.) was used as a check assayer.

Atomic adsorption analysis was used for gold and silver determinations with numerous checks made by fire assay. At Sulphur, both methods appear to compare favorably. Gold values obtained by fire assay generally are slightly lower (±10%) when compared to those determined by AA. Silver values by fire assay are found to fluctuate more erratically in the 0.05 oz/ton range. Gold and silver values obtained to date are felt to accurately represent the metal dispersion found at Sulphur.

A portable compressor and chipper hammers were necessary to take samples in many of the areas due to the extreme hardness of the massive silicification. A series of adjoining channel samples were often taken to test value continuity.

The need to test both vertical and horizontal metals deposition presented difficulties in trying to obtain representative values. Diagonal samples were taken along a vertical plane to minimize any false values in area where the direction of metals dispersion was unknown. Obvious vein, structure or bedding related zones were always sampled perpendicular to the feature.

Thirty one replicate samples were taken to test repeatability of sampling techniques and the accuracy of the analytical laboratory. Results were favorable when both the initial and replicate samples were taken by the same sampler at the same time. Less favorable results were obtained when the replicate sample was taken later than the initial sample and by a different sampler. This reflects the difference in techniques between samplers and the difficulty in resampling the exact channel after a period of time has elapsed.

Mineralization: The dominant mineral introduced throughout much of the project area is pyrite (see Plate 3). It always occurs with massive chalcedony and/or fine-grained silica flooding, however, silica depostion is not always accompanied by pyrite. Several generations of pyritization have been noted. The first, an early, pervasive micro-pyrite, is intimately associated with an extremely fine-grained silica. This has produced a black to dark green coloration throughout much of the rock. The pyrite formed contemporaneously with the silica gel and, where solidification was slower, concentrated in small framboidal aggregates. A second pyrite episode formed visible, individual, subhedral to anhedral pyrite grains not exceeding 0.05 inches in size. Not as common as the first two generations, are slightly later pyrite veinlets. Total pyrite content varies from trace amounts to approximately 6% with an average approximating 2% to 3%. Pyrite has formed extensively over a large portion of the property. Much of the cliff area in the north is pyritized, as well as the north-south structures along the western flank, the central zone, at depth in many of Duval's drill holes and in the footwall volcanics along the eastern fault.

The next most abundant mineral by volume is native sulfur which has been extensively mined in the past from numerous areas within the district. Sulfur formed at and near the surface as small pods, as matrix material, and along fractures and faults. Both the lateral and vertical migration of the sulfur has been noted. At the Devil's Corral area it formed within a brecciated fracture system beneath a silica cap. This indicates a more forceful depostional system rather than the passive fillings of vugs and cavities as found elsewhere.

Sulfur crystals larger than 0.5 inches are found in the Snyder adit along the Eastern fault zone. Sulfur occurs only within the solfataricly-altered zones and seems to be related to the northerly trending structural system. It is currently forming encrustations at the surface of a small vent which is eminating hydrogen sulfide. This gas is also being expelled from several of Duval's drill holes although no sulfur deposition has been seen. Although sulfur is widely dispersed, it does not appear to be of sufficient quantity to be of economic interest. An appraisal by Bert White (1980) should be referred to for further data.

As previously mentioned, alunite occurs in vein throughout portions of the property. Several series of parallel veins up to 20 feet in width are found along the West and Central structural zones. These veins grade randomly to kaolinite indicating a decrease in H_2SO_4 and potassium according to a chart illustrated by Schoen, et al (1974). X-ray powder diffraction determinations would have to be made on representative rock specimens throughout the area to accurately resolve the quantity of pervasive alunite. A larger amount of pervasive alunite is believed to occur throughout the silica/pyrite zone than has been reported to date.

Next in abundance is cinnabar which is found sporadically throughout much of the target area. Cinnabar occurs in minor amounts in several of the sulfur pits as horizontal streaks along bedding. It is found less often as blebs within the massive sulfur pods. It is only associated with the solfataricly altered rocks, generally within solid opalline silica layers. Small occurrences have been located in the more resistant opal/chalcedony outcrops along the north-south structural trends. Thin black coatings of metacinnnabarite occur as an oxidation product of the exposed cinnabar.

Stibnite and stibiconite (antimony oxide) occur in several sections within the claim group. Just south of Pulpit Rock, stibnite forms as very small radiating clusters along horizontal surfaces. They also are found as fine crystals southeast of the small placer mill; as large, coarse radiating crystals just east of Duval's diamond drill hole No. 2; and north along this fault zone for several thousand feet. They are also sporadically associated with small opal/chalcedony veins throughout portions of the north and west central areas. Many of these smaller siliceous veins are dark brown in color, probably caused from an extremely fine-grained stibiconite. At least three other antimony-bearing minerals have been identified in polished section and scanning electron microscopy (SEM): berthierite (iron antimony sulfide), valentinite (antimony oxide), and bournonite (lead copper antimony sulfide). These occur in small amounts as very fine-grained aggregates, sometimes adjacent to stibnite, and are either contemporaneous to, or possibly later than, the accompanying stibnite and pyrite.

Other minerals recognized as occurring here in very small amounts, and identified only in polished section and SEM, are: tiemannite (mercury selenide) marcasite, barite, uranophane, native gold, native selenium and an unnamed lead tin antimony sulfide.

Calcite veins up to 5 feet thick with large, well developed scalenohedrons are found immediately southeast of the Devil's Corral. Large irregular massive black-tinted calcite and gypsum veins have formed in several locations along the Easterly fault. Randomly oriented thin veins of clear gypsum are found within the Devil's Corral pit.

Iron oxides (goethite, jarosite and hematite) occur extensively throughout the property in varying amounts (see Plate 3). Goethite forms as coatings in narrow fractures, as rims surrounding oxidizing pyrite grains and as aggregates in both matrix and clast material of the sedimentary units. Jarosite is widely distributed in minor to moderate amounts as coatings along fractures that cut silicified host rocks, in weakly altered sections of the clastic unit, in cavities, and as replacement of feldspars within igneous clasts. Hematite is very pervasive throughout much of the central and southern areas of solfataric alteration where it coats and permeates both matrix and clast material. Dispersion of hematite is felt to be the result of an acidic reaction directly related to solfataric alteration and marks the boundary between altered and unaltered gravels. Further discussion of this relationship will continue in the section comparing Sulphur with a hot springs model.

Trace amounts of gold are found dispersed throughout much of the area sampled (see Plate 4). Of the 657 samples taken within the target area, (minus the Eastern fault target zone) 133 (20%) contain 0.01 oz/ton gold or more. The average of these 133 samples is 0.051 oz/ton gold. 374 samples (57%) ran from trace to 0.009 oz/ton gold and, when combined with the previous 133 samples, give a total of 77% of the samples containing trace amounts of gold or higher.

The solfataric altered areas have been found to be void of any gold values. Significant gold values occur along the central silica/pyrite zone from just east of the Mercury Pit northward to near the cliff area. One sample taken along the silicified fault in the south contained 0.189 oz/ton gold by fire assay. Elsewhere along the fault, values ran from nil to moderate (0.04 to

0.05 oz/ton - eight samples) in gold. Gold here appears to be directly related to the silica-rich veins which are associated with the north-south fault system.

The largest area containing the most anomalous gold found to date lies just south of Pulpit Rock between the amphitheater area and the edge of the valley to the west. This area is considered to be the primary gold target. One sample assayed 0.126 oz/ton gold and 30 other samples over this 2000 foot long east-west zone contain between 0.04 and 0.099 oz/ton. Mode of deposition of this area differs from that found elsewhere on the property, and even varies between both ends of the same zone. The eastern portion (amphitheater area) includes some similarities found in the west but, differs in that numerous vertical chalcedony veins with adjacent beds containing very fine-grained disseminated pyrite are exposed here. Mineralization in this zone appears to have been structurally controlled, forming below the surface at a moderately shallow depth, possibly along a west-northwesterly fault zone which is located within this area. The central and western portions differ from the amphitheater in that mineralization has probably formed at or near the surface. The western zone has two small knobs which resemble old hot springs mounds that formed when a metals-bearing silica-rich mud and/or gel was deposited at the surface (see report by Honea, September 15, 1980). Slump breccia features within these mounds illustrate obvious surface deposition. Nearby, flat-lying rocks and horizontal sulfide mineralization also suggest contemporaneous surface deposition by silica and metal-rich waters. Some preferential bedding replacement and alteration has probably also taken place in the nearby rocks. Eleven samples tested the gold bearing zone over a vertical distance of 45 feet. The weighted average grade for these is 0.056 oz/ton gold. The dark grey to black metal-rich unit grades vertically, upward and downward, to barren agglomerates and ash-fall tuffs. Fossiliferous beds are common above the metal-rich zone and are capped by a thin, wafer-like siliceous sinter. Opaline alteration varies throughout, but is much more pronounced in the upper unit. It should be mentioned that only trace amounts of silver have been detected in the samples containing anomalous gold. SEM microprobe X-ray analysis shows that silver is contained within the gold which is in turn enclosed by a quartz gangue. Other associated minerals include tiemannite (mercury selenide) an unknown lead tin sulfide, uranophane (calcium uranyl silicate) and native selenium.

Minor to moderate gold values have been detected just above the south-western corner of the mapped area. Here, the gold definitely appears to be structurally related, occurring along a silica/sulfide zone with the two highest values assaying at 0.042 and 0.064 oz/ton gold.

The Eastern fault zone assays only minor gold but contains significant silver values. Of the 112 samples taken along this predominately silver bearing zone, 32 (29%) contained no detectable gold, 74 (66%) contained trace to 0.009 oz/ton and 6 (5%) averaged 0.015 oz/ton.

Mention should be made of the moderate to significant gold values obtained in many of the holes drilled by Duval Corporation in 1974. Two consecutive 25 foot air hammer samples in RDH #6 contained 0.1 and 0.12 oz/ton gold at the bottom of the hole. Two other holes had samples which ran over 0.03 oz/ton and ten other holes contained detectable or higher gold values. Due to the fact that the sample interval was 25 feet and the sample collection method was not performed with the intention of testing for gold, these results should not be taken as an accurate representation of absolute gold values, but they do indicate the existance of anomalous gold in subsurface zones. Many of these gold-anomalous drill holes are located where there are no outcrops or any evidence of surface mineralization, thereby greatly enlarging the potential for gold and silver mineralization by use of third dimension data. Checks have been made of several of the samples left at several of the drill sites. Sample by sample correlation was impossible as there are no sample numbers left on the bags, but an acceptable correlation was made with holes that contain reported high values and low values respectively, indicating some level of confidence in the previous work.

A gross silver zonation pattern is seen by plotting all of the silver values taken at Sulphur (see Plate 5). None to very minor silver values are found to the north along the cliff area, south of Pulpit Rock and within all of the solfatarically altered areas. Anomalous to very abundant amounts occur along the Eastern fault zone, within the middle to southern portion of the Central fault system and in the southwestern part of the map around the Silver Camel Hill.

Silver analyses were divided into three groups at Sulphur: none detected, trace amounts to 0.79 oz/ton, and those 0.80 oz/ton and above. Of these three categories, 214 samples (28%) did not contain detectable silver, 490 samples (64%) ran trace amounts to 0.79 oz/ton and 57 samples (8%) contained an average of 4.75 oz/ton silver. The majority of those in the last group are located in and around the Silver Camel Hill. The values contained in this area are quite impressive, running up to 65 oz/ton. They are however definitely related to near vertical veins which have formed along north-south faults and fractures. Silver values decrease rapidly on both sides of these structural systems.

The primary silver target is the Snyder Adit, located in the eastern part of the property. The adit crosscuts the Eastern fault that bounds the Sulphur group and Kamma Mountains volcanics (see Figure 2). Eleven samples (average sample width of 4 foot) taken across an 85 foot wide brecciated and silicified zone average 2.66 oz/ton silver. An unidentified mineral thought to be a silver sulfide, was found on surface along the projected upward dip of this fault. Anomalous silver values also occur intermittently along this north-south silicified fault zone for approximately 6000 feet.

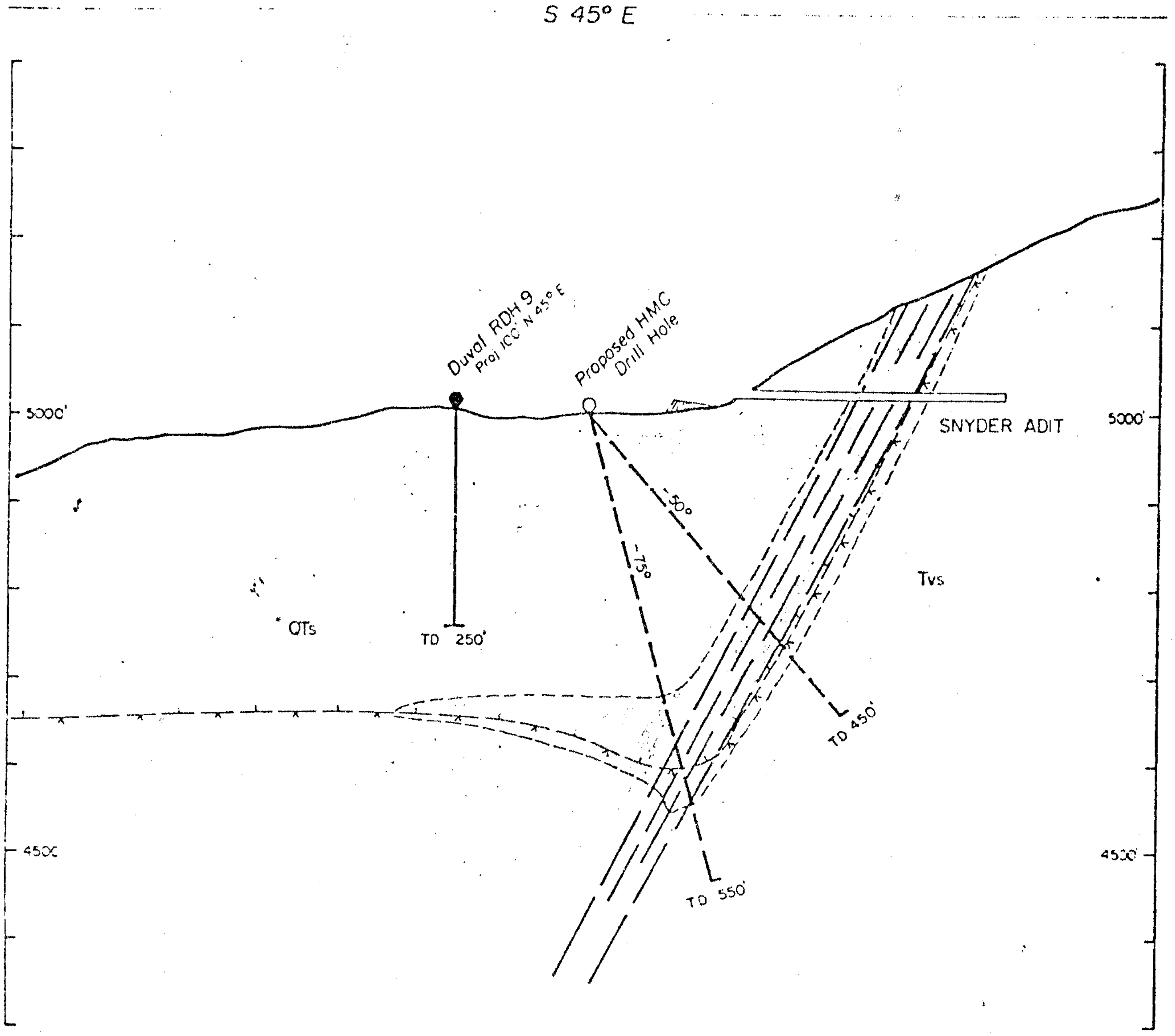
Vanderburg (1938) reports that, in the Silver Camel area, $100,000 worth of silver was mined (1908 to 1912) from numerous trenches, adits and shallow shafts (see Appendix A). "Silver occurs as cerargyrite in narrow seams varying from a fraction of an inch to 4 inches in width." He also states that silver is absent below a depth of 20 foot. Wallace (1980) mentions that the supergene silver production came from the east-west zones but that some primary mineralization also occurs along the north trending systems. He also states that silver enrichment ceases at approximately the 100 foot depth. This is based on a small drilling program conducted by Summa Corporation in 1970, and from some drill core left by an unknown company in the mid 1960's. Samples taken of some of this core show up to 0.026 oz/ton gold and 0.41 oz/ton silver. Most of this core is missing and is presumed to have contained the more important mineralized zones. No further data has been obtained regarding these previous programs.

From trace amounts to 2.4 oz/ton silver has been reported in the drilling program by Duval Corporation. These values occur only within the silica/sulfide zone, located below the solfataric alteration. Again, it should be noted that these samples represent 25 foot intervals taken by an air hammer drill and therefore can only be used as an indicator of silver at these locations.

Gold values, associated with the anomalous silver areas, are low, usually in the several thousandths of an ounce. Very seldom are they over 0.01 oz/ton.

Approximately 30% of the total samples taken were analyzed for arsenic and antimony, 10% for mercury and only several for thallium and selenium.

Definite statements regarding the correlation of antimony and arsenic analysis with the gold and silver values are difficult, but it is felt that these elements can be useful as indicators. Generalized statements regarding the sample data accumulated are:



GENERALIZED - CROSS SECTION, SNYDER ADIT

Explanation

QTs	QUATERNARY TERTIARY SULPHUR GROUP SEDIMENTS
Tvs	TERTIARY KAMMA MOUNTAINS VOLCANIC SERIES
(symbol)	SOLFATARIC ALTERATION
(symbol)	SILICA/SULFIDE ALTERATION & MINERALIZATION
(symbol)	ZONE OF POTENTIAL SILVER ENRICHMENT
(symbol)	FAULT ZONE, INTENSE FRACTURING

HOMESTAKE MINING COMPANY

CROFOOT-SULPHUR

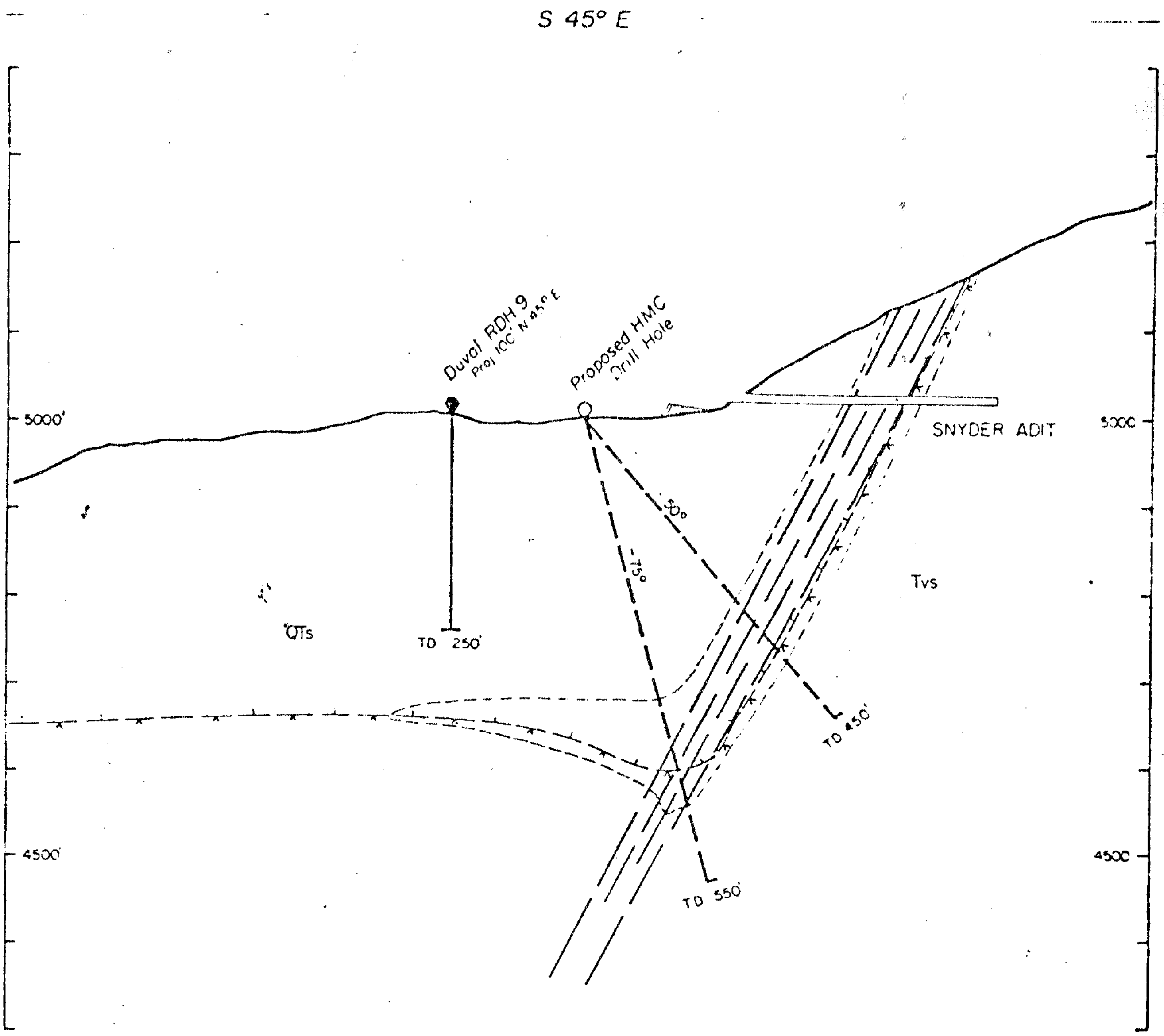
HUMBOLDT COUNTY, NEVADA

0 200' 400'

DATA: H.O.F.
DATE: FEB 198_

REVISIONS:

FIGURE 2



GENERALIZED – CROSS SECTION, SNYDER ADIT

Explanation

- QTs — QUATERNARY TERTIARY SULPHUR GROUP SEDIMENTS
- Tvs — TERTIARY KAMMA MOUNTAINS VOLCANIC SERIES
- SOLFATARIC ALTERATION
- SILICA/SULFIDE ALTERATION & MINERALIZATION
- ZONE OF POTENTIAL SILVER ENRICHMENT
- FAULT ZONE, INTENSE FRACTURING

HOMESTAKE MINING COMPANY

CROFOOT-SULPHUR

HUMBOLDT COUNTY, NEVADA

0 200' 400'

[illegible]

REVISIONS:

FIGURE 2

1. anomalous antimony (10's to 2800 ppm) and arsenic (10's to 1200 ppm) can occur at sample locations which contain anomalous gold and/or silver,

2. there does not yet seem to be a direct relationship to the relative ratios between any of these four elements and,

3. the higher antimony and arsenic values occur along strike of the Central and Westerly north-south structural zones.

The remaining samples should be analyzed for antimony and arsenic so a more complete geochemical appraisal can be made.

Mercury seems to show an inverse relationship to the gold and silver values. This relationship is expected since cinnabar is found only in the solfataric zones which appear to be void of any anomalous gold and silver content. Not enough mercury values have been obtained to determine whether or not a mercury halo has formed vertically and/or laterally away from anomalous gold and silver zones.