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ANDERSON MINE GEOLOGY REPORT

BY

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INTRODUCTION

The Anderson Mine Property, located in Yavapai County, Arizona, is 45 miles northwest of Wickenburg. The area is located along the northeast margin of Date Creek Basin and is bordered on the north by the Black Mountains and the Santa Maria River. The properties held by Minerals Exploration Company are mining claims and state mineral leases in Section 2-5, 8-11, 15 and 16, T11N, R10W and in Section 34 T12N, R10W.

In 1974 Minerals Exploration Company took an option on the properties, and then purchased them in 1975. Drilling has proceeded from 800 foot centers to 400 foot centers, to 200 foot centers. To date, 513 holes including 32 core holes and two geotechnical holes have been drilled.

The latest drilling program (a 306 hole, 120,000 foot program on 200 foot centers) was completed in April, 1977. This program further delineated the edge of the orebody, extended the known orebody in the northeast corner of Section 16, and confirmed the sheet-like nature of the mineralization. Data from this drilling will provide ore reserve projection, and structural, hydrological and metallurgical information imperative to future developmental planning.

This report summarizes the geologic information obtained from drilling programs, field reconnaissance and other sources. The report is not a final statement on the geology of the Anderson Mine area, but is a generalized summary of a very complex geologic area.

SURFACE DRAINAGE & TOPOGRAPHIC EXPRESSION

In the vicinity of Anderson Mine the topography and drainage are primarily controlled by the Santa Maria River. However, stratigraphy, dip and faulting play an important modifying role on the topographic expression and drainage of the area.

Date Creek Basin (Figure 1) is bordered by the Black Mountains on the north and northeast, by the Rawhide, Buckskin, and McCracken Mountains on the west, and by the Harcuvar Mountains on the south. To the east and southeast it is bordered by a low drainage divide governed in part by the Harcuvar Mountains and/or the Black Mountains. The basin has a gently sloping topography to the west and northwest.

Surface Flow across the basin is accomplished by three drainages; the Santa Maria River, Date Creek and Bullard Wash. The south-flowing Big Sandy River joins the Santa Maria River in the northwest portion of the basin just west of the confluence of Date Creek and the Santa Maria. This combined drainage flows southward into Alamo River Reservoir becoming the Bill Williams River.

Tributaries of Bullard Wash are almost exclusively from drainage of the northern flank of the Harcuvar Mountains. The wash is developed along the southern margin of the basin and drainage is due west to Alamo Reservoir.

Date Creek heads in the Date Creek Mountains and courses west-southwesterly across the nearly buried southern end of the Black Mountains, and into Date Creek Basin. Near the center of the basin the drainage shifts

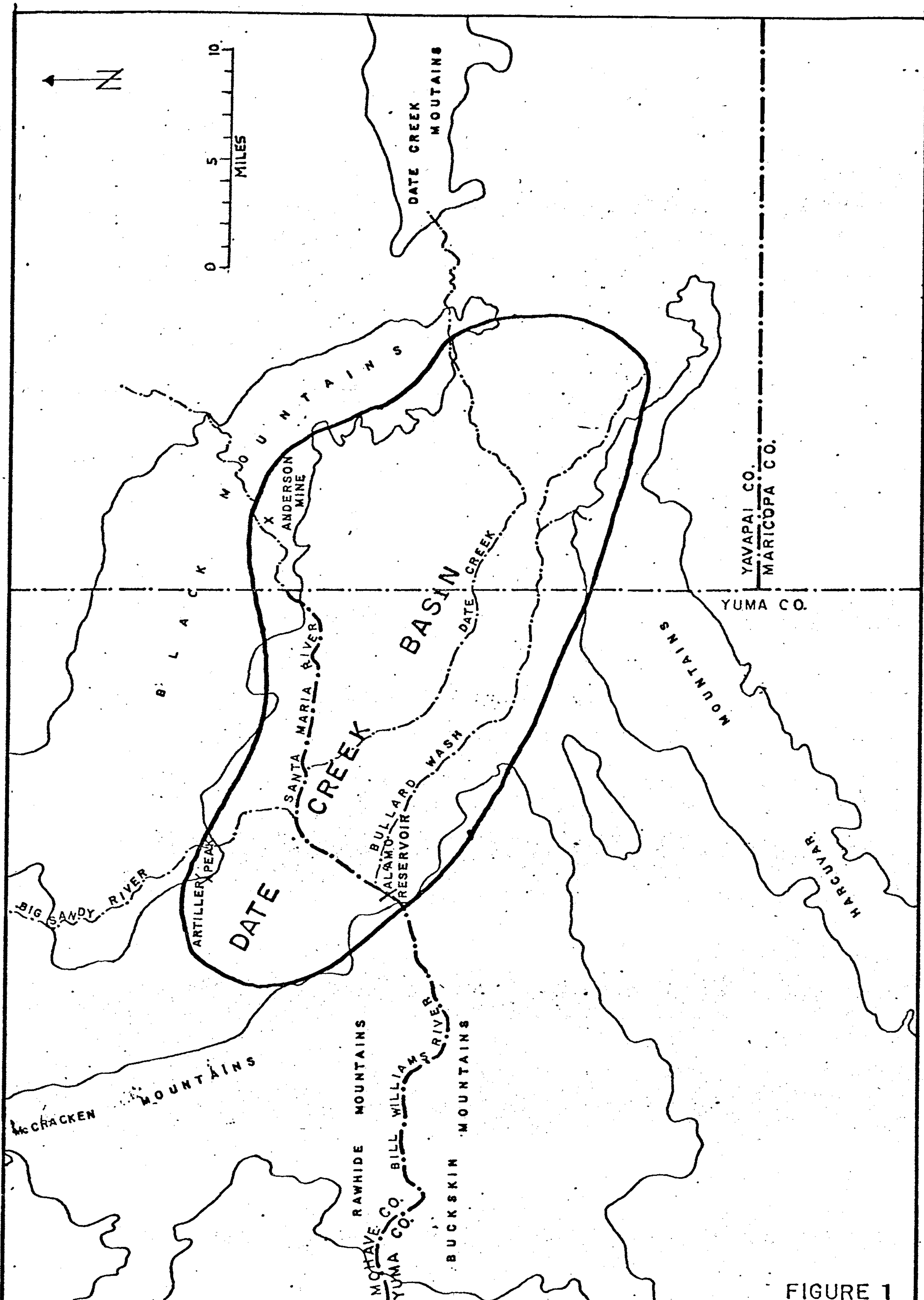

N
0
5
10
MILES
DATE CREEK MOUTAINS
BLACK MOUNTAINS
X ANDERSON MINE
DATE CREEK BASIN
DATE CREEK
SANTA MARIA RIVER
BULLARD WASH
ALAMO RESERVOIR
ARTILLERY PEAK
BIG SANDY RIVER
YAVAPAI CO.
MARICOPA CO.
YUMA CO.
HARCUVAR MOUNTAINS
McCRACKEN MOUNTAINS
RAWHIDE MOUNTAINS
BILL WILLIAMS RIVER
BUCKSKIN MOUNTAINS
MOHAVE CO.
YUMA CO.

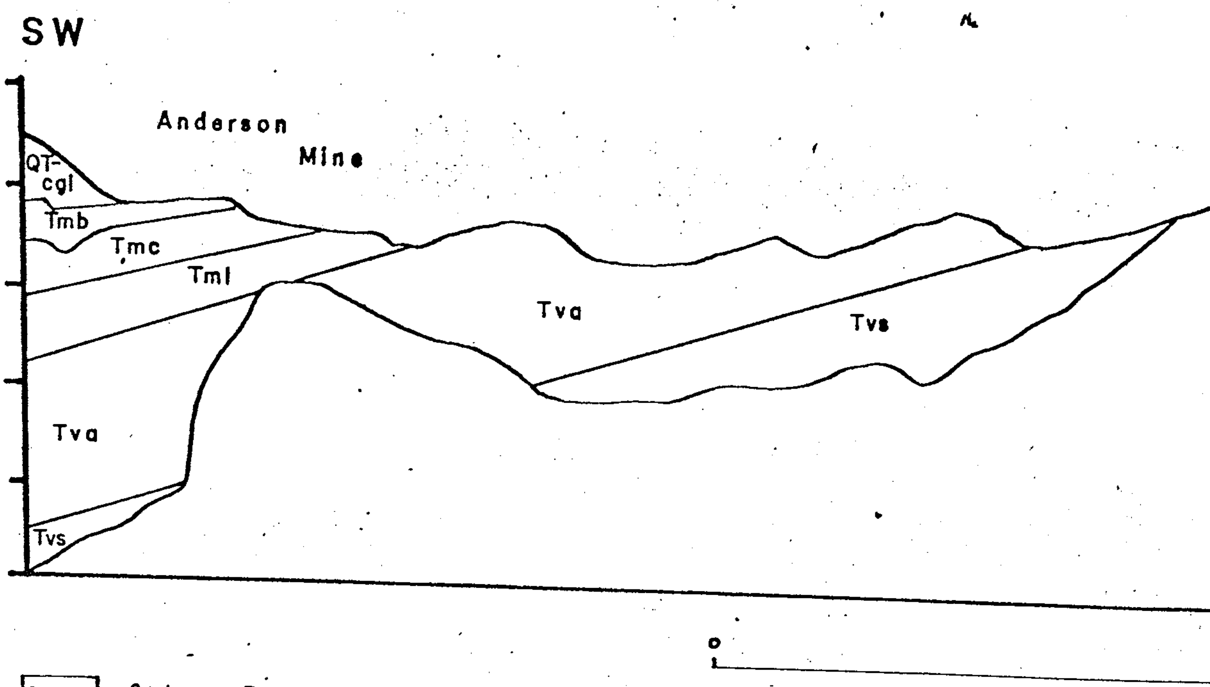
FIGURE 1

to the northwest and empties into the Santa Maria River. Most of the surface drainage of Date Creek Basin is into Date Creek. The Date Creek Flood Plain is approximately 200 feet below the basin surface.

The Santa Maria River heads in the mountains above Bagdad, Arizona, and has a very large catchment area. The river cuts through the Black Mountains' volcanics and granite or granite gneiss "core". It then trends westerly along the southern edge of the Black Mountains on the north side of Date Creek Basin. Drainage in this northern portion of the basin is to the Santa Maria. Approximately 10 miles west of Anderson Mine, the Big Sandy joins the Santa Maria and they flow south along the western margin of the basin into Alamo Reservoir. The Santa Maria Flood Plain is cut 400 feet beneath the Date Creek Basin surface at Anderson Mine.

All of the drainage on the Anderson Mine Property is to the north and northwest into the Santa Maria River. The headward erosion of these tributaries southward into the Date Creek Basin surface has resulted in a series of subparallel gullies and ridges trending north to northwest. Maximum topographic relief at Anderson Mine is 700 feet.

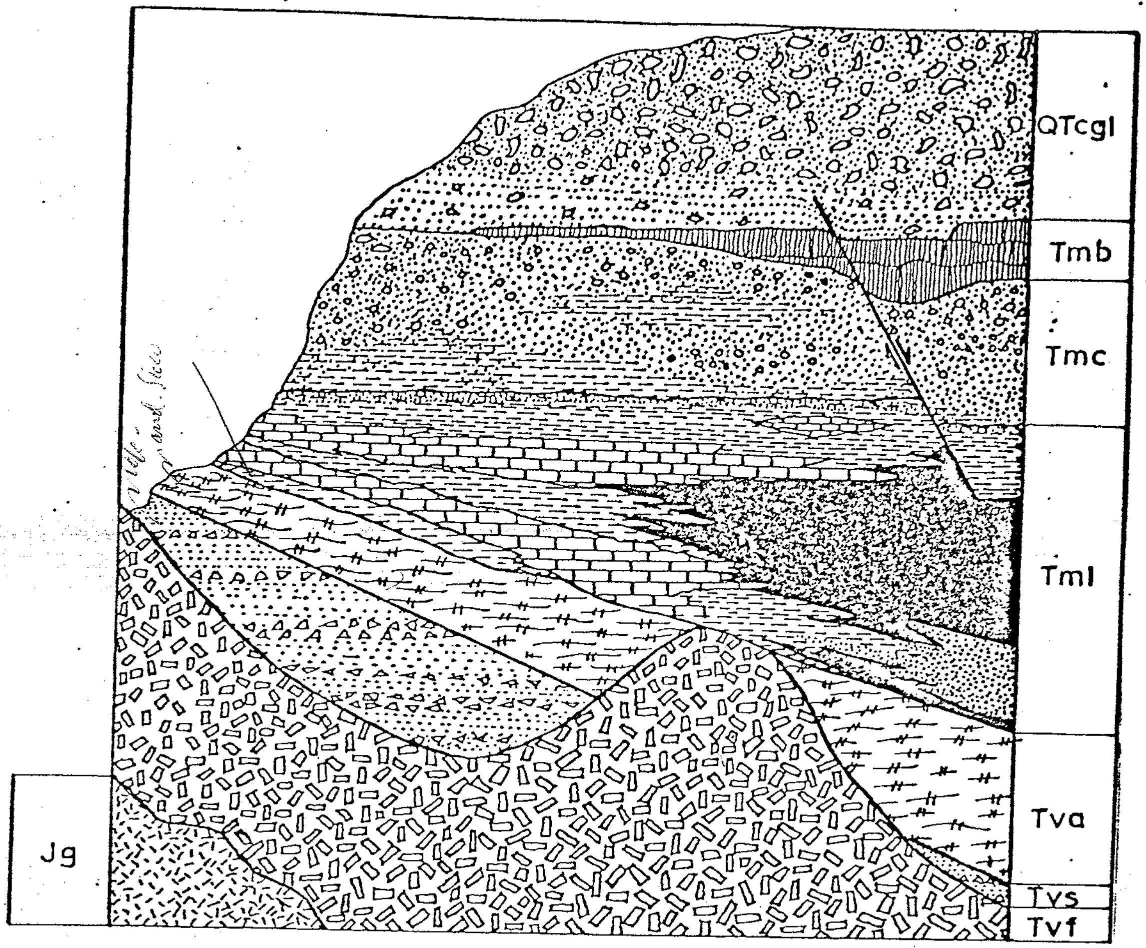
Faulting (see Structure below) in the area trends northwest-southeast and many of the tributaries are developed partially along fault traces. The southerly dip and resistance to erosion of the stratigraphic section have tended to inhibit the headward migration of the tributaries.



QTcgl	Quaternary—Tertiary conglomerate, 0-400', tan to white, sandy to very coarse, locally calcite cemented, granitic metamorphic felsic & basaltic clasts
Tmb	Tertiary Miocene basalt, black fine-grained to aphanitic, calcite—filled amygdules, commonly jointed parallel to flow surface, 0'–120'
Tmc	Tertiary Miocene conglomerate, tan to brown siltstone grades upward into arkosic sandstone & then into conglomerate with granitic & felsic clasts, 200'-450'
Tml	Tertiary Miocene lacustrine sediments, basal arkosic sandstone, carbonaceous siltstone & lignite, silty limestone, limy siltstone, green siltstones & mudstones, tuffaceous material throughout, 0'–400'

GENERALIZED CROSS SECTION A

FIGURE 2



STYLIZED STRATIGRAPHIC COLUMN, ANDERSON MINE, ARIZONA

FIGURE 3

STRATIGRAPHY

Within the boundaries of the Anderson Mine claims nine (9) informal stratigraphic units have been recognized by Minerals Exploration Company. From oldest to youngest these are: 1) Crystalline Intrusive Rocks, 2) Felsic to Intermediate Intrusions and Flows, 3) Felsic to Intermediate Volcaniclastic Sediments, 4) Andesitic Volcanic Flows, 5) Lacustrian Sediments, 6) Lower Conglomerate, 7) Basaltic Volcanic Flows and Dikes, 8) Upper Conglomerate, and 9) Alluvium (figures 2 and 3).

Crystalline Instrusive Rocks (Jurassic) J

In the extreme northeast portion of the claims group, the Santa Maria River and its tributaries have cut into a crystalline basement complex. These rocks are low in quartz content but are granitic. This granitic rock is purplish-grey in color, medium to coarse crystalline to pegmatitic and is intruded by veins of quartz and plagioclase feldspar with large crystals of hornblende and black biotite. A sample of the crystalline basement complex has been dated by the Geochron Laboratories Division of Kruger Enterprises for Bendix Field Engineering Corporation by the K-Ar method to be Jurassic (157.5+-3my). In drill hole AM 515 (NW¼ Sec 2, T11N, R10W), 35 feet of this granite was encountered. Gamma radiation is two to three times the normal background radiation (figure 4).

Felsic to Intermediate Volcanics (Tertiary) Tvf

Unconformably overlying the crystalline basement or in fault contact with it is a series of felsic to intermediate volcanics. This series includes intrusive necks, flows, lahar breccias and tuffs. These volcanic rocks appear

MINERALS EXPLORATION CO.

CASPER, WYOMING

HOLE NO. AM 515

LOCATION	ANDERSON MINE	GAMMA SCALE	100:10CPS/in
COUNTY	YAVAPAI STATE ARIZONA	PROBE TYPE	Scint.
OP.	1,241,334 ... 642,291.... ELEV. 1671	K FACTOR	5.70x10-8
SEC. TWP. RGE.		DEAD TIME	7.1
DATE	4-18-77	TIME CONSTANT	2
DEPTH DRILLED	80	PROBE ...	1 5/8
DEPTH LOGGED	78	CALIPER	
FOOTAGE LOGGED	78	DIRECTIONAL SURVEY	
HOLE DIAMETER	5	TEMPERATURE	
WATER FACTOR	-	OPERATOR	Ritterling
RESISTIVITY	- OHMS/...	DRILLER	Eremy
SELF POTENTIAL	- MV/...	CONTRACTOR	UNIVERSAL
		LAST A.E.C. ...	
		FLUID LEVEL	

	1ST RUN	2ND RUN	3RD RUN	REMARKS
...				
BOTTOM				
TOP				
TOTAL ...				
SCALE ...				

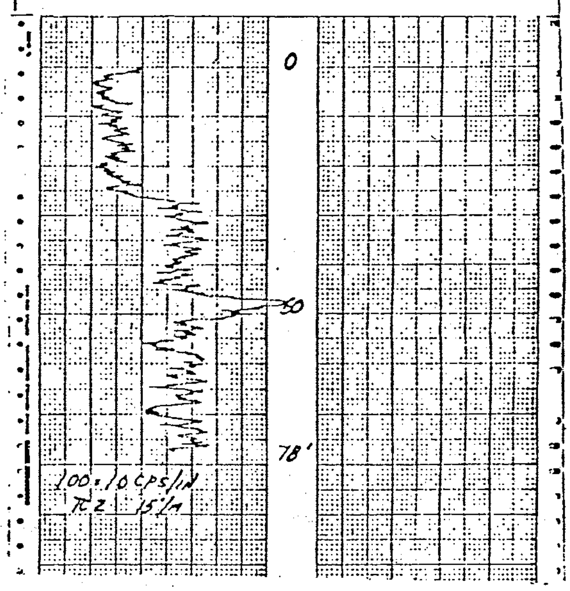


FIGURE 4

to be rhyolitic to andesitic in composition and are generally white to light gray in color.

Volcaniclastic Sediments (Tertiary) Tvs

Interbedded with and unconformably overlying the felsic to intermediate volcanics are tuffs, ashes and volcaniclastic sediments. All of these appear to be of felsic to intermediate composition and are, therefore, believed to be contemporaneous with the felsic to intermediate volcanics. However, deposition of this unit continued after the felsic to intermediate volcanic activity ceased, as they are also interbedded with the overlying andesitic volcanics.

The most complete section of this unit in the area is located in the northeast portion of the claims group. Here the basal part of the section is composed of white felsic to intermediate tuffs, thin ash flows or volcaniclastic sediments, lahar breccias and volcanic bombs. Volcaniclastic sediments increase upward in the section and the color changes from white to yellow tan to tan. These sediments include felsic volcanic material and arkosic sandstone.

Many aspects of these sediments (crossbedding, thin continuous beds, etc.) lead to the conclusion that they were deposited in a lake bed ancestral to the overlying lacustrine sediments.

Where exposed on the surface or encountered in drill holes, these volcaniclastic sediments exhibit no anomalous gamma activity.

Andesitic Volcanics (Tertiary) Tva

A series of andesitic volcanic flows unconformably overlies the felsic to intermediate volcanics or the volcaniclastic sediments. Reyner (1956) described the unit as a fine-grained, vesicular augite andesite locally containing calcite-filled amygdules. The flows are generally purple, red brown, gray brown, or gray. In several areas of outcrop they are interbedded by volcaniclastic sediments composed of felsic volcanic pebbles and arkosic sands. The andesitic flows have been considered "basement" at Anderson Mine, as no mineralization has been observed in or below them. Before deposition of the lacustrine sediments, erosion and faulting developed a complex paleotopography and locally thick red brown paleosols on the top of the andesitic volcanics.

Lacustrine Sediments (Miocene) Tml

The lacustrine sediments unconformably overlie the andesitic volcanics over most of the Anderson Mine Property. However, to the east-central they overlie the volcaniclastic sediments and further to the east they onlap the felsic to intermediate volcanics. One drill hole, AM 341 (SE¼ Sec 10, T11N, R10W), encountered the felsic to intermediate volcanics or the tuffaceous part of the volcaniclastic sediments immediately below the lacustrine sediments.

Evidence now suggests that deposition of the lacustrine sediments occurred in a restricted basin (see Geologic History). Therefore, these sediments represent time-transgressive facies deposited within a narrow, probably shallow, basinal feature. This type of depositional environment exhibits complex relationships between individual facies; lensing out, vertical and horizontal gradation, interfingering, etc.

Ljung et al (1976) simplify these complexities by dividing the lake bed sequence into four (4) subunits: 1) a basal coarse clastic unit, 2) a mudstone-siltstone unit containing intercolated carbonaceous zones, 3) a succession of interbedded limestones, silicified limestones, cherts, mudstones and siltstones, and 4) a thin fissile, fossiliferous marker bed which has been designated the top of the lacustrine unit.

The lake sediments include green siltstones and mudstones, white calcareous siltstones, and silty limestone or calcareous tuffaceous material. Much of this material is silicified to varying extents and was derived in part, from volcanic ashes and tuffs common throughout the lake beds. Also present in the lacustrine sequence are zones of carbonaceous siltstone and lignitic material. Along the southern boundary with Urangesellschaft, drill holes encounter the basal arkosic sandstone. To the south and southwest the "typical" lake beds interfinger with and eventually are replaced by a thick, medium to coarse-grained, arkosic sandstone unit.

All of the lake beds facies may exhibit some uranium mineralization. However, the highest grade and most consistent mineralization is located in the carbonaceous siltstones and lignitic materials.

In addition to the organic material in the carbonaceous zones, abundant plant remains (including twigs, reeds, and small roots) are present in the lacustrine sediments. Reyer et al (1956) recognized abundant silicified palm type wood. Fresh water mollusks, up to 1½ inches in length, are locally common. Thin laminated calcareous siltstone near the top of the lake beds contain small fresh water fish fossils. A jaw of a rhinoceros reportedly found at Anderson Mine is on display at the Wickenburg Museum. The leg bone of a duck found in the unit has been dated as Miocene by the Los Angeles County Museum. William Breed (1977) of the Museum of Northern Arizona and his associates collected fossils at Anderson Mine in April of 1977. Included in their finds were fresh water fish (Eocene to Recent), a camel bone, and a rhinoceros tooth (Miocene).

Lower Conglomerate (Miocene) Tmc

Immediately above the lacustrine sediments a tan to brown siltstone usually is present. This siltstone grades upward into arkosic sandstones and then into the conglomerate. The unit is composed primarily of arkosic sands and granitic and metamorphic clasts. Minor amounts of rhyolitic and andesitic volcanic materials are present throughout the unit. The sandstone and conglomerate may either be locally well cemented by calcite or relatively unindurated. To the southwest where the lake beds interfinger with sandstones the lower conglomerate is indistinguishable from these sandstones.

Basaltic Volcanics (Miocene) Tmb

Basaltic volcanic flows unconformably overlie the lower conglomerate forming erosionally resistant caps on many of the mesas and eroding cliffs. Ljung et al (1976) describes the basalt as "black fine-grained to aphanitic, containing calcite-filled amygdules, and commonly jointed parallel to the flow surface". The basalt attains a maximum thickness of 120 feet southeast of Flat Top Mesa and thins to the east where eventually it is no longer present. At least two flows are present in the western portion of the property. To the northeast of Flat Top Mesa (NE¼ Sec 9, T11N, R10W) several dikes, possibly basaltic, have been noted. These dikes cut the felsic to intermediate and andesitic volcanics, however, no direct pipe has been observed to the basaltic flows from these dikes. Wes Peirce (1977a) of the Arizona Bureau of Mines, reports that a sample of basalt taken at Anderson Mine near AM 368 (SE¼ Sec 10, T11N, R10W) has been dated by Paul Damon of the University of Arizona, using the Potassium Argon Method, as being 13 to 14 million years old or Miocene in age.

Upper Conglomerate (Quaternery Tertiary) QTcgl

The upper conglomerate unconformably overlies either the basaltic volcanics or the lower conglomerate. The unit is composed of cobbles and boulders of felsic to mafic volcanics, and granite and metamorphics in a matrix of medium to coarse-grained arkosic sandstone. The unit is weakly to moderately indurated and is locally well cemented by calcite.

Alluvium (Quaternery) Qal

Unconsolidatd sands and gravels are present in most of the drainages at Anderson Mine. At least one older alluvial terrace is present in the northeast portion of the claims group. Remnants of several older alluvial deposits are present along some of the deeper drainages. Most of these older alluvial deposits have well developed caliche zones within them.

GEOLOGIC HISTORY

The geologic history of the southwest United States has been extremely complex. This complexity arises from the area's situation along the southwestern margin of the North American Plate. The area has been subjected to repeated orogenies and crustal deformations.

During the Older Precambrian era, a broad northeast trending geosyncline was dominate across central Arizona. At the end of this time the Mazatzal Orogeny transformed central Arizona into roughly northeast trending mountain ranges. Accompanying this orogeny was extensive volcanism and the implacement of many grantitic plutonic bodies.

Erosion greatly reduced this mountainous area during Middle Precambrian time. However, central Arizona remained a positive area throughout the remainder of the Precambrian, and during most of Paleozoic and Mesozoic Eras. At the end of the Precambrian the Grand Canyon Disturbance resulted in deformation and intrusion of diabase to the northwest and southwest of the positive area.

During the Paleozoic Era, the positive area (Mazatzal Land) remained relatively stable. The Cordillaran Geosyncline to the northwest and the Sonoran Geosyncline to the southeast of Mazatzal Land became very active and were the sites of deposition of thousands of feet of Paleozoic sediments. Deposition in these geosynclines continued into the Mesozoic.

In the Mesozoic the relative movement of the North American Plate westward or northwestward increased the compressional forces on western North America. A trench or subduction zone formed along the North American Plate margin and the small plate(s) between this plate and Pacific Plate were subducted. This activity initiated a series of orogenies that generally progressed eastward deforming the cordillarian geosyncline. Although parts of this general activity have been given separate names, many workers now apply the name Laramide Orogeny to the entire series of deformations. The Laramide Orogeny also affected the Sonoran Geosyncline. Orogenic activity continued into the Cenozoic Era.

In the middle of the Cenozoic, in the Late Oligocene, the East Pacific Rise was subducted in the California trench system or passed eastward under the North American Plate. Whichever occurred, the trench system ceased, transform movement between the North American and Pacific Plates was initiated, compression forces were released, and tensional forces began. With the transform movement and related tensional forces, western North America was literally pulled apart. The basin and range block faulting is the result of this activity. Commonly associated with this activity are basaltic volcanic occurrances.

The geology at Anderson Mine reflects many of these regional geologic trends. The mine is located in an area that has been marginal or is marginal to every regional deformation. It was on the northwestern margin of Mazatzal Land, the southeastern margin of the Cordillarian Geosyncline, deformed by the Laramide Orogeny, and is presently on the margin of the Basin and Range Physiographic Province.

The lack of Paleozoic rocks at Anderson Mine is the result of the area's position on the margin of Mazatzal Land. Rocks of this era were either not deposited or were eroded from the area.

After this long period of relative quiescence, the Laramide Orogeny began in the Mesozoic. During the late Jurassic, the granite on the northeastern margin of the claims group was implaced. This was the result of the Nevadian Orogeny, or part of the Laramide Orogeny using the expanded definition. The California trench system was actively subducting the small plates between the Pacific and North American Plates. Subduction is normally associated with felsic to intermediate volcanic activity behind the trench on the non-subducted plate. The felsic volcanics at Anderson Mine appear to conform to this general pattern. It is expected that dating of these volcanics would provide dates falling in the late Cretaceous to middle Tertiary.

With the cessation of the trench system at the end of the Oligocene, Basin and Range block, transform, and normal faulting began. The lacustrine sediments have been dated paleontologically as Miocene and a geochemical date of Miocene (13 - 14 M.Y.) has been obtained for the basalt. Thus, lake beds are probably early or middle Miocene. During this time volcanism was waining, however, ashes and tuffs would still have been common.

Drill hole data from the Anderson Mine, shared information with Urangesellschaft and information obtained from Exxon, Public Service of Oklahoma and Sohio lead to the conclusion that deposition of the lacustrine sediments occurred in a very restricted area. To the north of Anderson Mine in Section 4, T11N, R10W, the basalt caps Hill 2826 and is underlain by the lower conglomerate. This in turn rest unconformably on the "basement volcanics". Two possibilities arise: 1) the lake beds were never deposited here, or 2) they were deposited and subsequently eroded. Since the lake beds are thinning rapidly northward, it is felt that the lake beds were never deposited here. The intertongueing and interfingering of the "typical" lake beds with clastic siltstones and medium to coarse grained sandstones to the southwest and south limits the lake in this direction. The relationship of coarse-grained lithologies in this direction and the lack of them to the north in the "typical" lake bed sequence implies that the sediments source was from the west or south. Urangesellschaft drilling has traced the lake beds and mineralization to the southeast. Public Service of Oklahoma drilling to the southeast of Urangesellschaft has encountered interbedded green siltstones and sandstones and little mineralization. Thus it appears that the lacustrine sediments were deposited in an area less than three miles wide and only about five or six miles long. The lake trended roughly northwest-southeast, generally parallel to the dominate Post-Oligocene faulting trend of the area. One further lithologic implication is of interest. The northern and northeastern margin of the lake was probably the Black Mountains, however, they must have been topographically lower, only a slight bit above the lake beds, as there are no coarse clastics in the lake sediments along this margin.

The lower conglomerate overlying the lake beds attests to the continuation of basin and range faulting and development. Erosion from nearby sources, possibly from the north or northeast, is indicated. Near the end of Miocene the basaltic volcanics flowed across the area, possibly marking the passage of the East Pacific Rise beneath the area. Normal faulting continued and the upper conglomerate was deposited. Its very coarse texture implies very near sediment sources and a very high energy environment of deposition. The inclusion of fresh basaltic boulders suggest the source was to the north and that the transporting agent may have been the Santa Maria River.

STRUCTURE

The Anderson Mine Property is located in the Basin and Range Physoigraphic Province and exhibits the general structural pattern common to the province. Parallel to subparallel fault blocks with usually normal bounding faults predominate. These faults are often rotational or hinged and may have experienced some logitudinal movement. While much of the basin and range faulting is on the magnitude of thousands of feet of displacement, displacement along faults at Anderson Mine are measured in tens and hundreds of feet.

At Anderson Mine faulting was active prior to and during the deposition of the Miocene section (lake beds, lower conglomerate and basalt). The general 5^{o} to 15^{o} to the south appears to be the result of the recurrent nature of the faulting and may be in part the result of fault hinging and rotation of fault blocks. Drag folds are common along many of the faults and in these areas dips may surpass 20^{o}. Many of the onlap, pinchout and lens relationships in the lake beds are probably due to or related to recurrent faulting.

The recurrent and hinging nature of the faulting makes it extremely difficult to predict how a specific fault will affect the individual units along it. At one point along a fault there may be only a few feet of vertical displacement while two hundred feet beyond that point portions of the section may be displaced several tens of feet. Many of the faults that displace the lake beds show diminished or no movement in the basalt and most of the faults die out before or in the upper conglomerate.

Three major faults, the East Boundary Fault System, Fault 1878, and the West Boundary Fault System are present in the area. In addition to these are many parallel faults which have less displacement than the major faults.

All of these faults trend between N30^{o}W and N55^{o}W. Another set of faults trending more westerly (N65^{o}W) are present at least in the south-central portion of the property. A set trending northeast has been conjectured by Urangesellschaft and others but has not been observed in the field.

The West Boundary Fault System includes at least two distinct normal faults. Movement on these faults is down to the southwest. Vertical offset of the volcanic basement across the two faults is approximately 400 feet. Another fault is indicated to the southwest which vertically offsets the volcanic basement about 250 feet. While total vertical offset of the basement volcanics across the West Boundary Fault System is over 700 feet, vertical offset of the basalt is less than 200 feet.

Fault 1878 in the east-central portion of the properties exhibits 200 feet of vertical displacement near the boundary with Urangeshellschaft. To the northwest along the fault displacement appears to decrease and movements appear to be distributed across a zone of faults. The movement along this normal fault has been down to the southwest. Along the zone of faults, movement (while generally down to the southwest) has produced horst and graben features.

The East Bountary Fault System consists of several large faults along the eastern and northern portion of the porperties. These faults are beyond the limits of mineralization and therefore, very little is known about them. In general they are downthrown to the southwest and several of them probably have displacements approaching a thousand feet.

MINERALIZATION

Uranium mineralization at Anderson Mine is primarily associated with carbon. In the typical lake beds carbonaceous siltstone and lignitic facies are present. These facies are the primary mineralized zones at Anderson Mine, and it is suspected that mineralization that appears to be unassociated with carbonaceous material, may in fact, be associated with such material. This association may be around the pinch out of carbonaceous material or with very thin carbonaceous laminae.

Occasional mineralization has also been noted in the basal sandstone of the lacustrine sediments and in the lower conglomerate. Carbonaceous material is known to interfinger with the basal sandstone and carbon has been noted in the lower conglomerate. Remobilization of the uranium has resulted in the deposition of mineral as fracture fillings around and below the main mineralized zones.

The mineralization is syngenetic as evidenced by the continuation and offset of mineralization across faults. Carbon tends to immediately fix uranium when soluble uranium comes in contact with it. Much of the mineralization is at the top or bottom of the carbonaceous facies, however, mineralization does occur in the middle of some carbonaceous zones. This later relationship implies that mineralization occurred during the deposition of the carbonaceous material.

Silicification of various parts of the Anderson Lake sediments probably occurred soon after deposition. Devitrification of the tuffaceous and ashy lake bed sediments and/or the felsic volcanics were probably the primary sources of silica. This silicification would tend to lock the uranium mineralization and protect it from remobilization.

The origin of the uranium at Anderson Mine presents some interesting possibilities.

Reyner and others (1956) suggest three possible origins for the uranium at the Anderson Mine property: hypogene, ash leach, and bog deposition. A fourth possible origin, mobilization across Date Creek Basin is discussed at the end of this section.

"Reyner et al (1956) cites field evidence in favor of a hypogene source and states that: 1) uranium ore has not been observed beyond the boundary faults; 2) intense silicification has altered mudstone and limestone; 3) limonite and hematite staining occurs on bedding and fracture planes; 4) calcite, chalcedony, sepiolite, and manganese are found associated with the west bounding fault." This field evidence can be interpreted differently. Drilling data indicates that the carbonaceous sediments also have not been observed beyond the boundary faults. This may explain why the mineral is localized within the boundary faults. Further, if uraniferous solutions migrated up faults, one would expect mineral and grade to be concentrated along the faults. Subsurface interpretations indicate no such association. Data indicates that faulting offsets mineralization. Intense silicification is probably a result of devitrification of silicic volcaniclastic sediments. Bentonite, common in the area, is also an alteration product of tuffaceous material. Hematite and limonite stain on bedding and fracture planes was possibly derived from pyrite associated with carbonaceous material. Calcite, sepiolite, chalcedony, and manganese deposited along this zone, but without associated uranium. Such deposits cannot significantly be cited as evidence that uraniferous solutions migrated up the fault zone.

"Reyner et al (1956) speculate that two other types of origin are possible: ash leach and bog type deposition. Both leaching of ash and deposition in bog type reduction traps are conceivable. Reyner further alludes to a vitrophyric andesite source. Andesite is not commonly a uranium souce. Silicic volcanic rocks are known to contain anomalous amounts of uranium (Love, 1961; Turekian and Wedepohl, Table 2, 1961)....The presence and diagenesis of the tuffaceous component of the lacustrine sediments in combination with adjacent geochemically favorable paludal sediments, provides a possible ash leach-bog deposition model for the origin and deposition of uranium at the Anderson Mine property....The known affinity of uranium for carbonaceous material (Bredger, 1974) accounts for the fixation of uranium within the paludal unit." (Ljung, et al, 1976)

A fourth possibility is that the uranium was mobilized from the western Date Creek Basin, carried by groundwater across the basin and deposited in the reducing environment of the lacustrine sediments. It is interesting to note that uranium mineralization in the western Date Creek Basin is limited to the Artillery Peak Formation of Oligocene Age. Overlying the Artillery Peak Formation is the Chapin Wash Formation which is composed of altered (red) arkosic sandstones. Peirce (1976) suggests correlation of the Chapin Wash and the Anderson Lake Sediments. Sedimentation at Anderson Mine suggests a western or southern source. Groundwater movement during the Miocene therefore, may have been easterly across the basin from the west. Uranium, remobilized from the Artillery Peak Formation or derived from the same but later source, could have been carried in soluble form across the basin to the lacustrine sediments where the reducing environment of the carbonaceous facies precipitated its deposition. Other sources (ashes, tuffs, and granites) may have contributed to some extent to the mineralization of the lacustrine sediments.

Support for this source, over devitrification, is implied by mineralization throughout the carbonaceous materials. If the source had been from overlying sediments containing volcanic fragments, mineralization would be expected only at the top of the carbonaceous zones. Further, if mineralization had been tied with devitrification, uranium should be present in all of the partings and fractures where silica was deposited. This is not the case at Anderson Mine.

HYDROLOGY

Groundwater in the Anderson Mine area appears to be controlled by structure. Groundwater movement appears to be along fault blocks and to the northwest. Catchment and recharge is possibly along the Black Mountains in the Aso Pass-Tres Alamos area. Groundwater movement may be directed and restricted by faults; and fault zones at Anderson Mines, if continuous, would be exposed in this area of the Black Mountains. Restriction of groundwater reservoirs by faults at Anderson Mine is indicated in several areas. For instance, water table levels vary nearly 150 feet between drill holes AM 405 and AM 424 (SE¼, Section 10, T11N, R10W) which are only 300 feet apart.

Water Development Corporation is compiling an in-depth study of the hydrology, and information from Dames & Moore's report on pit slope stabilities may provide more detail on groundwater in the area.

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