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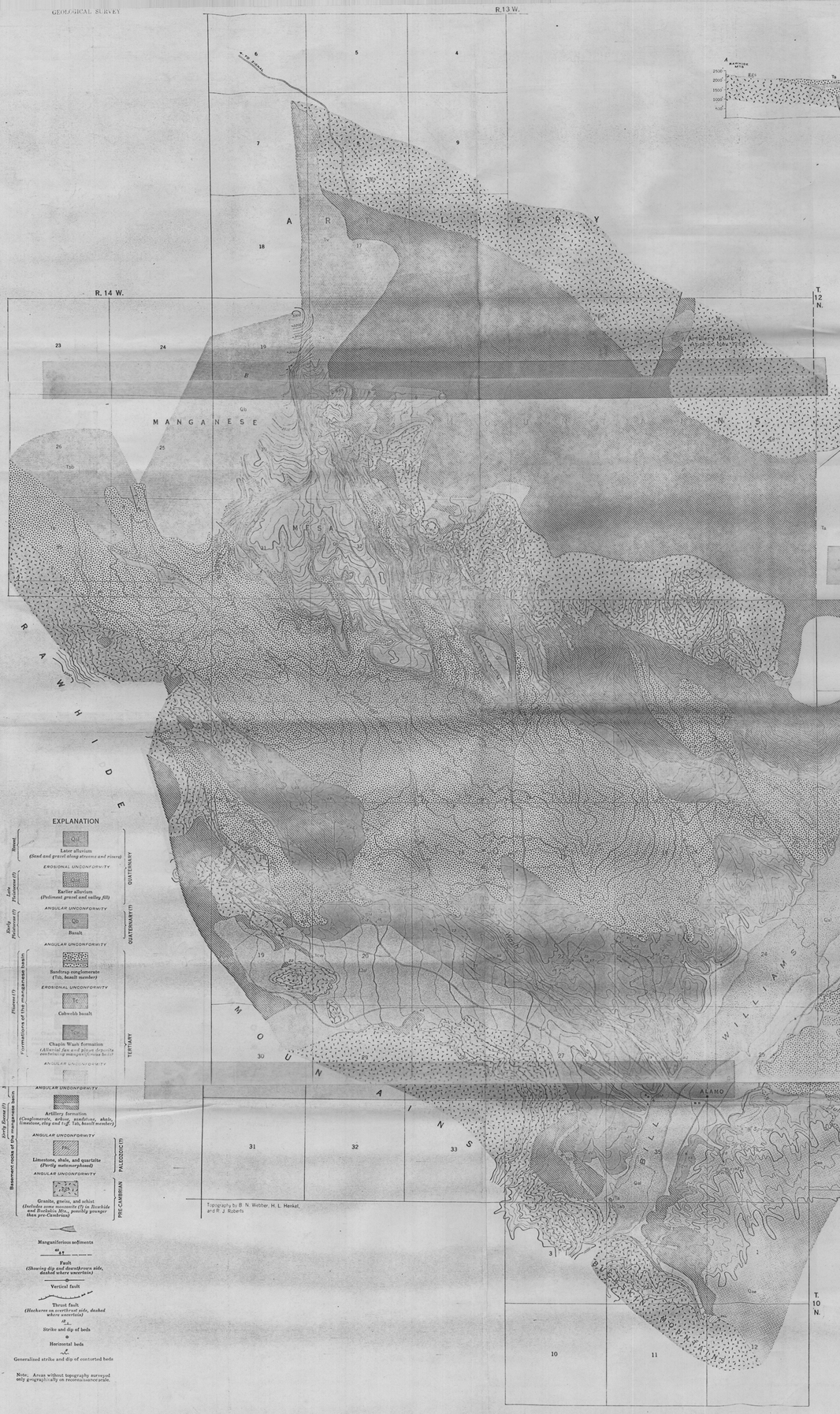
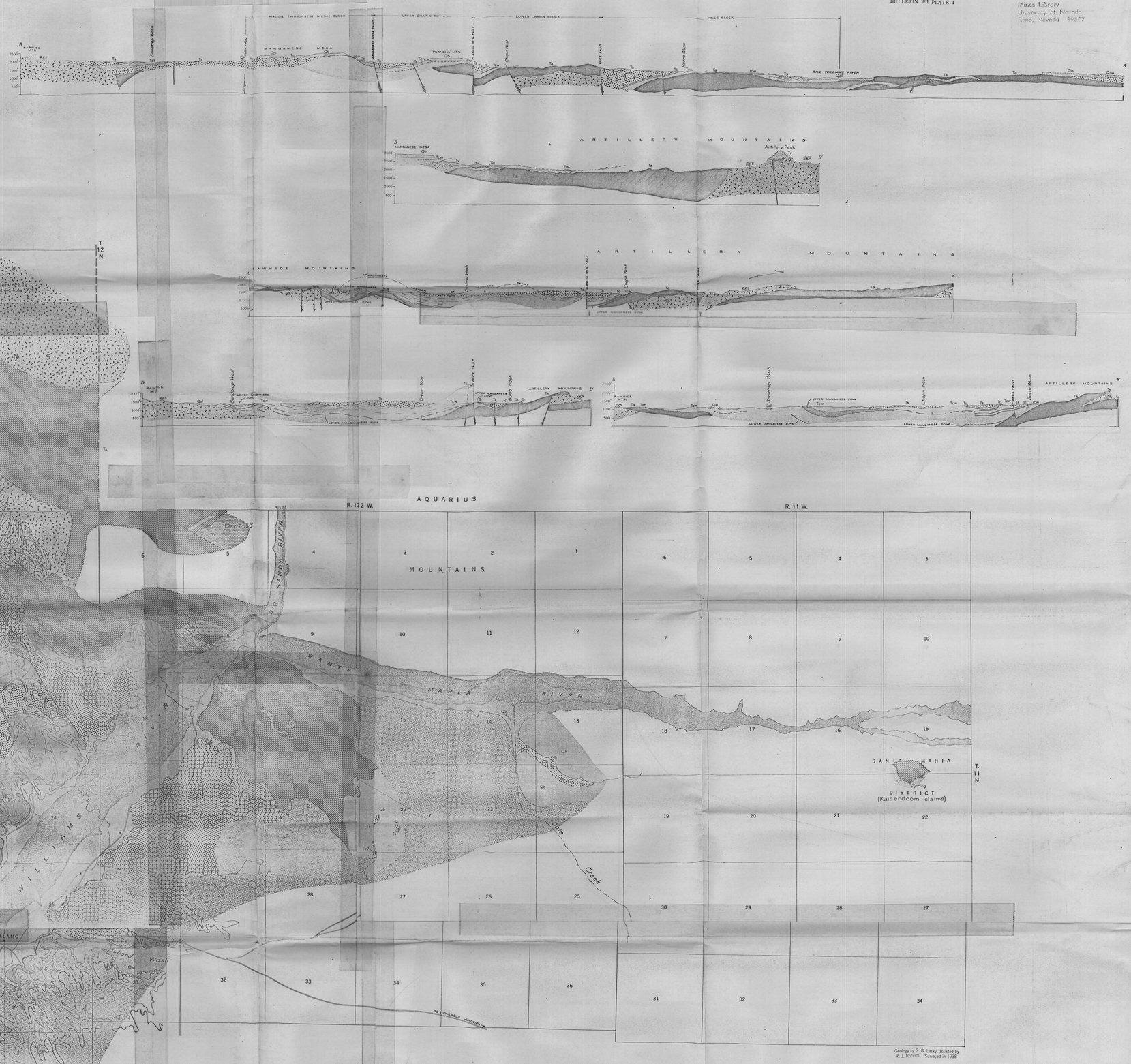
GEOLOGIC MAP AND SECTIONS OF THE ARTILLERY MOUNTAINS MANGANESE REGION, ARIZONA





Geology by S. G. Lasky, assisted by R. J. Roberts. Surveyed in 1938

Scales 1:62,500

1 0 1 2 3 Miles

Contour interval 25 feet
Datum is mean sea level
1919

Geol. Map - Artillery Mts. Manganese Region

R. 10 W.

T. 11 N.

Not mapped

Not mapped

Santa Maria River (intermittent)

CENTRAL AREA

SECTION ALONG LINE A–A'

SECTION ALONG LINE B–B'

SCALE FEET 0 750 1500 2250 3000

GEOLOGIC MAP
OF A PORTION OF
SOUTHWESTERN YAVAPAI COUNTY, ARIZONA

EXPLANATION

QUATERNARY

PLEISTOCENE & RECENT

- Qal — ALLUVIUM

UPPER PLIOCENE(?)

- Tcc, Tcb — Tcc — CAPPING CONGLOMERATE; Tcb — BASALT FLOWS
- Tuc — UPPER CONGLOMERATE
- Tml — MUDSTONE LIMESTONE UNIT

LOWER PLIOCENE(?)

- Taa Dikes, Taa, Tuva — Taa — AUGITE ANDESITE; Tuva — UPPER VITROPHYRIC ANDESITE FLOWS, DIKES AND VENTS.
- Tlc — LOWER CONGLOMERATE

TERTIARY

MIOCENE (?) & LOWER PLIOCENE(?)

- Tb — BASALT FLOWS
- Tva, Tvb — Tva — VITROPHYRIC ANDESITE (Undifferentiated); Tvb — BASALT FLOWS NEAR BASE.

PRECAMBRIAN

- pCgr — GRANITE – SCHIST COMPLEX

CONTACT (Dashed where inferred)

FAULT (Dashed where inferred)

STRIKE AND DIP OF BEDS

ATTUTUDE OF FLOWS

ROADS

INTERMITTENT STREAMS

N

PLATE I

Geologic Map
SW V[illegible] Co

FIELD NOTES FROM THE ARIZONA BUREAU OF MINES

Vol. 7 No. 1 | Earth Sciences and Mineral Resources in Arizona | Spring 1977

Arizona Uranium

The Search Heats Up

by H. Wesley Peirce

Increased demand and soaring uranium prices are the prime ingredients that are fueling a late-1970's world-wide uranium rush. It's a time for dusting off both old literature and aging geological consultants who gained valuable experience during the first uranium boom between 1946 and 1954.

In that time interval, as a consequence of incentive programs, the number of uranium mines in the western United States increased from about 15 to over 900. In Arizona, we now know of 404 documented uranium occurrences (Keith, 1970, p. 214) that serve to provide a substantial base for the intensive border-to-border search presently in progress.

In 1974, uranium ores were produced in six western states: New Mexico (5,400 short tons U_3O_8), Wyoming (4,000 tons), and 3,200 tons from the combined output of Colorado, Texas, Utah, and Washington. Seventy-five percent of U.S. production came from two states, New Mexico and Wyoming. For economic reasons there has been almost no Arizona uranium production for several years. Since 1953, uranium prices have declined almost continuously through 1973 when the average price per lb. U_3O_8 was $6.50. The price started upward in 1974 ($10.50), and in January 1975 was $15.00, August of the same year, $25.00, and at year's end 1976, the spot market price was about $41.00. Apparently, some contracts for delivery in 1980 involve prices in excess of $50.00 per lb. U_3O_8. These prices reflect the importance attached to the future use of nuclear fuels, especially in the generation of electrical power. In order to cover anticipated demand in the U.S., considerable expansion of domestic mining-milling capacity is required. First, however, exploration activity must pick up if the additional domestic resource base is to be discovered, outlined, and developed.

Present and anticipated uranium pricing is encouraging deeper (as well as more) drilling. Additional uranium reserves in New Mexico's Grants Mineral Belt are being developed at depths of between three and four thousand feet.

In 1956 there were 161 uranium mining operations in Arizona, representing 10 of the State's 14 counties. Although most operations were small, total production for that year was 1,341,600 lbs. of U_3O_8 for an average of just over 8,300 lbs. per operation. 136 of these 161 operations were in the three Plateau counties of Apache (60), Coconino (64), and Navajo (12), and the majority of these were on the Navajo Indian Reservation.

Only a very small portion of the State's all-time cumulative production of nearly 18,000,000 lbs. U_3O_8 came from the Basin and Range province. Now, early in 1977, there are indications that perhaps more uranium has been found in this province, in just one area of Yavapai County, than is represented in the State's all-time cumulative production.

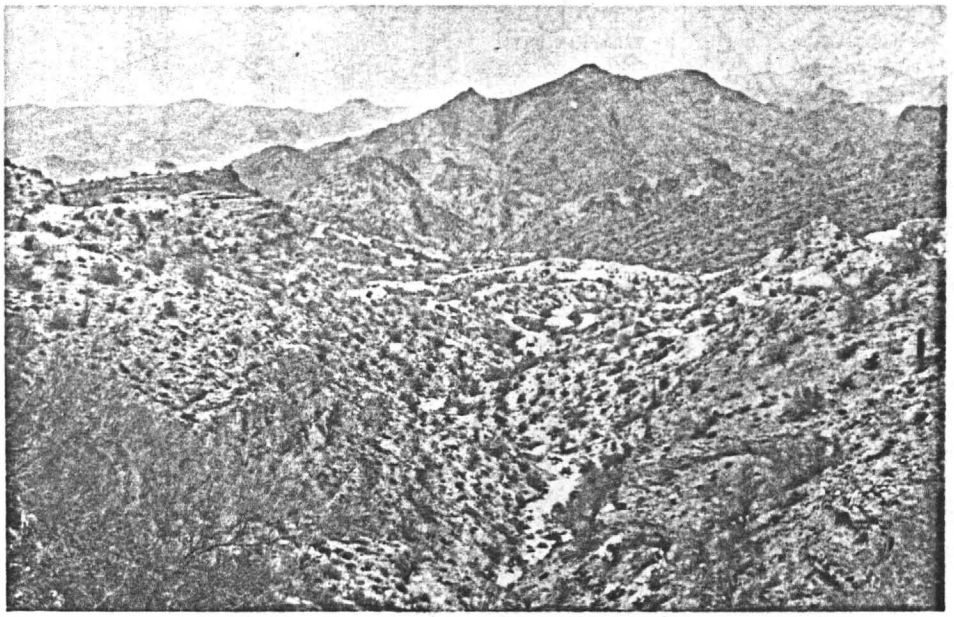
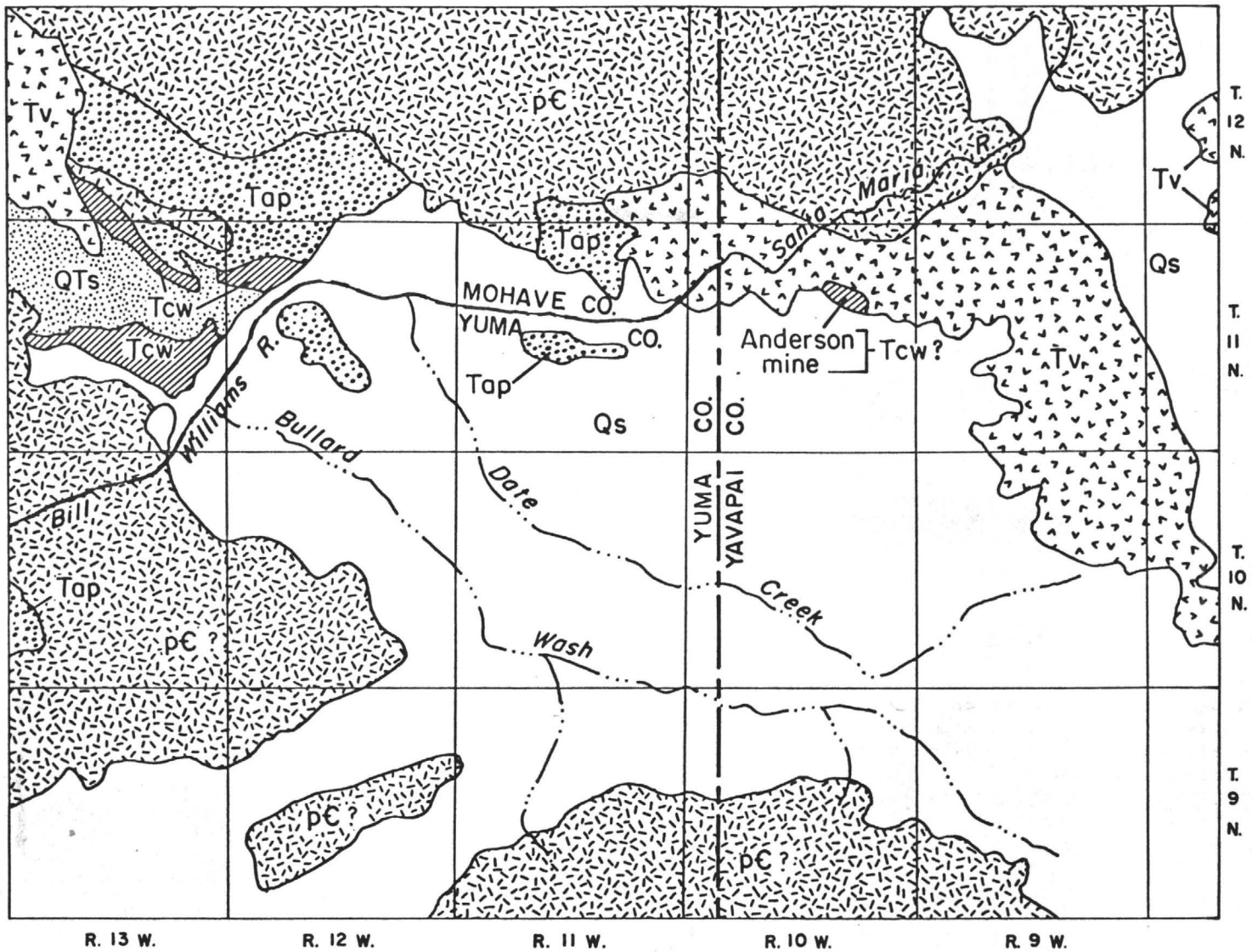


Fig. 1. Anderson mine area showing erosionally exposed light-colored uranium-bearing host rocks in middle distance. Older volcanic rocks in far distance and covering younger rocks in foreground. Looking northwesterly.

Dr. Peirce is a geologist with the Arizona Bureau of Mines.

Also In This Issue:



EXPLANATION

CENOZOIC

Sedimentary rocks

Qs

QTs

Tcw

Chapin Wash Formation

Tap

Artillery Peak Formation

Volcanic rocks

Tv

Undifferentiated Volcanics

PRECAMBRIAN

pC

Undifferentiated Crystallines

Generalized geologic map of west-central Arizona

U.S. Energy Research and Development Agency regional geologist Harlen Holen of Albuquerque, New Mexico, says that the uranium exploration now taking place in west-central Arizona is the most intense within his region (except for the Grants District of New Mexico), which embraces Arizona, New Mexico, and West Texas.

The area receiving most attention in Arizona at this time embraces at least 150 square miles in southwest Yavapai County and northeast Yuma County. Generally, it is east of the Bill Williams River and south of the Santa Maria River and includes the valley occupied by both the Date Creek and Bullard Wash drainages (see map on opposite page.)

The prime stimulus to exploration in this region stems from an outcrop discovery first made in 1955 by T.R. Anderson with the aid of an airborne scintillation counter. Numerous claims were located by the related Uranium Aire Corporation, and near-surface mining operations supported some ore shipments to the Atomic Energy Commission (AEC) ore-buying station at Cutter, Arizona, east of Globe. The property generally is known either as the Anderson mine or the Uranium Aire group – the former name will be used here.

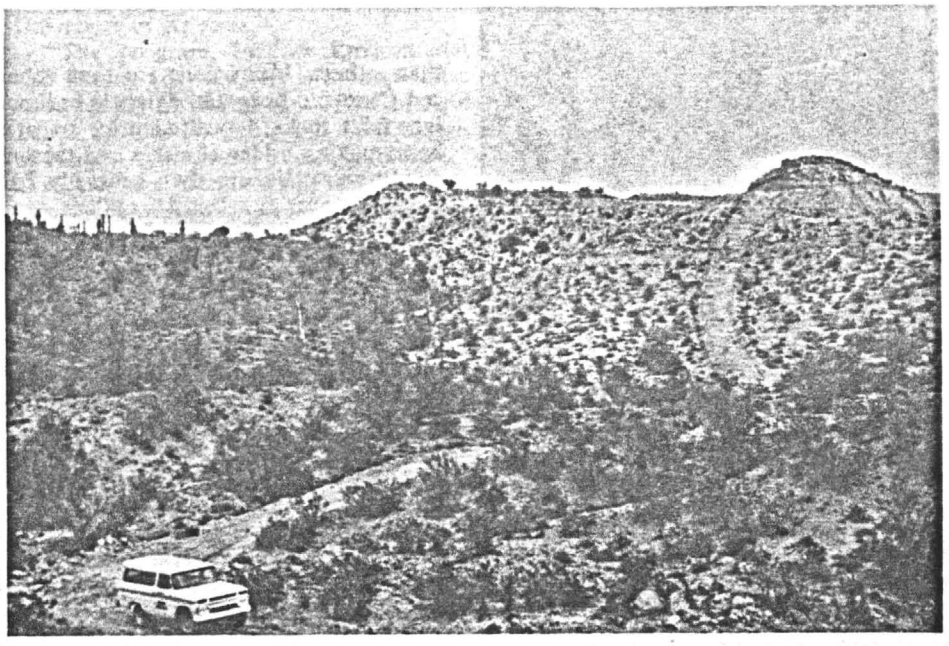


Fig. 2. Lower contact of Anderson mine host rocks with darker underlying andesitic volcanic rocks to left. Looking easterly.

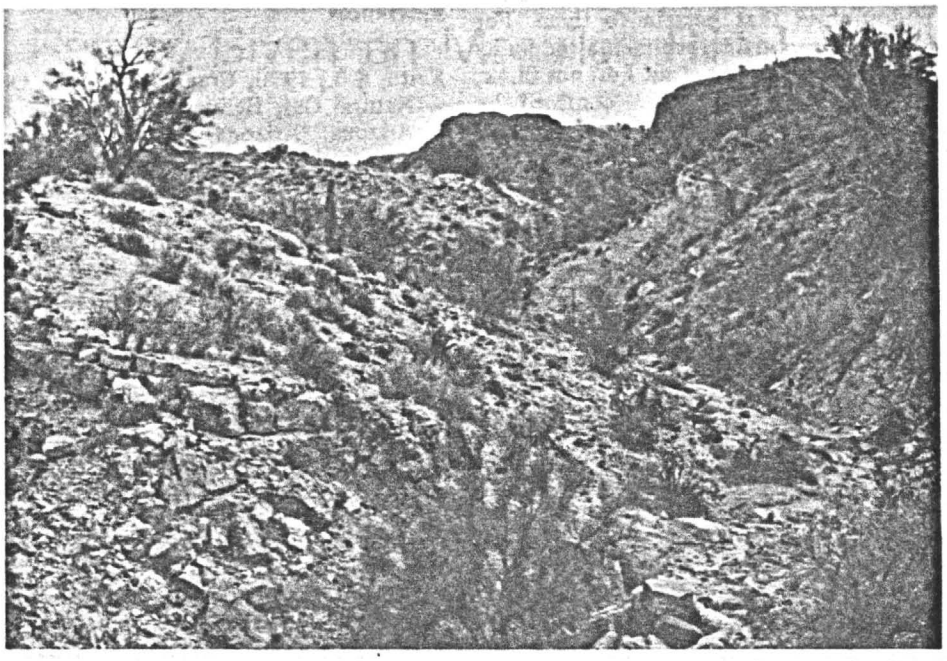


Fig. 3. Tilted Anderson host rocks showing cliff-making covering strata in distance. Looking easterly.

More specifically, the Anderson mine is located in the northeast quarter of T.11 N., R.10 W. A yet smaller area is best circumscribed on the geologic map of Yavapai County, which depicts an elliptically shaped geologic unit labeled QTL. It is similarly circumscribed on the State geologic map but is not labeled.

The geology of the Anderson mine and the general geologic setting of the larger region are topics of increasing interest. This is the result of a widening recognition of the possible existence of large volumes of buried mineralized rock, not only below and flanking the Anderson mine, but regionally beneath the present valley surface. Too, in addition to the more local applications, there are geologic questions, the answers to which might help shape a general uranium exploration philosophy for Arizona's Basin and Range province.

Of immediate local exploration interest is the continuity of the Anderson mine host rocks beyond the surface exposures. Drilling ventures now in progress hope to find this out. Preliminary data indicate that at least six companies are active in the larger region and that some drilling might have exceeded 2000-foot depths.

The Anderson mine host rocks are fine-grained (Figure 4), low-energy sedimentary rocks usually referred to as lake beds. Their existence is revealed by erosional down-cutting along a tributary to the Santa Maria River which, at the position of the mine, is partially controlled by the contact of the softer lake beds with harder, underlying Tertiary andesitic volcanics (Figures 1, 2). These rocks are tilted towards the south, therefore the tendency is for erosion to move the lower contact southward. The Anderson host rocks are about 200 feet thick in the mine area and are overlain by younger sediments and a thin basalt flow where the host rocks pass beneath cover to the south. The lake beds are fossiliferous, faulted and folded (Figure 3), have been locally silicified, and contain lensing lignitic units. The principal uranium mineral is carnotite, the source of which is not known.

The isolated, window-like exposure of these lake beds renders regional stratigraphic correlation imprecise. The only attempts made at correlating with previously named and mapped geologic units have been to the west in the Alamo-Bill Williams River-Artillery Peak area on either side of the Yuma-Mohave County boundary. Lasky and Webber (1946) originally defined an older Artillery Peak Formation and a younger Chapin Wash Formation. Tentative corre-

Fig. 4 (far left). Fine-grained Anderson host rocks exposed in cut. Note rock pick for scale.

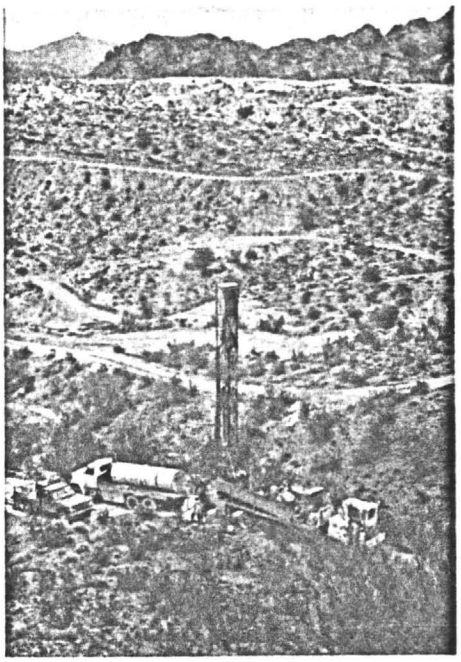


Fig. 5. (left). Exploration drilling of underlying Anderson host rocks. Older volcanics in distance; Anderson rocks in middle distance. Looking northerly from capping younger strata.

lation of the Anderson host rocks with the Chapin Wash Formation has been made by Reyner, et al., 1956, and by Jones, 1970, in an unpublished report. This correlation seems to have considerable merit even though the respective units are at least 10 miles apart. On both the county and State geologic maps all three of these units are assigned different ages, the Anderson host rocks being the youngest. However, in my opinion, the Anderson rocks almost certainly are older than is depicted on these maps. It is interesting to observe that in the Chapin Wash-Artillery Peak area it is the older Artillery Peak Formation that contains known uranium occurrences whereas the Chapin Wash Formation does not (Keith, Plate 18 and Table K). These formations as well as the Anderson host rocks potentially underlie, at variable and unknown depths, much of the piedmont surface east of the Bill Williams River. Many claims have been staked and drilling has been active in various parts of the region.

The Chapin Wash Formation was designated lower Pliocene (?) by Lasky and Webber, and the Anderson mine host rocks were similarly designated by Reyner et al. Lindsay and Tessman (1974, p. 4) assign a mid-Miocene age to the Anderson rocks on the basis of vertebrate fossils that include a camel and a rhinoceros. An unpublished date on a basalt (Cobweb Basalt of Lasky and Webber) that conformably overlies the Chapin Wash Formation suggests that the latter is not younger than mid-Miocene (no younger than 12 million years). Another unpublished age date on a basalt in the older Artillery Formation further suggests that the Chapin Wash Formation is no older than lowest Miocene (25 million years). If correlation of the Anderson host rocks with the Chapin Wash Formation is assumed, then it appears likely that the Anderson host rocks are lower- to mid-Miocene in age.

Structural deformation in the form of folding, tilting, and faulting is evident in both the Chapin Wash and Anderson units (Figure 3). Although others have characterized these rocks as being playa and/or lake deposits (basin-fill deposits), it is important to note that they accumulated in a basin whose origin preceded the onset of latest Tertiary (upper Miocene) basin-making (Peirce, 1976, p. 325). As such, these uraniferous Anderson rocks are remnants and caution is indicated in developing exploration philosophies that pertain to them. For instance, the original sedimentation limits of these units is not clear. I do not think, however, that they were confined by paleogeographic elements coincident with today's bounding topographic highs (Figures 1, 5). This is to suggest that the later tectonic events that deformed these rocks significantly altered the structural-physiographic setting that had prevailed during deposition. The present topography is impressed upon this later (post-deposition) episode.

Much exploration attention is being given to the so-called lake bed, basin-fill deposits of Cenozoic age within the Basin and Range province of southwestern Arizona. Uranium occurrences are known in many localities and host rock ages are notably variable.

Cenozoic (last 60 million years) geologic history in southern Arizona is very complex. However, it appears likely that portions of this history were more conducive to the potential creation of large volumes of uranium mineralization than others. Indications are that enhanced Cenozoic potential exists in sedimentary host rocks deposited prior to latest basin-making under climatic and tectonic conditions different than generally have prevailed over the last 10 million years. The question is: Are significant volumes of these rocks preserved, and, if so, where?

The purpose of this article is to point out that some are preserved in west-central Arizona where they presently constitute the basis of an exploration effort that portends to be of national energy significance. Where else similar host rocks might still exist in Arizona's Basin and Range country is a substantial geologic question. It is a puzzle with many pieces and it seems likely that many explorationists are destined to be challenged to attempt to put it together.

For the nation's sake, we wish them success.

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V. 63, No. 4 (April 1979), P. 621-640, 18 Figs., 3 Tables

AAPG Bull.

Major Uranium Discovery in Volcaniclastic Sediments, Basin and Range Province, Yavapai County, Arizona[1]

J. E. SHERBORNE, JR.,[2] W. A. BUCKOVIC,[2] D. B. DEWITT,[2] T. S. HELLINGER,[3] and S. J. PAVLAK[2]

Abstract The Anderson Mine uranium deposit in west-central Arizona is one of the first significant uranium discoveries in the Basin and Range province. The deposit occurs in gently dipping Miocene lacustrine sediments near the northeastern margin of the Date Creek basin. Mineralized units are primarily carbonaceous mudstones and siltstones interbedded with fine tuffaceous sedimentary rocks, freshwater marlstones and limestones, and a few thin sandstones. The sequence is underlain by Eocene(?) andesitic volcanic rocks and overlain by Miocene sedimentary rocks and basalt.

The uranium deposit has a tabular or blanket-type configuration with minimum dimensions of approximately 1,000 by 1,500 m. Mineralization extends at least 1,000 m farther downdip to the south. The mineralized zone is composed of several beds that are generally 1 to 3 m thick, but range up to 11 m. The mineralization is stacked in most areas and aggregate thicknesses greater than 15 m are common. Mineral grades range from 0.03 to 0.10% U_3O_8, with an average grade of approximately 0.07%. Molybdenum, sulfur, vanadium, and organic carbon are concentrated with the uranium mineralization. Other elements which are anomalous in much of the Anderson Mine strata include manganese, lithium, and fluorine. In parts of the orebody, there are variations in the disequilibrium factor; however, the overall factor is approximately 1.00.

The uranium-bearing tuffaceous sediments were deposited during periods of felsic volcanism in sheltered backwater areas marginal to an expanding Miocene lake. During subsequent compaction and dewatering of these uranium-rich lake sediments, the expelled alkaline fluids came in contact with strongly reducing paludal sediments causing the precipitation and fixation of uranium. Associated zeolitization, silicification, and argillic alteration indicate an early diagenetic origin for the primary coffinite(?) mineralization. Some remobilization and precipitation of uranium minerals in fractures have occurred in recent geologic time.

INTRODUCTION

The Anderson Mine area is located in the Basin and Range physiographic province approximately 72 km northwest of Wickenburg, Arizona (Fig. 1). The uranium deposit occurs in Tertiary rocks in the northern part of an area designated by Otton (1977b) as the Date Creek basin. This basin, which encompasses an area in excess of 900 sq km, has recently gained national attention as the result of considerable land acquisition and cent publication by the U.S. Energy Research and Development Administration (U.S. ERDA, 1976) which stated that the $30/lb uranium reserves for the entire Basin and Range province are 2,800,000 lb U_3O_8 (Table 1). Exploration drilling at the Anderson Mine indicates that the reserves in this area alone are considerably in excess of this figure, which lends credence to the high uranium resource estimates for this province made by ERDA in the same publication.

The Anderson Mine area is located in southwest Yavapai County on the south side of the Santa Maria River in Secs. 2, and 9 through 16, T11N, R10W, from the Gila and Salt River baseline and meridian. This area is at the northern edge of a broad plateau incised by intermittent tributaries of the Santa Maria River. Approximately 210 m of relief is present in the mine area

[1]Manuscript received, April 11, 1978; accepted, October 24, 1978.

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Additionally, we thank other members of the Casper and

RME-2057

GEOLOGY OF URANIUM DEPOSITS IN TERTIARY LAKE SEDIMENTS OF SOUTHWESTERN YAVAPAI COUNTY, ARIZONA

by M. D. Regner, W. R. Ashwill, & R. D. Robison

December 1956
U. S. AEC (SLAO)

Part I

Table of Contents

mainly of partly silicified rhyolite porphyry; narrow discontinuous fractures cut the rhyolite and are stained by iron minerals. Small prospect pits have been dug where the fractures are filled with calcite and hematite.

The rhyolite porphyry is slightly radioactive throughout, a representative sample of the rock containing 0.008 percent eU. The only increase in radioactivity was detected at a prospect pit on the south side of the hill near the crest where a narrow carbonate vein that contains a small amount of dark-purple fluorite and flecks of uranophane or autunite is exposed. A grab sample of vein material contains 0.11 percent U.

Black Rock district, Yavapai Co., Ariz.

The Abe Lincoln mine in the Black Rock district is in the SW¼ sec. 11, T. 8 N., R. 3 W., (unsurveyed) and is 14 miles by road northwest of Wickenburg, Arizona. The Abe Lincoln vein system occupies a northeast-trending fault zone in a pre-Cambrian (?) gneiss-schist complex intruded by granite and dikes of felsite, trachite porphyry, and basalt. Chalcopyrite is the chief ore mineral with subordinate azurite, chalcocite, and malachite. The gangue minerals are principally pyrite, quartz, calcite, purple fluorite, and limonite. Some specimens of vein material on the dumps contain a secondary yellow uranium mineral which, in one specimen, was identified by X-ray methods as schoepite ($4UO_3 \cdot 9H_2O$?); pitchblende may be present. Samples from the dumps ranged from 0.074 percent to 0.46 percent U. Samples of radioactive material in place could not be obtained inasmuch as most of the mine workings are caved and flooded.

Radioactive material was found also on the Bracken property 1 mile west of the Abe Lincoln mine. Samples from the northwest-trending quartz vein on

the property contain 0.006 and 0.012 percent U. No uranium minerals were observed. Also on the Bracken property a 20-foot zone of radioactive altered migmatite is exposed in a road-cut. A 1.6-foot channel sample across the most radioactive part of this zone contains 0.012 percent U.

Another area, approximately 13 miles by road northeast of Wickenburg, contains weakly radioactive material in granite gneiss exposed in a road-cut 0.8 mile northeast of the Monte Cristo mine. Although other slight increases in radioactivity were detected within a mile of the roadcut, no significant concentration of uranium-bearing material could be found.

Tyrone district, Grant Co., N. Mex.

A reconnaissance for uranium is currently being conducted in areas adjacent to the central part of the Tyrone district. Uranium is present in the White Signal district southeast of Tyrone, in the Tyrone district, and in the Black Hawk district northwest of Tyrone. The purpose of the present work is to determine whether uranium occurs in the apparently favorable areas between the three districts.

Interest in the occurrence of uranium in the Dripping Spring formation in Gila Co., Ariz., has greatly increased. As an indication of the interest, it is reported that approximately 1000 claims were located in a single 2-month period this spring.

Nevada-Utah district
by A. O. Taylor

Most of the report period was spent on map compilation, preparation of reports, and laboratory study of rock and ore samples. Reconnaissance

INTER-OFFICE CORRESPONDENCE

COPIES TO:

TO J. B. Imswiler

FROM G. A. Parkison

DATE April 6, 1977

SUBJECT Notes Concerning the Uranium Deposits in the Artillery Peak-Date Creek Area, Mohave, Yavapai and Yuma Counties, Arizona

Introduction

The Tertiary lake sediments within the Artillery Peak-Date Creek basin are possibly host to upwards of 100,000,000 pounds of U_3O_8 at grades of about 0.15 percent. Recent speculation has suggested that the district is richer than the Grants district in New Mexico. During the past year or so nearly 13 townships have been completely staked and the companies engaged in this staking reads like a who's who of the uranium mining companies.

During March 22, 23, and 24, 1977 a general reconnaissance of the Artillery Peak-Date Creek area was made. Fortunately, an earlier AEC report (RME-2057, Geology of Uranium Deposits in Tertiary Lake Sediments of Southwestern Yavapai County, Arizona, by Reyner, Ashwill and Robison) was made of much of the area and includes much useful information. Also, a report and map covering the Artillery Mountains manganese area gives good coverage of the Artillery Peak area (Losky et al, U.S.G.S. Bull. 961). Incidentally, J. Otten of the U.S.G.S. is currently investigating the uranium deposits of the district and preparing a paper concerning them. The Artillery Peak-Date Creek district is actually divisible into two rather distinct areas of interest on either side of the Bill Williams River. The Date Creek area (including the Anderson Mine) lying to the east and south of the Santa Maria River and containing Miocene volcanic rocks deposited upon the Precambrian basement and overlain by the uraniferous Lower Pliocene (?) lakebeds. The Artillery Peak area lies to the west of the confluence of the Big Sandy and Santa Maria Rivers to form the Bill Williams River. In this area Eocene basal conglomerate and overlying lake sediments are in turn overlain by Miocene volcanic rocks and Pliocene lakebeds. Stratigraphic correlations from one area to the other are the subject of much debate and it appears that some facies changes have occurred within correlative units.

Date Creek Area

The Date Creek area was first noted as containing uranium during a private airborne survey in 1955. Shortly thereafter, a few hundred claims were staked surrounding outcropping carnotite-bearing lakebeds. A small mine was opened and although much rock was moved, only about 50,000 to 60,000 tons of ore with 0.10 to 0.15% U_3O_8 was shipped. In 1973 Union Oil acquired the property. In 1974 Urangesselschaft staked some adjoining property. Starting in late 1975 and early 1976 the rush was on to acquire most all the ground in the Date Creek area.

The stratigraphic sequence and relationships are shown well by the attached figures. The mudstone-limestone unit is the favorable unit and contains two ore zones stratigraphically separated by about 85 feet. Both zones average about two to three feet in thickness and have a fairly constant grade of 0.10 to 0.15% U_3O_8. The ore-bearing horizons have been traced continuously for a strike length of over 3 miles. The strata bounding the ore zones are generally gray-green mudstones and white limestones. Both of these units and the ore horizon have been variably silicified, the silicification being somewhat erratic both along and across bedding. No ore grade material has been found outside the two well-defined ore horizons. Carbonaceous matter is ubiquitously associated with the ore zones, and is generally restricted to these zones. Abundant fossil plant fragments are found within the ore zones. Silicification is present in the ore zone but does not seem to have affected grade, the alteration perhaps being superimposed on the probable syngenetrically enriched lakebeds.

The sedimentary sequence has a gentle pervasive southerly dip with only slight folding. Faulting is insignificant within the main prospect area, but strong normal faults cut the sequence and limit the ore horizons to a strike length of about 3 miles. While equivalent strata do occur across these faults, they are not uraniferous.

The origin of the uranium seems to be distinctly syngenetic. The association of the uranium with the organic matter, the well defined and confined nature of the mineralization, the nearly constant grade, and the lack of any relation between grade and silicification all suggest that there was in situ enrichment of the ore beds as they were being deposited. While many lakebeds are anomalous in uranium content owing to probable special paleogeologic and paleogeographic considerations, the grade of the Date Creek lakebeds is an order of magnitude greater than nearly all other lakebeds noted in the literature. Why this is so is pure speculation at present.

Artillery Peak Area

The Artillery Peak area was noted as containing uraniferous sedimentary rocks as early as 1955 when the activity in the Date Creek area was starting. Apparently no PRR's exist for the localities in this area. Renewed interest in this area started at the same time staking started in the Date Creek area. The major property holders are Public Service of Oklahoma, Getty, Homestake and Utah International. To this date probably all favorable ground has been acquired and staking has now slopped over to favorable looking

GENERALIZED GEOLOGIC COLUMN

SOUTHWESTERN YAVAPAI COUNTY, ARIZONA

AGE	LITHOLOGIC UNIT	COLUMNAR SECTION	THICK-NESS	CHARACTER AND DISTRIBUTION
QUATERNARY	ALLUVIUM			Silt, Sand, and Gravel, locally cemented with Caliche. Present as desert cover, Valley fill, and Terrace gravels.
				Angular Unconformity
TERTIARY — UPPER PLIOCENE	CAPPING CONGLOMERATE GROUP		200' + 0-40'	Pinkish-brown Conglomerate with included Basalt flows. Forms cap rocks and cliffs
				Angular Unconformity
TERTIARY — LOWER PLIOCENE (?)	LAKE SEDIMENTS AND INCLUDED LAVA FLOWS GROUP — UPPER CONGLOMERATE UNIT		0-500'	Arkosic Conglomerate with beds and lenses of friable Sandstone. Contains fragmental Vertibrate fossils. Forms steep slopes
	LAKE SEDIMENTS AND INCLUDED LAVA FLOWS GROUP — MUDSTONE LIMESTONE UNIT		0-200'	Fine grained Sediments with minor Conglomerate and ash beds. Contains mollusks, fossil wood, and Uranium.
				Erosional Unconformity
	LAKE SEDIMENTS AND INCLUDED LAVA FLOWS GROUP — INTERBEDDED ANDESITE FLOW UNIT		0-300'	Vitrophyric Andesite flows to the East and Augite Andesite flows to the West. Dikes and vents present. Forms jagged ridges and peaks.
	LAKE SEDIMENTS AND INCLUDED LAVA FLOWS GROUP — LOWER CONGLOMERATE UNIT		0-300'	Sandstone to sandy Conglomerate dominantly composed of Vitrophyric Andesite material. Forms rounded hills and bad land topography
				Erosion Unconformity
			0-150'	Basalt flows that are missing to the East and thicken rapidly Westward. Forms buttes and rough hills.
				Angular Unconformity
TERTIARY — MIOCENE (?)	OLDER VOLCANIC EXTRUSIVES GROUP — VITROPHYRIC ANDESITE FLOWS FRAGMENTAL TUFF, & BASALT FLOWS		1500±	Banded flows of Vitrophyric Andesite that devitrifies to ash-like material. Thin fragmental tuff beds in Eastern portion of area. Basalt flows present near base. Forms jagged peaks and cliffs and, where altered, rounded hills.
			0-200'	
				Angular Unconformity
PRE-CAMBRIAN	BASEMENT COMPLEX			Medium to coarse grained Biotite granite, Schist, and Meta-quartzite with included Basalt and Pegmatite dikes.

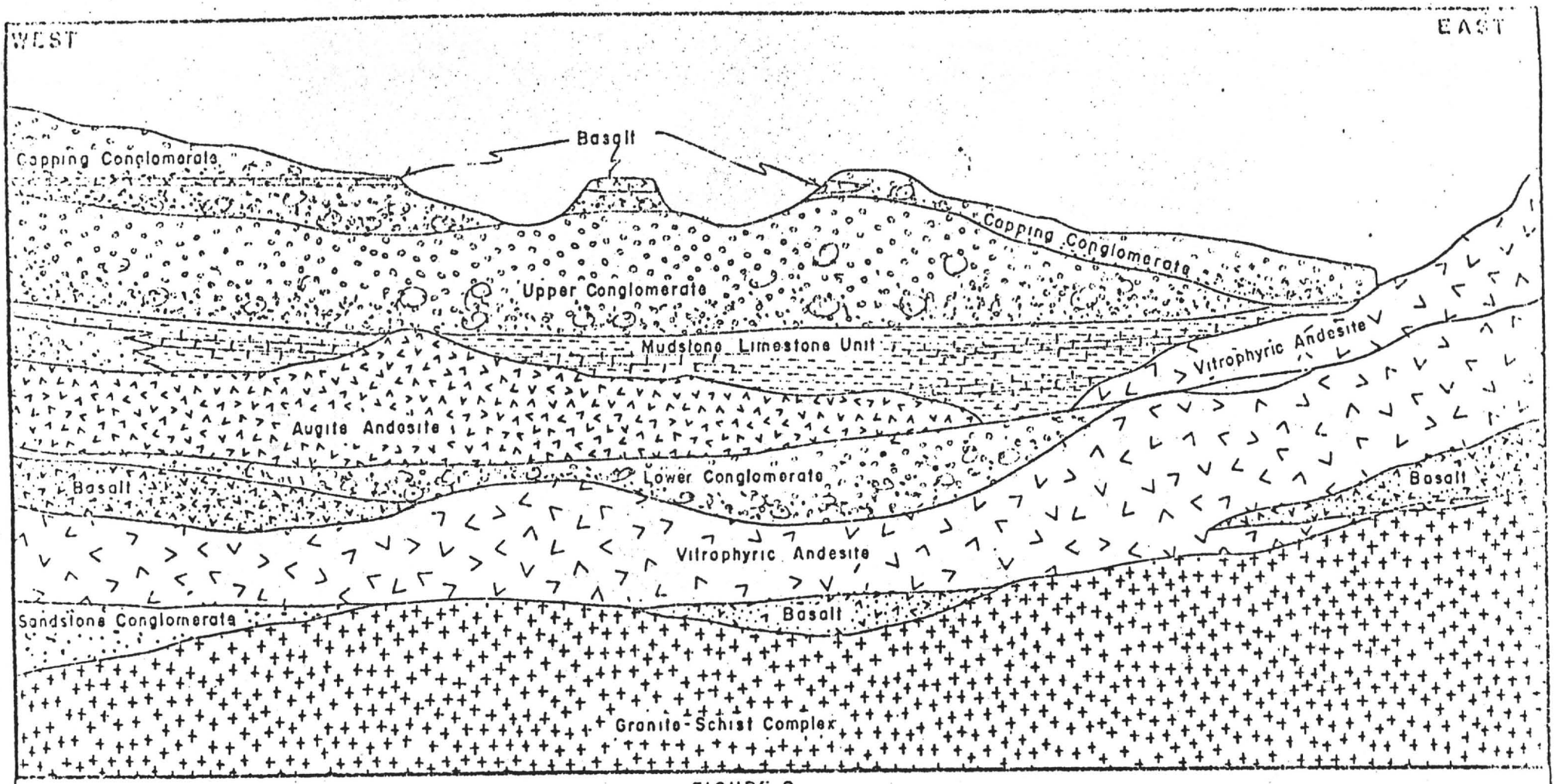


FIGURE 2

SCHEMATIC CROSS SECTION

Showing

STRATIGRAPHIC RELATIONSHIPS

Through

AREA MAPPED

HORIZONTAL DISTANCE APPROXIMATELY 8 MILES

areas some 5 to 10 miles to the south.

Numerous ore-bearing horizons are present within the Artillery Peak area. These are all associated with Eocene and Pliocene lakebed sequences. At least one ore horizon is present in the Eocene Artillery Fm. strata and probably three or more within the Pliocene Chapin Wash Fm. The ore horizon in the Artillery Fm. is about 2 to 3 feet thick and occurs about 10 feet above an approximately 60 foot thick basal red arkosic conglomerate which is not anomalous. The ore zone crops out just south of Artillery Peak. The ore zone is composed of a massive green limy mudstone with small amounts of pitchblende coating small fractures. No carbonaceous matter or yellow uranium minerals have been noted. This bed contains from 0.10 to 0.15% U_3O_8 for an outcrop length of at least several thousand feet. Other similar beds in the thick lakebed sequence of predominantly interbedded red and gray siltstones, limestones, mudstones and cherts are irregularly uraniferous.

A few miles to the south of Artillery Peak itself the Pliocene Chapin Wash Fm. overlies the older Artillery Fm. with a pronounced unconformity. Within the Chapin Wash Fm. there are probably three ore horizons within the lakebed or playa deposit portion of the formation. The formation is also host to thick sections of manganiferous sandstone, generally outcropping to the south of the area of uranium shows. The lakebed sequence here is similar to that of the Date Creek area uraniferous mudstone-limestone area although silification here is not as prominent. Several distinctive tuff beds are also included within this sequence in this area. Although the anomalous ore zones were not visited in this area, they are reportedly somewhat like those at the Anderson Mine at least in appearance. It is not known what the grade or continuity of these ore zones are.

A distinctly syngenetic origin is invoked for these deposits as well. Little evidence for extensive groundwater redistribution is seen although some slight remobilization of uranium is probable as the uranium minerals coat some slickensides and fractures within the ore zones. It seems quite remarkable that in such an area as this, with original basinal dimensions of about 40 by 15 miles, there has been recurrent uranium mineralization of such a high grade and wide areal extent.

Speculation as to Genesis

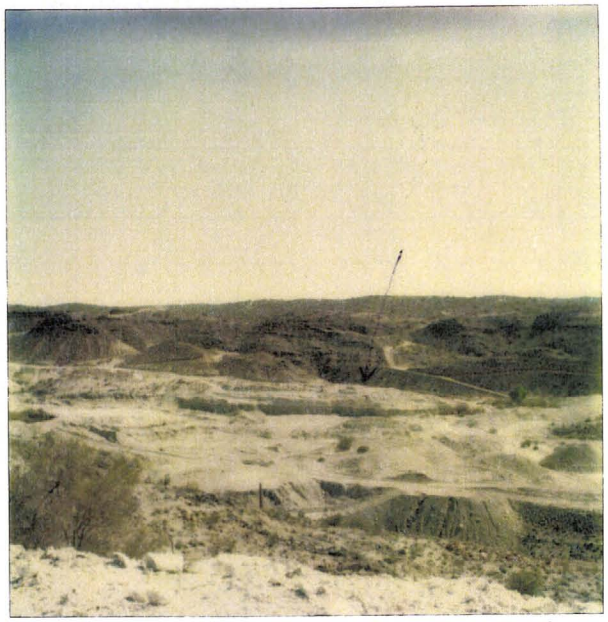
As much more information becomes available concerning these deposits in the Artillery Peak-Date Creek district through drilling, surface sampling and mining, a general scenario for their origin is sure to emerge. For now, the only consensus is that they are probably syngenetic and the uranium has been only slightly, if at all, remobilized from its original host. It is known that the Precambrian rocks surrounding the basin are somewhat anomalous in uranium content. Also, the abundance of volcanic rocks and tuffs raises the possibility that these rocks might also have contributed much uranium. However, even if the uranium was available, how did it become concentrated to such an extent in the ore horizons and with little enrichment elsewhere. For now, it can only be said that special circumstances were involved, perhaps involving multiple enrichment through cannibalism of older

uraniferous lakebeds or the introduction of distinctly uraniferous tuffs into the basin. How this could have happened more than a few times through the basin area over a period of some 50 million years is not known. The only possible modern day analogue which comes to mind might be uraniferous peat bog deposits. In the Sierra Nevada, peat bogs at Hoffman and Petit Ranch meadows contain up to .25% U_3O_8 in humic material and decomposed plant matter taken from the bogs. Although these meadows represent a somewhat dissimilar environment than that prevailing during deposition of the Artillery Peak-Date Creek district beds, a study of these bog deposits might shed some light on the origin of these deposits.

Suggestions for Future Prospecting

I have personally inspected and also read enough reports of uraniferous lakebeds to realize that the lakebeds of Artillery Peak-Date Creek area are a special case and perhaps a singular occurrence. While there is nothing unusual about the district in terms of basin dimensions, sedimentary fill sequence, surrounding source rocks, etc., the same geologic features are probably closely duplicated over much of the Basin and Range province, the large amounts of contained uranium are most unusual. It would probably be foolish to expect to find another deposit of this type with similar size and tenor of mineralization. Within Arizona itself are a half-dozen areas which are known to contain uraniferous lakebeds. Most of these have marginal to submarginal grade and quite erratic mineralization. However, even these have been the source of much recent exploration. It is to be expected that exploration will fan out from the Artillery Peak-Date Creek district in the hope of finding similar districts which I believe are doubtful to exist.

However, there are certain areas which do probably contain mineralization within lakebeds which although probably not approaching the dimensions of this new "type example" will nevertheless be economic ore bodies. At present the geologic constraints are so few upon this type of deposit that little a priori reasoning can be done to delimit exploration targets. I propose that the fastest and most cost-efficient way of exploration for these deposits is by low-altitude rim flying of outcropping Tertiary lakebeds. Airborne methods are well suited to the discovery of these large, relatively low-grade syngenetic deposits.



Main pit area of Anderson mine. Arrow points to other photo. Photo looking south (downdip). The pit bottoms in main mineralized zone. White beds are silic. ls. Dark beds (ridge formers) are upper conglom. and ls.

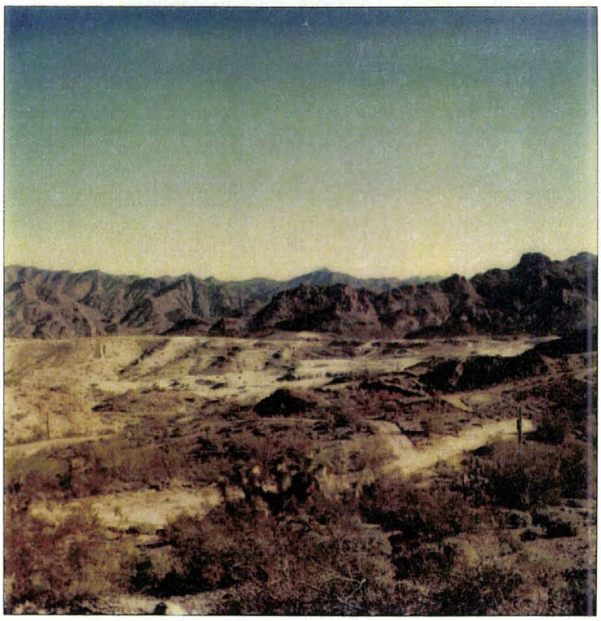
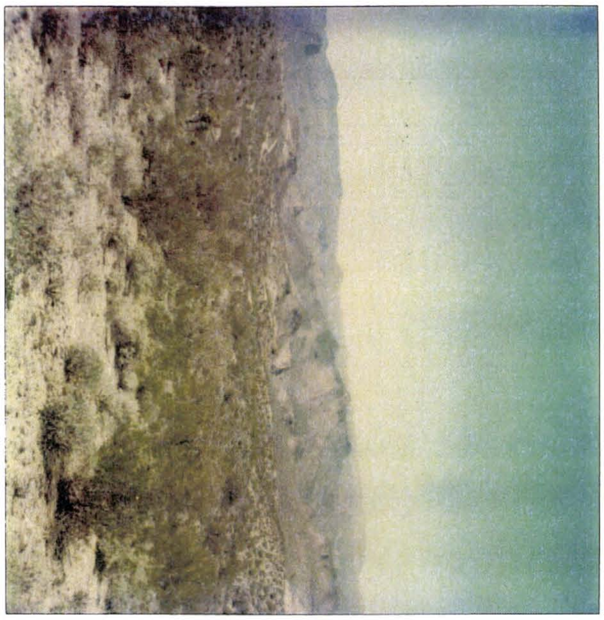
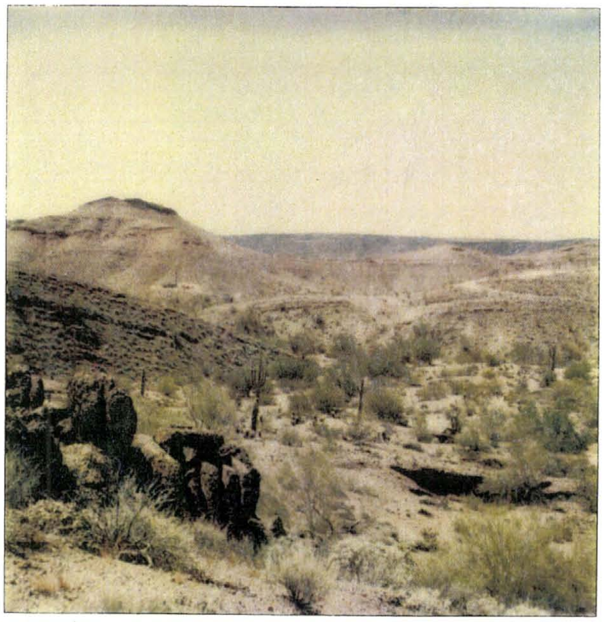


Photo looking N.E. from the S.W. Anderson Mine in middle distance. Mineralized bed at pit bottom, dipping to south under observer. Mts. in background form N. rim. Boulder border of sed. basin. Rocks in foreground are capping cgl. and upper cgl.

Photo in bottom of pit. Mineralized zone at bottom of pit. Lower gray-green beds are massive, mud-clay stones. Upper beds are silicified limestones. Both of these liths are pretty clean.



General overview of the Uranium-Aire (Anderson) Mine area (central area of photo)



Area of active drilling by Homestake about 1 mi. west of Artillery PK. in the Artill. Pk. Fm. Looking S.W. perp. to bedding of Fm. Foreground is pegmatitic Pe granite, just below contact w/ basal cgl. Near skyline still in Eocene rx. Note drill rig.

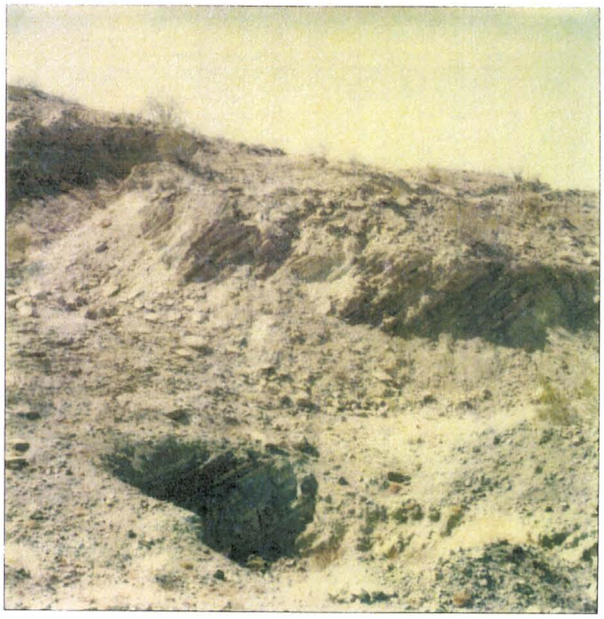
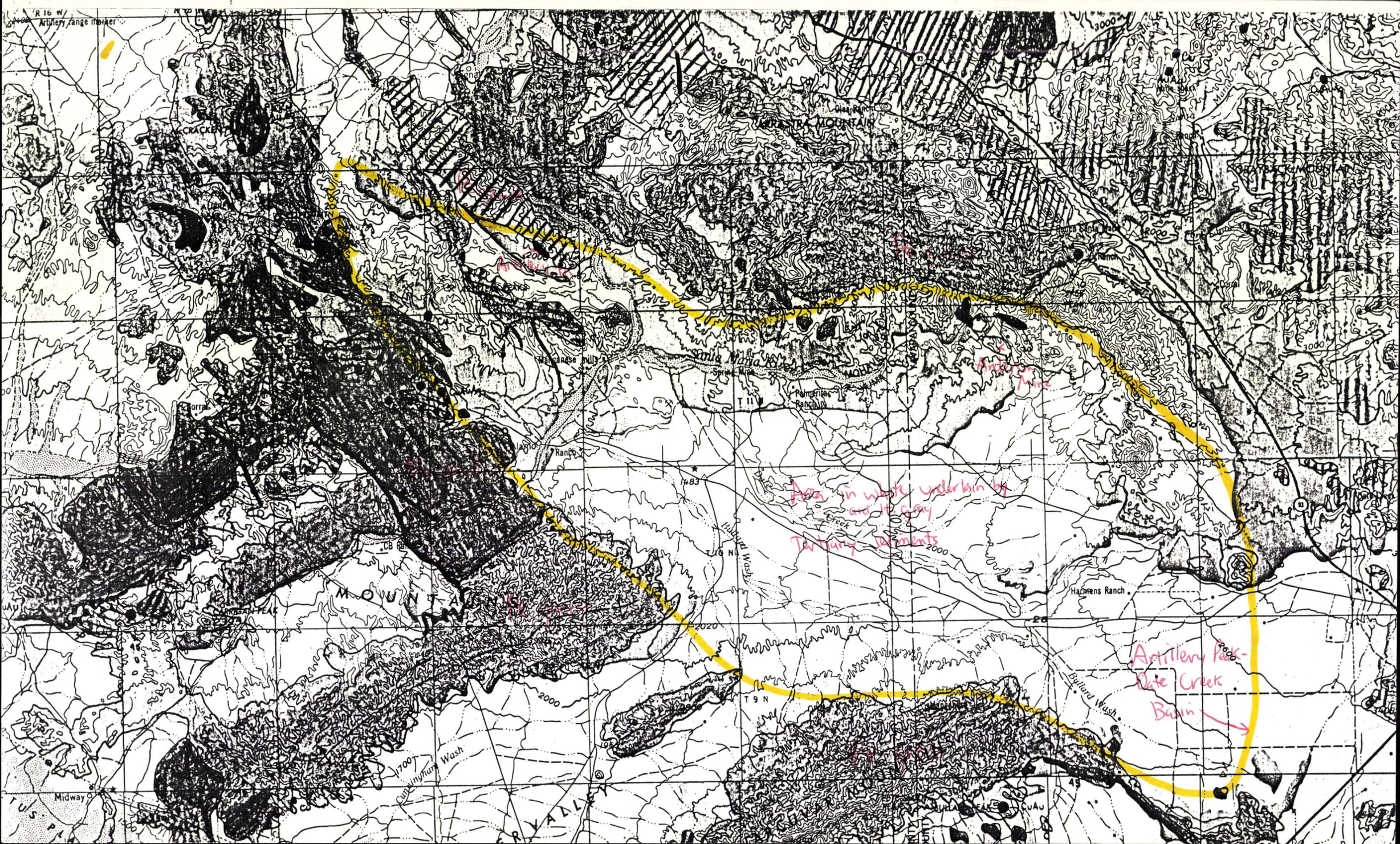
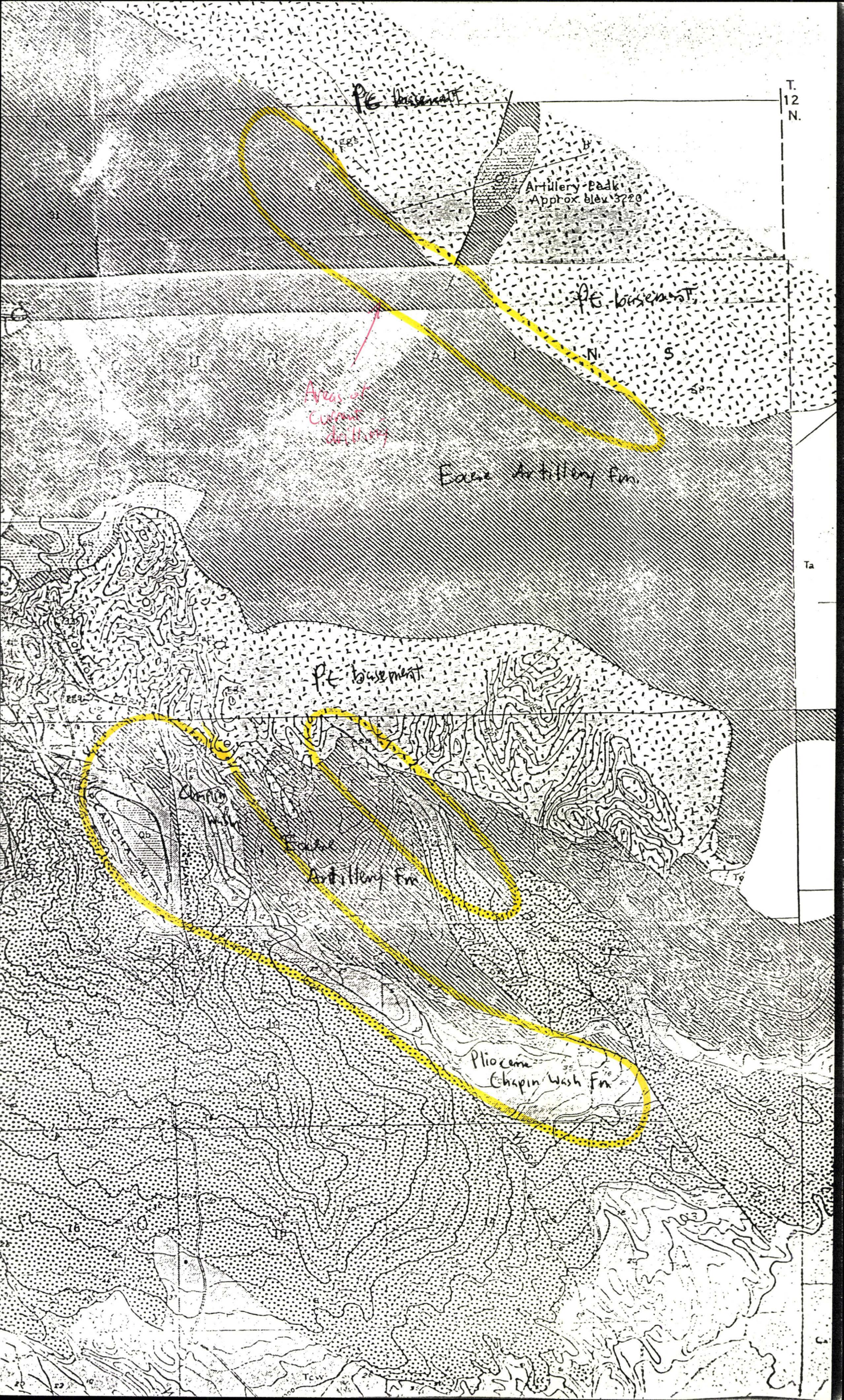


Photo of original workings of Masterson area — Artillery PK. This is just above change to lake beds in Artillery Fm (Eocene). Pit in foreground has hi count to 4000 cps where basal beds in pit (~1ft') have pitchblende along fracts. Note other lake beds. Looking N.W.


R 16 W
Artillery range marker
CRACKER
Santa Maria Mts
Manganese hills
Spring Mine
Palmerlee Ranch
Ranch
1483
Hammens Ranch
CARRIGAN PEAK
MOUNTAINS
Midway
Cunningham Wash
Bullard Wash
T 9 N
T 10 N
T 11 N
Area in white underlain by
and its clay
Tertiary sediments
Artillery Peak-
Rate Creek
Basin


T. 12 N.
Pε basement
Artillery Peak
Approx elev 3720
Pε basement
N
S
Areas of
Current
drilling
Eocene Artillery Fm.
Ta
Pε basement
Chapin
Wash
Eocene
Artillery Fm
Pliocene
Chapin Wash Fm