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Memorandum on the geology and ground-water resources of Dripping Springs basin, Gila and Pinal Counties, Arizona

By

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Prepared in cooperation with
Arizona State Land Department
Roger Ernst, Commissioner

[redacted]

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INTRODUCTION

Purpose

This report gives the results of one of the series of investigations of the geology and ground-water resources of Arizona being made under the terms of the cooperative agreement between the Arizona State Land Department and the U. S. Geological Survey. Field work was done intermittently between 1951 and 1954 under the general supervision of S. F. Turner and L. C. Halpenny, District Engineers, U. S. Geological Survey, Ground Water Branch.

Location

The Dripping Springs basin is in the central mountain area of Arizona, about 15 miles south of Globe (fig. 1). Most of the basin is in Gila County; only a few square miles are in Pinal County. The basin is about 15 miles long and 9 miles wide and occupies a total area of approximately 120 square miles (pl. 1). The basin is limited by the Pinal and Mescal Mountains on the northeast and by the Dripping Springs Mountains on the southwest. The area is drained by Dripping Springs Wash, a tributary of the Gila River.

Climate

Rainfall within the basin is variable. The Pinal Mountains receive a maximum precipitation of about 28 inches a year, some of it as snow, whereas the Mescal and Dripping Springs Mountains receive about 16 inches annually. Much of the basin is at lower altitudes and receives still less precipitation. The average precipitation for the basin is estimated to be about 14 inches per year.

History of Development

The present period of development of the Dripping Springs basin began about 1900 when the area was opened up by various mining interests. Soon thereafter cattle were brought into the area, and by 1920 the countryside had been extensively overgrazed. Ranching is the main industry in the basin at the present time.

Previous Investigations

Earlier studies of the geology of the basin are described in the following reports:

Ransome, F. L., 1919, The copper deposits of Ray and Miami, Ariz., U. S. Geol. Survey Prof. Paper 115, 192 pp.

Ransome, F. L., 1923, Description of the Ray quadrangle, Ariz., U. S. Geol. Survey Geol. Atlas U. S., Ray Folio, Ariz. no. 217.

Ross, C. P., 1925, Ore deposits of the Saddle Mountain and Banner Mining districts, Ariz., U. S. Geol. Survey, Bull. 771, 69 pp.

GEOLOGY

Land Forms and Drainage

The Dripping Springs basin is in the Mexican Highland division of the Basin and Range physiographic province (Fenneman, 1931). The Pinal Mountains dominate the area and rise to an altitude of 7,850 feet at the highest point. The Mescal Mountains trend northwest and merge with the Pinal Mountains. They average about 6,000 feet in altitude. Dripping Springs Mountains form the southwest boundary of the basin and have altitudes generally less than 5,000 feet.

The basin is drained by Dripping Springs Wash, an intermittent stream. It maintains a gradient of about 90 feet per mile, falling from 3,750 feet at its source to 2,050 feet at its junction with the Gila River. The valley is asymmetrical, and Dripping Springs Wash is offset to the southwest. There are two well-developed stream terraces in the valley and a third terrace is less well developed.

The flood plain of Dripping Springs Wash averages less than one-half mile in width. A 1- to 4-foot bank separates the flood plain from the present stream channel, which changes with each successive flood. These features also can be found in some of the larger tributaries such as Silver Creek.

Geologic History

The oldest rocks exposed in the mountains are Precambrian schists. The schists were intruded by various granitic masses and the period of the intrusion was probably also one of mountain building. These Precambrian rocks were eroded to a surface of low relief and later submerged beneath marine waters. During the late Proterozoic and Paleozoic eras, the submerged rocks were covered with a series of essentially conformable sandstones, shales and limestones to a maximum thickness of more than 2,500 feet.

Following the Paleozoic sedimentation, folding, faulting and igneous intrusion occurred and the region was again elevated above sea level, and subjected to erosion. During the Cretaceous period, successive intervals of subsidence and uplift were marked by the deposition of sandstones, shales and volcanic rocks.

During Tertiary time, the rocks of the region were further deformed by folding and faulting and were intruded by magmas and partly covered by volcanic rocks. Following this period of deformation and intrusion, subsequent faulting along a northwest trend resulted in the major topographic features of the present. The stratigraphic displacement may have reached a maximum of more than a thousand feet.

During and after the Tertiary faulting, the valley troughs received thick deposits of alluvium from the upfaulted masses. The earliest fill probably consisted predominantly of volcanic debris. Eventually, as erosion progressed in highland areas, the older rocks were exposed and the trough received increasing proportions of non-volcanic debris. One or more temporary lakes occupied the basin during the time that the upper part of the fill was being deposited.

In early Quaternary time, through drainage was established to the Gila River and headward erosion dissected the older alluvial fills.

At present, erosion is continuing and rock waste from the higher elevations is being intermittently carried down the washes to the Gila River and out of the basin.

Structure

The Pinal Mountains are formed predominantly of Precambrian crystalline rocks. The Mescal Mountains are homoclinal blocks with variable southwesterly dips and are composed mainly of Precambrian and Paleozoic sedimentary rocks with diabase intrusives. The Dripping Springs Mountains are structurally complex and are made up of rocks that range in age from Precambrian to Tertiary. The cross section (fig. 1) diagrammatically shows a tectonic interpretation of the basin, based on morphological and structural evidence. Some faulting may have been contemporaneous with the deposition of the Gila conglomerate and there is post-Gila faulting, probably along old lines of fracture near the Dripping Springs Mountain front. However, faulting in the Gila conglomerate in this basin is the exception rather than the rule, as the formation is generally undisturbed.

Rocks and Their Hydrologic Properties

Pre-Tertiary rocks

The pre-Tertiary rocks of the area consist of schists, granite, sandstone, quartzite, shale, limestone and various volcanic and intrusive rocks. These rocks cover about 64 square miles, or about one-half the total area. They are, for the most part, highly indurated and contain only small amounts of ground water along fractures, small fault planes and bedding planes.

Gila conglomerate

The Gila conglomerate covers an area of about 50 square miles in the basin. The formation was deposited after the major structural features in the area were formed and is composed of both stream- and lake-deposited sediments.

The stream-deposited beds accumulated primarily as a series of coalescing alluvial fans which grade into lake beds in the central part of the valley. The deposits near the mountain fronts are typical fanglomerates--admixtures of subangular and subrounded boulders, cobbles and pebbles interbedded with silty sands. The poor stratification and sorting indicate deposition by waters from brief torrential storms, not unlike those of the present climate. The composition is influenced by the rocks of the adjoining bedrock areas. The coarser conglomerates are usually moderately to well cemented or indurated. The coarser conglomerates interfinger valleyward with deposits of sand and silt.

The lake deposits are mostly light colored imperfectly cemented clay, silty in part. They contain lenses and beds of marl, tuff, diatomite, gypsum and caliche. Erosion frequently develops a characteristic badland topography.

The known thickness of sediments below the valley floor is at least 802 feet, as shown by the log of well (D-4-16)7acb. This thickness, when added to lake-bed deposits that extend above the present valley floor, indicates that the total thickness of sediments in the axis of the trough probably exceeded 1,000 feet originally.

There are too few wells to permit any generalized statement concerning the water-bearing characteristics of the Gila conglomerate in this basin. Limited supplies of water have been developed in certain localities but as far as is known, no aquifers have been encountered that will yield water in quantities sufficient for irrigation on other than a very small scale.

Younger alluvial fill

The younger alluvium covers about 7 square miles in the Dripping Springs basin along the channel of Dripping Springs Wash and its tributaries. Drillers' logs (table 3) do not differentiate between the younger alluvial fill and the Gila conglomerate, but the thickness of the former is probably not more than 150 feet. The younger alluvium is predominantly fine textured, mostly sand and silt, although cobble and gravel streaks are present locally, as in wells (D-4-16)9cc and (D-4-16)16ad.

The coarse materials in the younger alluvium yield water in quantities sufficient for domestic and stock purposes.

GROUND-WATER RESOURCES

Ground water in Dripping Springs basin occurs in the pre-Tertiary rocks, the Gila conglomerate and the younger alluvial fill. Evaluation of the ground-water resources in this basin is made difficult by the scarcity of wells, particularly deep wells, lack of well logs, and lack of information regarding the yield of aquifers. Records of wells and springs are shown in table 1.

Occurrence

Ground water in pre-Tertiary rocks

Only two shallow wells are known to exist in granitic areas and most of the evidence of the presence of ground water in pre-Tertiary rocks is indicated by springs. The springs occur along fault contacts, bedding planes and fractures. They also have been observed along the contact between the older rocks and the overlying Gila conglomerate. Individual flows range from about 2 to less than 1 gallon per minute and many are seasonal.

Gila conglomerate

The Gila conglomerate supplies some ground water to stock and domestic wells in the upper part of the valley. Known yields of wells are small and may be limited by the capacities of the pumps. No tests have been made to determine potential yield. Well (D-4-16)7bc was drilled to a depth of 502 feet in an attempt to tap artesian water. The well was unsuccessful, although structural, sedimentary and hydrologic conditions appear to be favorable.

Younger alluvial fill

All wells in the middle and lower part of the valley appear to derive water from the younger alluvium. Although the quantity is sufficient for domestic and stock purposes no tests have been made to determine its potential productivity. The width of the younger alluvial fill rarely exceeds a half-mile and its thickness is estimated to be less than 150 feet. Therefore, its storage capacity is probably small.

Source and Movement

Most of the ground water in the Dripping Springs basin originates as precipitation in the mountain areas. Of the total amount of water that falls on the hard rock area, probably less than about 5 percent, or 2,500 acre-feet per year, recharges the ground-water reservoir. The remainder is evaporated, transpired by native vegetation or runs off as surface flow into the Gila River. Another 500 acre-feet per year may recharge the ground-water reservoir from direct precipitation and runoff on the younger alluvial fill in the washes. The ground-water gradient approximately parallels the surface and some ground water probably leaves the basin as underflow into the Gila River.

Discharge

Discharge of ground water in the basin occurs both through natural processes and by pumping from wells. Natural discharge includes evaporation, transpiration, underflow and spring flow. Quantitative data are unavailable for the total discharge from wells and springs, but the amount is known to be small as it generally is sufficient only for domestic and stock uses.

Depth to water

The depth to water in the alluvial fill of Dripping Springs basin ranges from more than 300 feet in the upland areas to less than 12 feet near the mouth. Depth-to-water measurements made in the past 4 years, 1951-54, indicate no systematic or uniform trend (table 2). The changes are erratic and possibly reflect local response to seasonal rainfall conditions.

QUALITY OF WATER

The analyses of water from 6 springs and 5 wells in the Dripping Springs basin do not reveal any great differences in the quality of water from the various sources. Calcium, magnesium, and bicarbonate are the predominant constituents. A dissolved-solids content of less than 500 ppm (parts per million) and a hardness of more than 200 ppm is characteristic of most of the water in the basin (table 4). The water is classified "excellent to good" for irrigation use (Wilcox, 1948). Except for the amounts of sulfate present in two sources, the concentrations of the various constituents do not exceed the maximum limits recommended by the U. S. Public Health Service (1946).

REFERENCES

Fenneman, N. M., 1931, Physiography of Western United States, McGraw-Hill, First Ed., 534 pp.

Ransome, F. L., 1919, The copper deposits of Ray and Miami, Arizona, U. S. Geol. Survey Prof. Paper 115, 192 pp.

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Ross, C. P., 1925, Ore deposits of the Saddle Mountains and Banner Mining districts, Arizona, U. S. Geol. Survey Bull. 771, p. 1-69.

U. S. Public Health Service, 1946, Drinking water standards; reprint no. 2697, Public Health Repts., vol. 61, no. 11, pp. 371-384.

Wilcox, L. V., 1948, The quality of water for irrigation use, U. S. Dept. Agr. Tech. Bull. 962, 40 pp.

Table 1.—Records of wells and springs in Dripping Springs basin, Gila and Pinal Counties, Arizona.

Well or Spring no.	Type of well or spring a/	Depth of well (feet)	Depth to water: Depth below land-surface (feet) b/	Depth to water: Date of measurement	Type of lift c/	Use of water d/	Yield (gpm) e/	Temperature (°F)	Water analyses on file	Log on file	Remarks
(D-2-15)											
26ca	Dr	125	31 R	-	C,W	D	-	85 f/	X	-	In granitic rock.
29ca	Sp	-	-	-	-	-	-	-	-	-	—
33cc	Sp	-	-	-	-	S	1,E	86 f/	X	-	"Pioneer Spring" along contact between Pre-Tertiary rock and Gila conglomerate.
34dd	Dg	36	23.14 M	5-3-51	-	D	-	64	X	-	
(D-3-14)											
3db	Dr	300	165 R	7-5-50	C,W	S	-	84 f/	X	-	In Gila conglomerate.
4ac	Dr	400	175 R	7-51	C,W	D,S	-	91 f/	X	-	In Gila conglomerate. Southern of 2 closely spaced wells.
8da	Sp	-	-	-	-	S	2,E	74	X		"Haley Spring" reported best spring in area. Issues alon contact of diabase and quart site.
10de	Dr	250	75 R	1950	C,W	S	-	77	X	-	In Gila conglomerate
11db	Dr	565	315 R	4-51	C,W	S	-	75	X	-	In Gila conglomerate. Water level reported to have declined considerably since 19
23ab	Dr	-	88.44 M	5-22-52	C,G	D,S	-	-	-	-	In flood plain of Dripping Spr Wash.
25dd	Sp	-	-	7-10-51	-	D,S	2,M	-	X	-	From mine tunnel in granitic r
26ac	Sp	-	-	-	-	S	2,R	68	X	-	From mine tunnel in fractured intrusive rock.
27ab	Dg	28	21.80 M	7-11-51	-	D	-	68	X		In granitic rock

a/ Dg, Dug; Dr, Drilled; Sp, Spring.
b/ Depths corrected to land-surface datum from measuring point; M, Measured; R, Reported.
c/ C, Cylinder; CF, Centrifugal; G, Gasoline; T, Turbine; W, Windmill.
d/ D, Domestic; S, Stock; I, Irrigation.
e/ Gallons per minute; E, Estimated; M, Measured; R, Reported.
f/ Sun-warmed temperature.

Table 1.—Records of wells and springs in Dripping Springs basin, Gila and Pinal Counties, Ariz.—continued.

Well or pring no.	Type of well or spring a/	Depth of well (feet)	Depth to water: Depth below land-surface (feet) b/	Depth to water: Date of measurement	Type of lift c/	Use of water d/	Yield (gpm) e/	Temperature (°F)	Water analyses on file	Log on file	Remarks
(D-3-15)											
4ac	Sp	-	-	7-20-51	-	S	1,M	73	X	-	Seep in channel at contact of quartzite and diabase.
9bb	Sp	-	-	7-20-51	-	S	1/8,M	84 f/	X	-	"Tuttle Spring" - seep in channe at contact of Gila conglomerat and pre-Tertiary diabase.
11cd	Sp	-	-	7-24-51	-	S	2,M	74	X	-	"Goat Spring" - issues from channeled limestone.
12cb	Sp	-	-	7-31-51	-	-	1,M	95 f/	X	-	Issues from fractured quartzite.
17bc	Dr	407	288.72 M	4-3-53	C,W	S	-	77	X	X	In Gila conglomerate. Water bearing gravels reported at 320, 305, and 407 feet.
20cc	Dr	290	65.41 M	7-15-51	-	-	50,R	-	-	-	
20dd	Dr	300	91.94 M	5-22-52	—	I	-	-		X	In Gila conglomerate.
21dd	Dr	250	134.62 M	7-13-51	C,W	S	-	74	X	X	In Gila conglomerate. Water bearing horizon encountered at 18 feet.
29aa	Dr	150	77.65 M	5-22-52	C,G,W	S	-	-	X	X	In Gila conglomerate.
29bb	Dr	190	91.67 M	5-22-52	C,G	D,S	40,R	-	X		In Gila conglomerate.
29da-1	Dr	-	100 R	-	T,G	D	-	-	-		In Gila conglomerate.
29da-2	Dr	250	82.54 M	5-22-52	C,G	D	-	70	X		In Gila conglomerate.
30cb	Sp	-	-	7-13-51	-	D	1/2,M	68	X		Near probable small fault conta between quartzite and limestor
31ad	Sp	-	-	7-13-51	-	D	1/2,R	68	X		Near probable small fault contac between granitic rocks and limestone.
35cc	Dg	108	101.38 M	7-13-51	C,G	D	-	70	X		In flood plain of Silver Creek.
(D-4-15)											
1cb	Dg-Dr	60	-	-	-	-	-	-	-	-	Dry hole.
5ab	Sp	-	-	7-13-51	-	S	1,M	68	X		"Kelly Spring" issued along faul between quartzite and granitic rock.
14ab	Sp	-	-	1-18-51	-	S	1/2,M	79	X		Near probable fault contact in limestone.

Table 1.—Records of wells and springs in Dripping Springs basin, Gila and Pinal Counties, Ariz.—continued.

Well or spring no.	Type of well or spring a/	Depth of well (feet)	Depth to water: Depth below land-surface (feet) b/	Depth to water: Date of measurement	Type of lift c/	Use of water d/	Yield (gpm) e/	Temperature (°F)	Water analyses on file	Log on file	Remarks
(D-4-16)											
7acb	Dr	802	63.70 M	7-15-51	–	–	–	–	–	X	Some water reported at 76 and 785 feet. Abandoned for insufficient water.
7acd	Dg	74	68.20 M	7-15-51	T,G	D	–	–	–	–	In younger alluvium.
9cc	Dg	50	40.30 M	7-15-51	C,G	D,I	–	–	–	–	In younger alluvium.
16ad	Dg	–	11.83	5-2-51	CF,G	D	–	68	X		In younger alluvium.
16ba	Dg	–	–	–	C,W,G	D	–	77	X		In younger alluvium.

Table 2.—Depth-to-water measurements in selected wells, Dripping Springs basin, Ariz.

Location	Depth of well (feet)	Depth to water below land-surface datum (feet) Measured in 1951	1952	1953	1954	Formation
(D-3-14)23ab	—		88.44	101.87	96.60	Gila (?)
(D-3-15)17bc	407			288.72	288.88	Gila
(D-3-15)20dd	300		91.94	97.70	97.62	Gila
(D-3-15)21dd	250	134.62	125.90	137.90	132.95	Gila
(D-3-15)29bb	190	100.50	91.67	90.12	90.35	Gila
(D-3-15)29da-2	250	82.54	84.32	84.46	84.27	Gila
(D-3-15)33cc	106	101.38	91.37	99.61	102.70	Younger alluvial fill
(D-4-16)7acb	602	63.70	57.80	57.00	40.42	Younger alluvial fill
(D-4-16)9cc	50	40.30	22.80	32.85	35.80	Younger alluvial fill

Table 3.--Logs of representative wells in Dripping Springs basin, Ariz.

Drillers' description of materials encountered	Thickness (feet)	Depth (feet)
(D-3-15)20dd		
Clay with silt, gritty and sandy. Hit first water at 100 feet.	100	100
Clay with silt	150	250
Water gravel and small pea gravel.	15	295
TOTAL DEPTH		295
(D-3-15)29aa		
Recent fill.	25	25
White talc (clay).	60	85
Older formation.	65	150
TOTAL DEPTH		150
(D-4-16)7acb		
Clay, almost all bentonite. Some water at 76 feet	535	535
Conglomerate	200	735
Some water at 745, made a gallon a minute	10	745
Clay with hard rock streaks.	57	802
TOTAL DEPTH		802

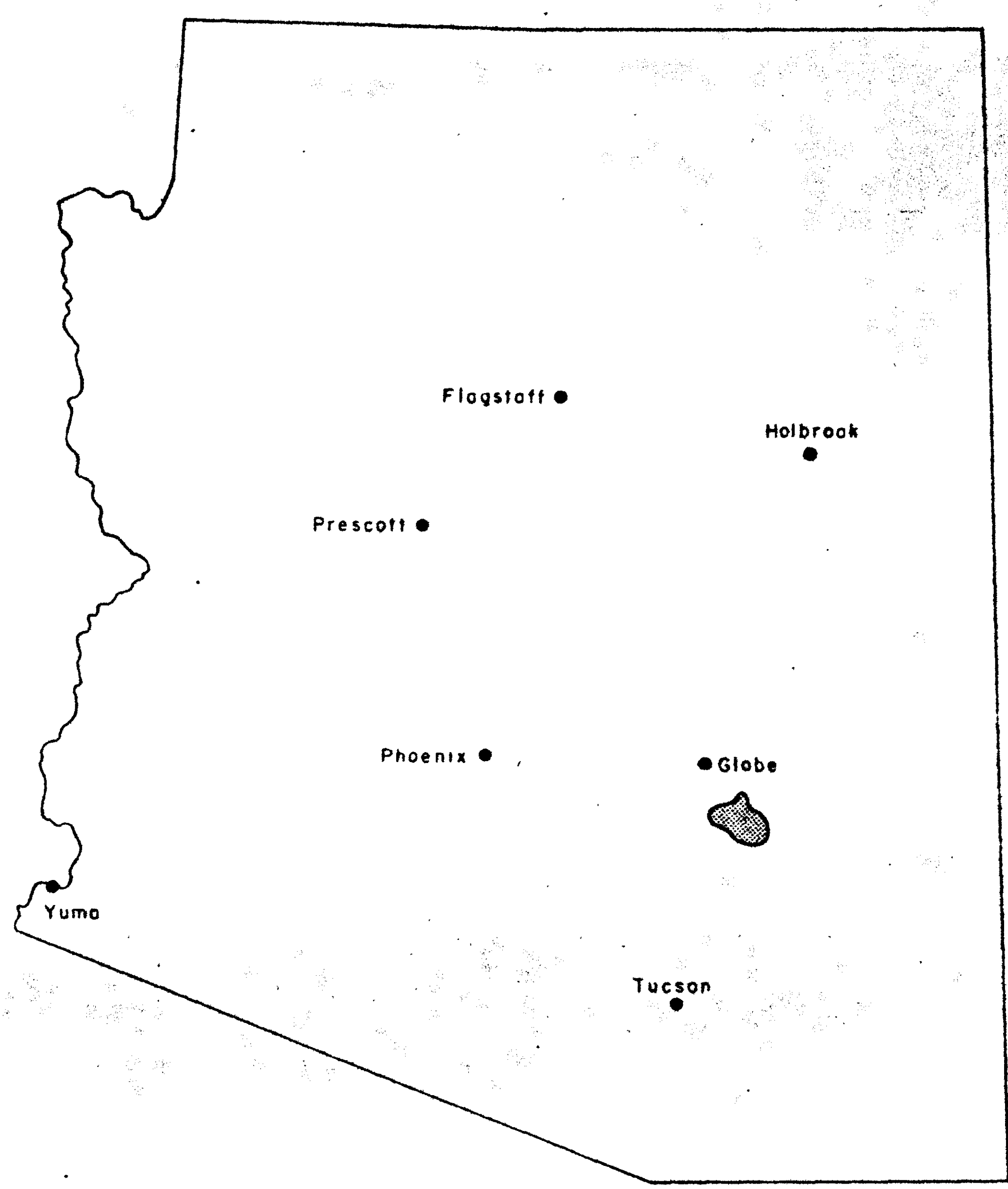

Figure 1.--Map of Arizona showing area described in this report.

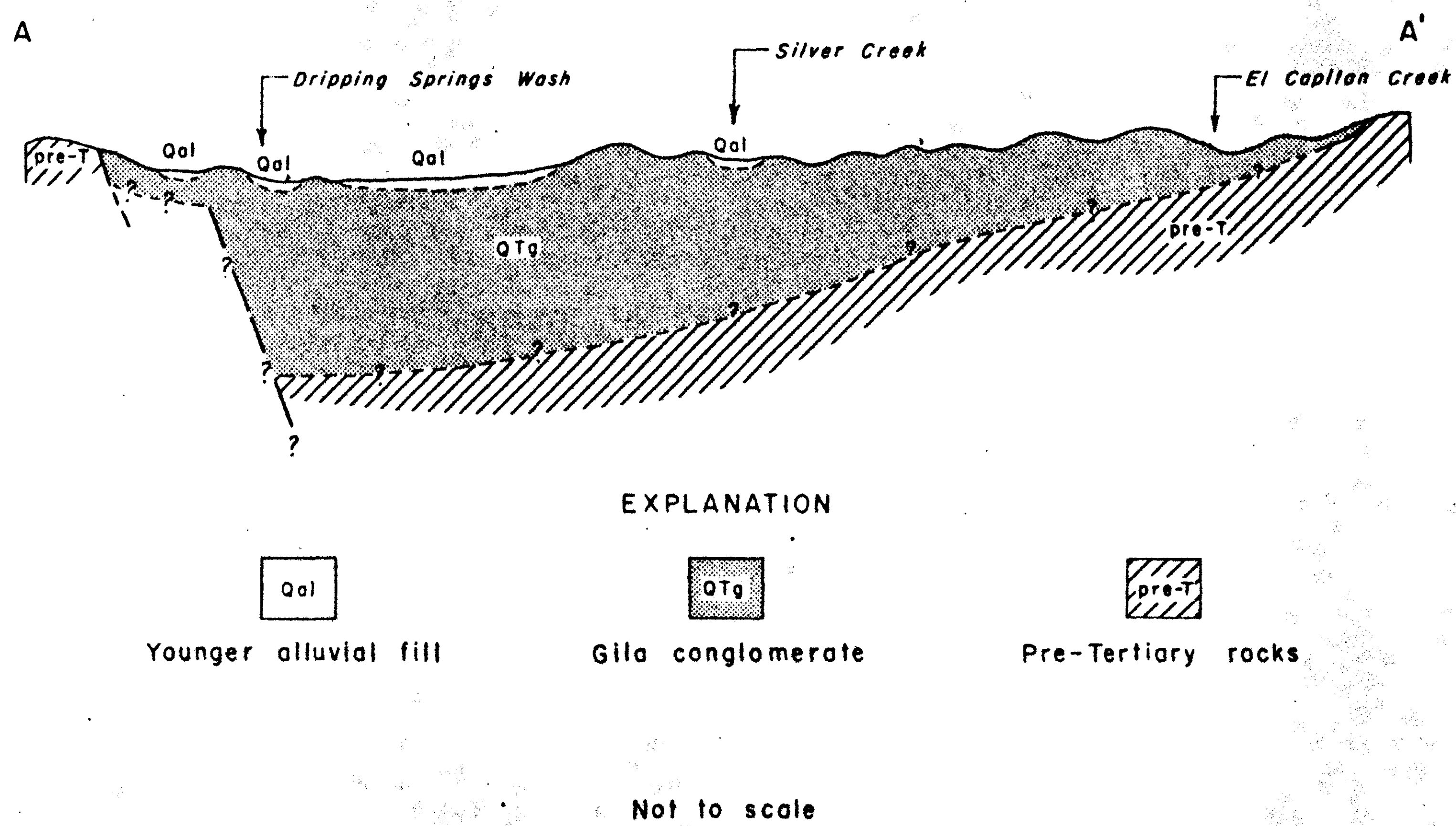

Figure 2.--Diagrammatic cross section, Dripping Springs Valley.

Geology and locations of wells and springs, Dripping Springs Valley, Gila and Pinal Counties, Ariz.