UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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# SUMMARY OF PETROGRAPHIC DATA OF BASEMENT ROCK SAMPLES FROM OIL WELLS IN THE SOUTHEASTERN SAN JOAQUIN VALLEY, CALIFORNIA

By

Donald C. Ross

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The Edison Oil field, east of Bakersfield, which produced part of its oil from fractured basement rocks, also produced a bonus for the study of the basement geology, because the basement was repeatedly drilled into and sampled. May and Hewitt (1948) recovered core material from nearly 100 wells south of 35°30'N in the southeastern San Joaquin Valley. They had thin sections made and reported on the lithology of these rocks (1948). The thin sections, now in the custody of the California Academy of Sciences, were kindly loaned to me. Unfortunately the whereabouts of the samples from which the thin sections were made is at present unknown. Thus the following discussion is based on the microscopic re-examination of rather tiny thin sections of 1-2 $cm^2$.

In examining the thin sections I noted some discrepancies between the mineralogy reported by May and Hewitt (1948) and what I saw in the thin sections, particularly in those rocks they referred to as "Hypabyssal intrusive rocks" and "Schist derived from igneous rock." The schists are dominantly "classic" greenschists dominated by chlorite, epidote-clinozoisite, and actinolitic amphibole. Pyroxene, widely reported by May and Hewitt (1948), is not present. The rocks called "hypabyssal intrusives" by May and Hewitt (1948) are dominantly greenschists composed of sodic plagioclase, actinolitic amphibole, chlorite, and epidote-clinozoisite in which volcanic (trachytic to felty) textures are evident in some rocks. Again pyroxene, widely reported by May and Hewitt (1948), was not seen.

Overall I interpret more rocks as relatively low-grade greenschists that are probably metavolcanic rocks than May and Hewitt (1948) did. I am at a complete loss to understand the "pyroxene anomaly." May and Hewitt repeatedly reported hypersthene, enstatite, aegerine-augite, and augite from greenschist and "greenstone" where such minerals are completely out of character. Possibly sphene, which they never reported, was mistaken for orthopyroxene, particularly where the sphene is pleochroic. The misidentified clinopyroxene appears to be amphibole.

In tables 1 to 4 the "Map number", "Well name", and "Location" data are copied from May and Hewitt (1948). "Rock name" and "Thin section mineralogy and other notes" are my interpretations of the thin sections, which as already noted are in part different from the descriptions of May and Hewitt (1948).

The accompanying index map (plate 1) shows the well locations and is keyed to rock type. It is apparent that there is a large area of greenschist and related low-grade amphibolitic rocks, which by mineralogy and in part by texture are shown to be a metamorphosed volcanic pile. Rather closely associated, but much less widely distributed are dense black carbonaceous schists that suggest original "black shale." These rocks may be subsurface extensions of the Pampa schist--they are quite unlike the Kernville metamorphic rocks (Dibblee and Chesterman, 1953). These metavolcanic rocks and black shales have not been found south of the White Wolf fault, but well data are sparse south of the fault. It is tempting to speculate, however, that the White-Wolf-Breckenridge "structural zone" marks a possible abrupt break in the metamorphic basement between diorite and gneiss on the southeast and lower grade metavolcanic rocks on the northwest.

From the tiny thin sections (mostly 1-2 $cm^2$) it is chancy to say anything about the granitic rock types, but several appear to be biotite quartz diorite with little or no hornblende, and with strongly oscillatorily zoned andesine crystals--most probably these are related to two masses of similar lithology in the Breckenridge Mountain 15' quadrangle.

In addition to the thin section specimens there are 42 well logs (table 5) that identify the type of basement, but no samples or thin section data are available. These wells are also located on the index map.

In summary the well data indicate a rather large area of volcanic greenschist associated with lesser carbonaceous schist, amphibolite, and gabbro. These rocks, which are dominantly sodic plagioclase, chlorite, actinolite, and epidote, are in marked contrast to the andesine, hornblende, biotite, and quartz-bearing metamorphic rocks of the surface outcrop areas. The subsurface metamorphic rocks may be "related" to the Pampa schist, but there are some significant differences. For instance no andalusite has been seen in the subsurface samples, yet andalusite hornfels is common and abundant in the westernmost outcrops of Pampa schist. In short the volcanic greenschists of the subsurface have no surface outcrop equivalents at this latitude.

## REFERENCES CITED

Dibblee, T.W., Jr., and Chesterman, C.W., 1953, Geology of the Breckenridge Mountain quadrangle, California: California Div. Mines and Geology Bulletin 168, 56 p.

May, J.C., and Hewitt, R.L., 1948, The basement complex in well samples from the Sacramento and San Joaquin Valleys, California: California Journal of Mines and Geology, v. 44, n. 1, p. 129-158.

# Table 1

META-IGNEOUS ROCKS
(mostly metavolcanic rocks)

| Map No. | Well Name | Location (Sec.-T.-R.) | Rock Name | Thin Section Mineralogy and Other Notes [1] |
|---|---|---|---|---|
| 16 | Richfield-Kramer #1 | 34-28S-27E | Amphibolite | Shattered rock dominated by well-twinned plagioclase (about $An_{50}$) and olive hornblende. Minor quartz, chlorite, and epidote. |
| 29 | Jergins-Hershey #9 | 14-30S-29E | Chlorite schist | Pale green chlorite dominates with abundant opaque material; lesser plagioclase and biotite. |
| 31 | Texas Co.-Bastian #1 | 34-30S-29E | Actinolite-chlorite-epidote schist | Dominantly epidote with lesser pale green chlorite and colorless to pale green actinolite; scattered sphene. |
| 32 | Texas Co.-Camp-West-Lowe #1 | 7-29S-27E | Chloritic "hornfels" | Much like 31, but coarser, less directional and has more sphene. |
| 36 | Honolulu Oil Corp. #76 | 18-28S-29E | Quartz porphyry | Square β-quartz cross-sections to 1.5 mm and somewhat smaller albite(?) phenocrysts. Some clots of fine-grained muscovite and a hornfelsed groundmass of albite, quartz, and muscovite. |
| 41 | Western Gulf Oil Co.-KCL #B-45 | 22-29S-27E | Tuffaceous grit? | Sub-angular to sub-rounded clasts of plagioclase and quartz to 0.4 mm set in groundmass of green chlorite and less epidote and feldspar. |
| 42 | Meridian Oil Co.-Meridian Fee #2 | 23-29S-27E | Actinolite-chlorite-epidote schist | Same as 31, but much epidote-quartz vein material. |
| 48 | T.W. Burnham-Chiquita #2 | 34-12N-18W | Pyroclastic(?) rock | Sub-angular clasts of quartz to 0.4 mm set in a matrix of chlorite, olive biotite, and muscovite. |
| 50 | Tide Water Assoc.-Di Giorgio #1 | 3-31S-29E | Chloritic "hornfels" | Directionless mat of pale green actinolite, green chlorite, epidote, and sodic plagioclase; minor quartz; some sphene. Much like 32. |
| 63 [2] | Di Giorgio #4 | 10-31S-29E | Diorite or amphibolite | Dominantly twinned plagioclase (about $An_{50}$) and very pale, fibrous amphibole. Abundant "ultra-blue" epidote. Looks like a diorite-quartz diorite-metamorphic belt rock. |
| 74 | Jergins-Jergins-Texas Fee #15 | 23-30S-29E | Plagioclase amphibolite | Directional fabric dominated by fibrous to stubby pale green actinolite(?), and sodic plagioclase. Also abundant green chlorite and epidote. Scattered opaque grains and sphene. Like 32 and 50, but somewhat higher grade (because of amphibole abundance?). |
| 86 | Midway Northern Brown #1 | 29-29S-30E | Amphibolite(?) | Pale green acicular amphibole (actinolite?) and dusty untwinned sodic plagioclase (albite?) dominate in an anastamosing fabric. Lesser pale brown biotite, quartz, and abundant opaque grains and sphene. Pampa schist(?). |
| 89 [2] | Shell-Porter-Day #1 | 29-30S-29E | Plagioclase amphibolite | Messy texture of gray green fibrous to irregular amphibole and fresh, well-twinned andesine. Minor epidote; much sphene and opaque grains. Seems higher grade than 50 and 74; suggests similarity to diorite-quartz diorite-metamorphic belt; related to 63? |
| 91 | Ohio Oil Co.-Derby B #B-1 | 33-30S-29E | Intermediate metavolcanic rock | Remnants of felty volcanic groundmass and scattered plagioclase phenocrysts to 1.5 mm. Mostly recrystallized to albite, pale green chlorite, and lesser muscovite, quartz(?), sphene, and epidote, some calcite. Some green biotite in masses with chlorite may mimic femag. phenocrysts. |
| 92 | Shell-Greer #1 | 15-31S-29E | Mylonitized metavolcanic rock | Strongly sheared with amphibole and epidote augen. Very fine grained, dominated by epidote; but locally actinolite, quartz, and chlorite. May be a sheared tuffaceous rock? |

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# Table 1 (cont.)

META-IGNEOUS ROCKS (CONTINUED)

| Map No. | Well Name | Location (Sec.-T.-R.) | Rock Name | Thin Section Mineralogy and Other Notes |
|---|---|---|---|---|
| 106 | Texas Co.-Jewett #2 | 16-31S-29E | Intermediate metavolcanic rock | Much like 91 with additional actinolite. Some felty volcanic texture preserved and a couple plagioclase (sodic) phenocrysts. |
| 109 | Monterey Expl. Co.-Shell-Duff #15 | 15-30S-29E | " | Phenocrysts of plagioclase and chloritized biotite to 2 mm. Groundmass dominated by greenish chlorite, lesser biotite, lath-like albite, and minor epidote, opaque grains, and sphene. |
| 113 | Di Georgio #48-10 | 10-31S-29E | Actinolite albite schist | Strongly foliated fabric of somewhat lath-like albite crystals, pale to colorless acicular actinolite, epidote, pale green chlorite. Scattered opaque grains and sphene. |
| 121 | Amerada-S.P. #2 | 15-29S-29E | Actinolite oligoclase quartz schist | Well-alined fabric of pale green actinolite, untwinned oligoclase, quartz, and epidote. Some opaque grains and sphene. |
| 123 | Jergins-Dougherty #5 | 14-30S-29E | Pyroclastic(?) rock | Quartz clasts(?) set in matrix of chlorite and serpentine(?). Some calcite and minor opaque grains. |
| 137 | H.H.Magee-Jergins-Dougherty #5 | 14-30S-29E | Andesine actinolite schist | Strongly schistose, dominantly acicular pale green pleochroic actinolite(?) with twinned andesine crystals that are in part subhedral and suggest volcanic texture (phenocrysts). Some epidote, much fine grained sphene, some quartz. |
| 138 | Monterey Expl. Co.-Citizens #2 | 14-30S-29E | Albite-actinolite-epidote schist | Well alined pale green acicular actinolite, albite, epidote, pale green chlorite, and minor quartz. Albite and quartz look like clastic fragments--tuff(?). |
| 139 | Monterey Expl. Co.-Duff #9 | 15-30S-29E | Chlorite-albite(?)-epidote hornfels | Directionless mat of fine-grained pale green chlorite, epidote, and albite(?). Some mineral clusters may mimic phenocrysts as does one 5 mm pale amphibole mass. |
| 140 | Di Giorgio #35-10 | 10-31S-29E | Amphibole-chlorite-epidote schist | Well alined fabric of nearly colorless to pale brown amphibole, and abundant epidote. Some calcite veinlets. Some amphibole clusters may mimic phenocrysts? |
| 148 | Continental-Derby #1 | 35-31S-29E | Metavolcanic tuff(?) | Fragments of albite, epidote, and quartz, also volcanic fragments (composed of lath-like albite, green chlorite, epidote, actinolite, and opaque grains). Matrix rich in chlorite and albite. Thin section badly fragmented. |
| 150 | H.H.Magee-Dougherty #1 | 14-30S-29E | Chlorite-actinolite-epidote schist | Strongly alined fabric of epidote, pale green actinolite, pale green chlorite, and possible plagioclase. Scattered opaque grains and sphene. Veinlets and lenses of calcite. |
| 152 | Federal Oil Co.-Federal-Omaha #1 | 21-30S-29E | Intermediate metavolcanic rock | Relict porphyritic texture shown by altered sodic plagioclase phenocrysts to 1.5 mm and similar sized equant actinolite(?) aggregates. Groundmass of lath-like albite-oligoclase, acicular actinolite, epidote, chlorite, and sphene. |
| 157 | Standard #72-21 | 21-29S-29E | Amphibolite | Dominantly grayish green to light olive amphibole in stubby crystals, shreds, and acicular grains. Plagioclase in part re-crystallized into aggregates. Abundant epidote, some chlorite, some primary quartz (retrograded igneous rock?). |

CONTINUED

Table 1 (cont.)

META-IGNEOUS ROCKS (CONTINUED)

| Map No. | Well Name | Location (Sec.-T.-R.) | Rock Name | Thin Section Mineralogy and Other Notes |
|---|---|---|---|---|
| 158 | Jergins-Texas Fee #25 | 23-30S-29E | Epidote-plagioclase schist | Schistose fabric, dominantly epidote and plagioclase (lath-like in part), also acicular pale green actinolite, chlorite, opaque grains, and sphene. Also brown biotite (which suggests a bit higher grade)? |
| 159 | H.H. Magee-Brockman #3 | 13-30S-29E | Intermediate metavolcanic | Seriate with albite phenocrysts to 2 mm down to laths about 0.2 mm. Groundmass is sugary mat of quartz, albite, and fibrous green chlorite. |
| 160 | Amerada-S.P. #58-23 | 23-29S-29E | Plagioclase amphibolite | Sugary mat of grayish green hornblende and partly twinned andesine(?); scattered opaque grains and sphene. Some plagioclase "phenocrysts" to 3 mm. |
| 161 | Standard #45-21 | 21-29S-29E | Diabasic plagioclase amphibolite | Directionless fabric of bladed, twinned, zoned andesine, and stubby, grayish green hornblende crystals; abundant opaque grains and common interstitial quartz. |
| 162 | Richfield-Di Giorgio #1 | 3-31S-29E | Intermediate metavolcanic | Weakly schistose. Dusty subhedral albite laths to 3 mm in matrix of pale green actinolite, epidote, pale green chlorite, and albite; abundant sphene. (A classic greenschist that retains original volcanic texture!) |
| 163 | Monterey Expl. Co.-Duff-Shell #1A | 15-30S-29E | Diabasic intermediate metavolcanic rock | Much like 162; more diabasic. |
| 164 | Richfield-Lawson-Bennett #1 | 26-30S-29E | Epidote-chlorite hornfels | Dominantly a mat of green chlorite sprinkled with small euhedral epidote crystals. Some mosaicked quartz masses to 1.5 mm may mimic phenocrysts. Some green biotite, actinolite, and sphene. |
| 165 | General Pet. Corp.-Speed #28-11 | 11-30S-29E | Intermediate metavolcanic rock | Much like 162 with albite phenocrysts to 1.5 mm (classic greenschist). |
| 167 | Jergins-Dougherty #6 | 14-30S-29E | Epidote-chlorite-amphibole schist | Another greenschist made up of epidote, pale green acicular to stubby amphibole crystals, chlorite, and minor plagioclase. Some sphene aggregates. Calcite in patches and veinlets. |
| 168 | Jergins-Hershey #5-1 | 14-30S-29E | Amphibole schist | Strongly schistose; dominantly rather bright green acicular amphibole and twinned plagioclase; abundant opaque grains. |
| 169 | Jergins-Hershey #3 | 14-30S-29E | Amphibole schist | Very fine grained and strongly schistose. Dominantly bright green acicular hornblende and untwinned plagioclase; much opaque material. Lesser chlorite and minor quartz. |

Table 1 (cont.)

| Map No. | Well Name | Location (Sec.-T.-R.) | Rock Name | Thin Section Mineralogy and Other Notes |
|---|---|---|---|---|
| 170 | Monterey Expl. Co.-Citizens #3 | 14-30S-29E | Amphibole schist | Directed fabric of pale green amphibole and epidote. Abundant sphene. Minor plagioclase and opaques. |
| 175 | British American Oil Co.-Portals #43-3 | 3-30S-29E | Amphibolite (retrograded metavolcanic) | Well-twinned, somewhat zoned labradorite crystals to 4 mm set in fine-grained matrix of acicular pale green amphibole and plagioclase. Some clots of fibrous amphibole mimic phenocrysts. Liberal sprinkling of epidote. Scattered opaques and sphene. |
| 176 | Richfield Oil Corp.-Couley #2-1 | 16-30S-29E | Actinolite-epidote-chlorite schist | Dense greenish rock with weak schistosity. Some felty plagioclase remnants. Sodic plagioclase, chlorite, actinolite, epidote, and sphene; minor calcite. |
| 177 | Jergins Oil Co.-Jergins-Texas Fee 17 | 23-30S-29E | Tuffaceous sedimentary rock (?) | Thinly layered clastic rock with dusty composite plagioclase clasts and abundant quartz clasts. Anastamosing network of dark brown biotite. Some epidote and garnet (clasts?). |
| 178B | Jergins Oil Co.-Handel #1 | 23-30S-29E | Amphibole-epidote-chlorite schist | Schistose rock with brown hornblende remnants of original rock as well as pale green acicular secondary amphibole. Abundant bright green chlorite, epidote, and minor plagioclase. |
| 179 | Monterey Expl. Co.-Citizens #2 | 14-30S-29E | Amphibole-epidote-chlorite schist | Strongly schistose; dominated by pale green fibrous amphibole (actinolite), epidote, and chlorite. Minor plagioclase. Abundant lenses of sphene. Minor opaques. |
| 186 | General Pet. Corp.-Calloway #66 | 17-29S-27E | Retrograded volcanic rock | Remnant felty (diabasic) texture overwhelmed by pale green actinolitic amphibole (some mimics phenocrysts) epidote, and chlorite; some sphene. |
| 201 [3/] | Union Oil Co.-DiGiorgio #71-3 | 3-31S-29E | Amphibole-epidote-chlorite schist | Specimens 201-218 all have very similar mineralogies. They are rich in plagioclase (presumably sodic), amphibole (presumably actinolitic), epidote, and chlorite. May and Hewitt note pyroxene in each of these specimens, but experience with other similar specimens suggests no pyroxene is present. All of these specimens are pretty surely typical greenschist. |
| 204 | Union Oil Co.-DiGiorgio #62-3 | 3-31S-29E | Amphibole-epidote-chlorite schist | |
| 206 | Western Gulf Oil-DiGiorgio #1 | 10-31S-29E | Amphibole-epidote-chlorite schist | |
| 211 | Oceanic Oil Co.-Osborne #1 | 15-30S-29E | Amphibole-epidote-chlorite schist | |
| 216 | Monterey Expl. Co.-Duff #10 | 15-30S-29E | Amphibole-epidote-chlorite schist | |
| 218 | Continental Oil Co.-Porter #1 | 28-30S-29E | Amphibole-epidote-chlorite schist | |

1/ "Epidote as used in this table includes clinozoisite.

2/ These specimens (63,89) suggest transition between greenschist and diorite-quartz diorite-metamorphic belt.

3/ Thin sections have been lost for specimens 201, 204, 206, 211, 216, and 218. Rock names and descriptive notes are based on May and Hewitt notes and my "extrapolations" based on other similar specimens.

Table 2

METASEDIMENTARY ROCKS

| Map No. | Well Name | Location (Sec.-T.-R.) | Rock Name | Thin Section Mineralogy and Other Notes |
|---|---|---|---|---|
| 20 | Richfield-Tejon #2 | 19-11N-18W | Impure quartzite | Granoblastic mosaic of quartz sprinkled with abundant brown biotite, scattered larger flakes of muscovite, weakly twinned plagioclase, abundant opaque material, and scattered apatite. Weakly schistose. |
| 38 | L.C.Morton-Barlow Farms #1 | 25-31S-29E | Carbonaceous schist | Schistose, dominantly quartz and green chlorite with lesser biotite. Strongly dusted with opaque "dust". Probably originally a carbonaceous shale. |
| 55 | Barnsdall-Slininger #1 | 26-30S-29E | " | Like 38; somewhat silty-coarser, rounded quartz grains in "pasty" matrix. |
| 60 | Jergins-Texas Fee #14 | 23-30S-29E | Marble | Mat of calcite with scattered clasts of quartz and plagioclase. |
| 87 | Jergins-McCowan B-7 | 13-30S-29E | Carbonaceous schist | Strongly foliated with thin (0.2 to 0.4 mm) somewhat boudinaged quartz layers. Mostly very-fine grained quartz, brown to green biotite, muscovite, and opaque dust; feldspar(?). |
| 93 | General Pet. Corp.-Arvin #1 | 26-31S-29E | Sandy marble | Gritty clastic rock with angular grains of quartz and plagioclase, and elongate muscovite crystals "floating" in a calcite matrix. Minor green biotite. |
| 103 | Mohawk Pet. Corp.-Weichelt #1 | 26-30S-29E | Carbonaceous schist | Much like 87, also greenish brown chlorite and small garnet crystals. |
| 108 | General Pet. Corp.-Mattson #1 | 1-32S-29E | Biotite quartz schist | Abundant shape-oriented quartz and much less sodic plagioclase or K-feldspar(?) with well-alined light brown biotite. Minor muscovite and trains of well-alined opaque dust. |
| 153 | Independent Expl. Co.-Mettler #1 | 19-30S-30E | Quartzo-feldspathic granofels(?) | Granoblastic-looking section with abundant quartz (60), plagioclase (32) that includes discrete muscovite flakes, minor K-feldspar (1), and reddish brown biotite (7) that includes haloed zircons. (This could be a messy quartz diorite--these very small thin sections can give very misleading modes!) |
| 172 | Amerada-Wagley #27-14 | 14-29S-29E | Garnetiferous felsic gneiss(?) | Fresh granoblastic (or aplitic?) mat of well-twinned sodic plagioclase that includes discrete muscovite and epidote crystals, quartz, olive biotite, and scattered pale pink garnet crystals. Looks like felsic gneiss in San Emigdio Canyon? |
| 174 | Texas Co.-Hintz #1 | 23-30S-26E | Carbonaceous schist | Like 87, but with "classic" cleavage developed at angle to foliation. |
| 178A | Jergins-Handel #1 | 23-30S-29E | Epidote quartz schist | Foliation shown by trains of epidote and shape-oriented quartz crystals. Minor plagioclase, distinctive green biotite, and sphene. (Originally a calcareous siltstone?) |
| 185 | Edward Gieck-Woodworth #1 | 30-31S-30E | Tourmaline carbonaceous schist | Strongly schistose and much like 87 with the addition of about 30% of highly pleochroic light brown tourmaline. |
| 187 | Jergins-McCowan 13A-#1 | 13-30S-29E | Carbonaceous schist | Same as 87. |
| 188 | Jergins-McCowan 13A-#2 | 13-30S-29E | " | Much like 87, but with alternating quartz-rich and opaque dust-mica-rich layers. Some cleavage like 174. |
| 189 | Jergins-McCowan 13A-#4 | 13-30S-29E | " | Much like 87, but with addition of green chlorite and some calcite. |
| 191 | Continental-Reay USL #1 | 28-29S-30E | Muscovite quartz schist | Strongly schistose. Muscovite and quartz dominate with lesser light brown biotite. Scattered carbonaceous spots. |
| 215 | Jergins-McCowan 13B-#5 | 13-30S-29E | Carbonaceous schist | Thin section has been lost, but May and Hewitt (1948) note the same minerals as in 87 and 38. |

Table 3

PLUTONIC ROCKS

| Map No. | Well Name | Location (Sec.-T.-R.) | Rock Name | Thin Section Mineralogy and Other Notes |
|---|---|---|---|---|
| 8 | Di Giorgio #1 | 12-31S-29E | Biotite quartz diorite | Oscillatorily zoned sodic andesine (67), K-feldspar (tr.), weakly strained quartz (22), brown biotite (11), traces of chlorite, epidote, zircon, opaques. |
| 9 | Di Giorgio #2 | 12-31S-29E | " | Much like 8. |
| 18 | Seaboard-Fuhrman #1 | 28-28S-28E | " | Oscillatorily zoned andesine (in part saussuritized), abundant quartz, biotite much chloritized, some unusual chlorite plus opaque masses may be pseudomorphs of hornblende (no remnants seen). |
| 24 | Union-Pacific States #21-53 | 33-28S-25E | Sugary fine-grained gabbro | Granoblastic mat of well-twinned fresh sodic labradorite and very pale brown clinopyroxene. Abundant pale green chlorite and opaque grains. |
| 47 | "Rock Pile" (outcrop) | 4-31S-30E | Biotite quartz diorite | Somewhat zoned fresh andesine, abundant quartz and brown biotite. Minor chlorite, muscovite. |
| 56 | Outcrop | 13-31S-30E | Hornblende biotite quartz diorite | Well-twinned, weakly zoned andesine, minor K-feldspar, abundant weakly strained quartz, green hornblende, and brown biotite. Traces of sericite, epidote, sphene, zircon, and apatite. |
| 57 | Outcrop (same as DR-3628) | 24-31S-30E | " | Same as 56. |
| 58 | Di Giorgio #3 | 7-31S-30E | Biotite quartz diorite | Strongly oscillatorily zoned andesine (like 8, 9, 18). Abundant quartz and brown biotite (in part chloritized). |
| 67 | Range #1 | 36-28S-28E | " | Much like 58 with strongly oscillatorily zoned andesine, in addition there are traces of green hornblende. |
| 71 | Standard-KCL #12-6 | 30-29S-26E | Diorite-gabbro | Well-formed plagioclase (about $An_{50}$) with chlorite in fractures. Patches of fibrous pale green amphibolite include some pale brown hornblende and clinopyroxene; some epidote. (Appears to be a dioritic rock "retrogressing" to green schist?) |
| 85 | Pebble Beach Oil Co.-Olcese #1 | 16-28S-29E | Hornblende-biotite quartz diorite | Highly fractured thin section of altered rock. Much chlorite, epidote, and secondary silica. Well-twinned andesine and coarse unstrained quartz. Minor remnants of hornblende (fresh rock probably had abundant hornblende and biotite. |
| 88 | Jergins-McCowan #13-1 | 13-30S-29E | Biotite quartz diorite | Oscillatorily zoned andesine and reddish brown biotite dominate. Quartz with only minor strain. Sericite, chlorite, and epidote alteration. |
| 90 | R&R Development #3 | 32-30S-30E | Hornblende-biotite quartz diorite | Well-twinned intermediate andesine. Brown biotite and very pale to grayish green hornblende. Trace of apatite and opaque grains. |
| 98 | Berry Edison-Duff #1 | 25-30S-29E | Biotite quartz diorite | Much like 88, but biotite is olive brown |
| 99 | Jergins-Ross #2 | 24-30S-29E | " | Same as 98, but more alteration. |
| 102 | R&R Development #1 | 29-30S-30E | Hornblende-biotite quartz diorite | Much like 90 (colorless to pale green hornblende and brown biotite). |
| 104 | Petroleum Prod. Co.-Welsh #1 | 35-30S-29E | Biotite quartz diorite | Same as 98. |
| 107 | Ohio Oil Co.-Cauley #2 | 36-30S-29E | " | Badly broken section. Dusty, weakly twinned plagioclase (oligoclase?). Abundant quartz, minor K-feldspar. Scattered brown biotite remnants--much green chlorite. |

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Table 3 (cont.)

PLUTONIC ROCKS (CONTINUED)

| Map No. | Well Name | Location (Sec.-T.-R.) | Rock Name | Thin Section Mineralogy and Other Notes |
|---|---|---|---|---|
| 147- | Standard-KCL #11-44 | 18-29S-26E | Gabbro (retrograded?) | Ophitic texture with laths of well-twinned sodic labradorite enclosed in large colorless masses of clinopyroxene that are in part altered to pale green fibrous amphibole. Some chloritic masses. Much like 71. |
| 151 | Richfield-Cauley #1 | 36-30S-29E | Biotite quartz diorite | Same as 98 with minor pale green hornblende. |
| 155 | Tide Water-Luck #154 | 30-28S-28E | " | Same as 98. |
| 156 | Richfield-S.P. #15-1 | 31-29S-30E | " | Same as 98. |

Table 4

GRANITIC GNEISS(?)

| Map No. | Well Name | Location (Sec.-T.-R.) | Rock Name | Thin Section Mineralogy and Other Notes |
|---|---|---|---|---|
| 49 | Outcrop | 16-32S-30E | Biotite quartz diorite gneiss | Gneissic to granoblastic "salt and pepper" fine grained rock. Calcic andesine, quartz, and light brown biotite dominate. Epidote, opaques, apatite, zircon. |
| 66 | Mettler and Sons-Mettler #1 | 25-30S-29E | " | Shattered, fragmented, sort of granoblastic. Elongate brown to opaque biotite flakes define a gross foliation. Abundant quartz. |
| 105 | Hall Baker-McCowan #1 | 20-31S-30E | Hornblende-biotite quartz diorite or granofels. | Xenomorphic to granoblastic. Abundant well-twinned andesine, quartz, olive brown biotite, and light olive hornblende. Dark minerals irregular and in clots. May be plutonic, but light colored hornblende suggests relation to diorite-quartz diorite-metamorphic belt rather than to Bear Valley Springs or Isabella units. |

Table 5

Subsurface basement data, southeastern San Joaquin Valley [3]
(no samples available)

| Map No. [4] | Well Name | Location Sec.-T(S)-R(E) | Well elevation (feet) | Total depth [1] | Depth to top of basement | Basement description from well log [2] |
|---|---|---|---|---|---|---|
| 1 | Standard KCL 31-21 | 1-29-26 | 383 | 10800 | -- | Greenish black gabbro (40% plagioclase, 60% augite, hornblende, biotite) |
| 2 | Reid M & T 1 | 31-28-29 | 619 | 4462 | -- | Diorite |
| 4 | Superior KCL 15 | 11-29-27 | 447 | 7724 | 7715 | Greenstone, gray to grayish green |
| 5 | Superior KCL 57-13 | 13-29-27 | 423 | 8232 | 8191 | Greenstone, dark green, serpentinized |
| 6 | Toscopetro KCL 33-44 | 34-29-27 | 404 | 11577 | 11545 | Schist, dark green |
| 7 | Standard KCL 29, 1-11 | 9-29-28 | 443 | 6986 | 6980 | Granitoid, gneissic, micaceous |
| 8 | Amerada SP 35-9 | 9-29-29 | 822 | 4747 | -- | Schist |
| 9 | Amerada Barrett 38-10 | 10-29-29 | 849 | 4280 | -- | Schist |
| 10 | Amerada King 61-22 | 22-29-29 | 894 | 4248 | -- | Schist, hard, green |
| 11 | Texaco Garrison-Davis 1 | 30-29-29 | 549 | 7613 | 7520 | Green chloritic Schist, dense greenstone, altered gabbro |
| 13 | Kern 34-28 | 34-29-29 | 660 | 5421 | 5416 | Granite |
| 14 | Standard 24 | 35-29-29 | 782 | 5400 | 5352 | Schist (epidote, calcite, feldspar, hornblende) |
| 15 | ARCO King 1 | 31-30-30 | 593 | 1566 | -- | Granite |
| 16 | Texaco Pauly 7 | 22-31-29 | 443 | 8779 | 8695 | Schist, green, fine-grained |
| 17 | Texaco "George" 4 | 23-31-29 | 470 | 6882 | -- | Schist |
| 18 | Green Pet. Kirkorian | 24-31-29 | 463 | 5900 | -- | Schist |
| 19 | H. F. Bloom Berge 1 | 24-31-29 | 460 | 5131 | -- | Granite |
| 20 | Getty Derby 25-25 | 25-31-29 | 443 | 6912 | -- | Schist, blue gray to black |
| 21 | Texaco Kovacevich 1 | 27-31-29 | 410 | 11242 | 11229 | Quartzite, greenish gray, schistose |
| 22 | Texaco Di Giorgio B-1 | 36-31-29 | 419 | 7831 | 7819 | Schist |
| 23 | Kenneth Lowell Gold Metal 1 | 17-31-30 | 528 | 1900 | 1730 | Granite |
| 24 | Texaco-Gardner 1 | 31-31-30 | 434 | 6066 | -- | Schist |
| 25 | Texaco TST Frick 1 | 12-32-29 | 441 | 10942 | -- | Schist |
| 26 | Comanche Point | 23-32-29 | 775 | 2301 | -- | Granite |
| 27 | Signal (Hancock) Intex-Tejon 66-26 | 26-32-29 | 650 | 3270 | -- | Granite |
| | | Sec.-T.(N)-R.(W) | | | | |
| 29 | Cliff Pet. Tejon 3-3 | 3-11-18 | 980 | 1449 | 1435 | Granite |
| 30 | Standard Tejon 4-65-8 | 8-11-18 | 739 | 2598 | 2593 | Gneissic, greenish black coarse mica |
| 31 | Sunset Tejon 41 | 11-11-18 | 1311 | 638 | -- | Granite |
| 32 | Bear Mtn 1 | 12-11-18 | 1300 | 1293 | -- | Granite |
| 33 | Lee Clayton Annex 1 | 14-11-18 | 1150 | 1235 | -- | Granite |
| 34 | Standard Tejon Ranch 5-34-16 | 16-11-18 | 825 | 2995 | -- | Granodiorite, light gray, biotite |
| 35 | Union Core Hole 3 | 18-11-18 | 718 | 4420 | -- | Granite |
| 36 | Standard Tejon Ranch 3-57-21 | 21-11-18 | 892 | 1815 | -- | Granite |
| 37 | Sococ Tejon 11-24-21 | 21-11-18 | 836 | 3322 | -- | Granite |
| 38 | Sococ Tejon 3-68-21 | 21-11-18 | 916 | 1601 | -- | Granite |
| 39 | ARCO Tejon B-1 | 28-11-18 | 989 | 1613 | -- | Granodiorite |
| 40 | Standard Tejon Ranch 25(2-10) | 28-11-18 | 920 | 2044 | 1927 | Granite |
| 41 | Gulf Tejon Ranch 1 | 29-11-18 | 800? | 4231 | -- | Granite |
| 42 | Unoco Reserve Hay 11-24 | 24-11-19 | 737 | 7688 | -- | Schist |
| 43 | Unoco Reserve Kerr 46-24 | 24-11-19 | 757 | 7076 | -- | Granite |
| 44 | Unoco Reserve Tejon 57-36 | 26-11-19 | 859 | 10371 | -- | Schist |
| 45 | Richfield KCL D-16-28 | 28-11-20 | 1477 | 11816 | 11725 | Granodiorite |

[1] Total depth generally no more than 50 feet below top of basement for those wells where "Depth to top of basement" not given.

[2] Descriptions generally based on cursory examination of well core fragments at well.

[3] Data from U.S.Geological Survey files of J. A. Bartow

[4] Numbers 3, 12, and 28 not used