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ASARCO

Southwestern Exploration Division

November 17, 1977

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FROM: J. D. Sell

Durham Hills -- A Zoned Mid-Tertiary
Intrusive and Associated Mineralization
Owl Head District
Pima County, Arizona

The Durham Hills (T8S., R12E) in the north central portion of the Tortolita Mountains quadrangle have a number of oxide-silicate copper occurrences which have attracted prospectors and explorationists for a number of years.

Recent reconnaissance related to the 96 Hills Recon. project and the publication of several USGS maps and reports (see References) have suggested several facets to the problems in the area.

1) The mid-Tertiary Samaniego quartz monzonite making up the central part of the Durham Hills is a core zone intrusive surrounded by
2) a complex diorite, quartz diorite, granodiorite, monzodiorite border zone which
3) intrudes into a sheared and mylonized terrain of older Precambrian Oracle Granite (sheared and mylonized to the extent of being called "schist" by many workers in the area) which
4) contains the majority and best occurrences of oxide-silicate-minor chalcocite copper mineralization.

Attachment A is a description of the rock units taken from Banks, et al (1977).

Figure 1 is taken from Banks, et al (1977), with minor additions from the 96 Hills SW mapping on the north side and the Magma Copper drill holes on the east side. No definitive information on mineralization or rock type has been acquired on the drill holes (Sell, 1977), but as Magma did not follow up on the drilling I would suspect that the results were inconclusive or not encouraging.

The most widespread mineralization is located in a block of sheared Oracle Granite and small outcrops of border phase diorite associated with several large fault structures. Also noted is a large number of individual diggings and pits on the northeast side very close to or in the alluvial covered boundary.

Figure 2 is a reconstruction of the district prior to the major displacing structural movement created by moving the blocks along the two large faults noted. In doing so it can be visualized as a composite intrusive with the border phase well developed on the north and south ends. On the east side the border zone is scant or as masses within the sheared Oracle Granite wall rock. No exposures of wall rock or border phase are noted on the west side other than several small bloopers of border phase on the west side of the central part of the range.

Reconnaissance of the north half of the core zone shows numerous dikes of granite aplite cutting the core zone. The dikes trend N10°-35°W (average N20°W) and have a similar trend as do the diorite and related dikes which cut the main core zone and the border zone on the north (and apparently in the border zone of the south end). One diorite-granodiorite dike was found in the schist hills to the NNW following a similar trend direction.

The petrographic samples in the north half show rare Type 2 fluid inclusions in the core phase monzonite (Sample T-96-14A) but good Type 2 inclusions in the small quartz eyes within the K-spar of the granite aplite (Sample T-96-14B). This is suggestive that abundant gas and liquid were present during the late stage fracturing and aplite emplacement within the core zone.

Figure 2 also shows the favored fracture-dike trend systems and indicates one trend subparallel to the axis of the core zone (NNW) and a second trending ENE through the center of the range. The latter trend passes through the major mineral distribution area.

The overlay for Figure 1 is a compilation of the high and low closure areas of the Asarco aeromagnetic coverage of various vintages which indicates a magnetic high over the main range (core phase) and another to the northeast where the border zone would project to swing around to the south. Three lows were outlined. One low is off the southwest corner of outcrop which may largely fall within the wall rocks outside the projected border phase. The large SW-trending fault when projected further to the SW would bisect the low. The second low is off the west side of the middle north part of the Durham Hills. The low would also project to be in and outside the border zone and be mainly south of the NW-trending major displacing fault zone. The third low zone is north of the main range and just southeast of the small schist hills. It also is undoubtedly within the wall rocks outside the border zone of the composite intrusive.

Mid-Tertiary intrusives presently known have not contained high copper values -- generally only having a maximum of 0.15-0.20% copper; i.e., Jhus Canyon, Santa Teresas, Rock House, and Gunsite areas, but it would be of interest if a late-stage differentiate would be found at the end(s) of the zoned composite intrusive which would carry substantially higher values (as with the Laramide equivalents).

A second feature of the mid-Tertiary intrusives is the apparent higher base metal-silver values associated with deposits in the wall rocks surrounding the intrusives; i.e., Hilltop next to Jhus Canyon, Aravaipa around Santa Teresas, and the Gunsite mine located in the intrusive but with thin remnants of schistose rocks. These mines (districts) had the following production values.

Mine (District)	Tons Ore	Copper Tons	Copper %	Lead Tons	Lead %	Zinc Tons	Zinc %
Hilltop	38,000	150	0.39	4,300	11.3	590	1.6
Aravaipa	273,000	918	0.34	16,200	5.9	13,600	5.0
Gunsite	16,000	minor		780	4.9	minor	

Mine (District)	Silver oz.	Silver oz/ton	Gold oz.	Gold oz/ton
Hilltop	152,000	4.0	100	0.003
Aravaipa	351,100	1.3	3,500	0.013
Gunsite	100,600	6.0	400	0.025

The overall NNE trend of the three magnetic lows shown on Figure 3 might suggest a major structure along that trend which would be capable of trapping or concentrating magnetite-destruction fluids which would result in magnetic lows. As noted earlier these lows should be in the wall rocks around the intrusive complex and on the east side of the range the known values are within the wall rocks, supporting the idea that they are the favored host.

Only two samples were collected for geochemical analysis of the wall rock as shown on Figure 1. The sample 96-14B is from the mylonized Oracle Granite whereas sample 96-17 is from Pinal Schist. No samples were collected from the mineralized areas during this study. The results are as follows:

Sample No.	PPM Values Cu	Pb	Zn	Mo
96-14B	42	34	67	4
96-17	30	12	80	1

These results are not suggestive of increased values in the wall rocks located 2-3 miles from the exposed intrusive.

Most of the alluvial covered ground around the Durham Hills is staked by the Great Western Company for the magnetite content (placer?) while numerous groups hold claims over the copper oxide occurrences and in the valley and low hills east and southeast of the Durham Hills.

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JDS:lb
Atts.

References:

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ASARCO Aeromagnetic Map CR-33, Tortolita Mtns.: Drafting files.

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MISCELLANEOUS FIELD STUDIES
MAP MF – 864
BANKS AND OTHERS–TORTOLITA MOUNTAINS, ARIZONA (1977)

INTRUSIVE ROCKS--An intrusive-metamorphic complex yielding essentially concordant mid-Tertiary potassium-argon and fission-track mineral ages (Creasey and others, 1976) crops out in the Santa Catalina-Rincon and Tortolita Mountains. At least four major intrusive bodies occur in the Tortolita Mountains. Three occur in the area mapped as the quartz monzonite of Samaniego Ridge and related rocks; the fourth and youngest is the quartz monzonite of the Tortolita Mountains. One or more igneous phases or metamorphic equivalents of the quartz monzonite of Samaniego Ridge occur in the Suizo Mountains, Durham Hills, Desert Peak, and the pediment and foothills in the northeast corner of the Tortolita Mountains quadrangle. At margins of separate intrusive phases, both host Precambrian igneous rock and earlier phases of the intrusive complex have been converted to gneiss (indicated by parentheses around unit symbol) and to protomylonite and schistose mylonite and ultramylonite (indicated by Greek letter μ). Widespread mylonitization of Precambrian Oracle Granite east of the Suizo Mountains suggests that the younger intrusive rock either underlies or once over-laid the rocks in those exposures. Most of the Tertiary igneous rock shows indications of both flow alinement of phenocrysts and xenoliths and postsolidification deformation. Septa or pendants of Paleozoic and older metasedimentary rocks occur in the complex in an east-northeast-trending belt in the southeast corner of quadrangle. In two areas pegmatite dikes are so numerous that contacts between the different intrusive phases of the host rock could not be defined by reconnaissance mapping. These areas are labeled Tspc on the map. Without data to the contrary, Banks, Dockter, and Briskey consider the intrusive complex to be mid-Tertiary in age as indicated by Banks (1976) and Creasey and others (1976). Davis, Keith, Budden, Kiven, and Anderson agree that the quartz monzonite of the Tortolita Mountains and a phase of the quartz monzonite of the Samaniego Ridge that crops out near the southern boundary of the quadrangle are probably mid-Tertiary but note that more mafic phases included in quartz monzonite of Samaniego Ridge may be older

QUARTZ MONZONITE OF THE TORTOLITA MOUNTAINS (Banks, 1976)--Equigranular quartz monzonite and related dikes occupying the southern part of the igneous complex and intruding a phase of the quartz monzonite of Samaniego Ridge at Desert Peak. Includes two quartz latite dikes near Antelope Peak and one east of the Suizo Mountains

Ttd DIKES OF QUARTZ LATITE AND QUARTZ MONZONITE--Gray to grayish-lavender dikes that crosscut both foliation of the complex and the main pluton of quartz monzonite of the Tortolita Mountains. The dikes commonly have flow foliation parallel to their margins and are generally oriented N. 25°-35° W.; a few are oriented N. 35° E. Thin dikes and dike selvages are quartz latite porphyry; centers of thicker dikes and entire dikes near southern border of quadrangle are fine-grained aplitic or hypidiomorphic granular quartz monzonite that is very similar to rock of the main pluton. Phenocrysts in the quartz latite are euhedral to subhedral plagioclase (as much as 5 mm long, some rimmed by potassium feldspar); subhedral to euhedral orthoclase (as much as 3 mm long) with microcline domains; euhedral biotite (as much as 3 mm in diameter), anhedral to euhedral quartz (as much as 2 mm across), and subhedral to euhedral magnetite (as much as 1/3 mm across). Plagioclase, quartz, and biotite phenocrysts are more abundant in dike centers than at margins. Groundmass is aphanitic and makes up as much as 80 percent of the quartz latite dikes. Overall composition of the quartz latite and quartz monzonite dikes varies between, along, and across individual dikes. Plagioclase (An_{40} cores, An_{20} rims) makes up 20-50 percent of the rock; potassium feldspar, 30-55 percent; quartz, 15-30 percent; biotite, 2-20 percent; magnetite, ½-2 percent. Accessory minerals are apatite, allanite, sphene, and zircon; all are more abundant in dike centers than margins

Ttqm MAIN PLUTON AND LARGER SATELLITIC BODIES OF QUARTZ MONZONITE--Equigranular fine- to medium-grained, gray hypidiomorphic granular quartz monzonite, much less foliated than older intrusive phases. Only the northernmost exposures of the main pluton occur in the quadrangle. Approximate rock composition is 35-40 percent subhedral plagioclase (An_{20-30}, as much as 4 mm long); 26-33 percent subhedral to interstitial orthoclase (as much as 4 mm long); 26-31 percent interstitial, anhedral quartz (as much as 2 mm across); 2-4 percent subhedral to anhedral interstitial biotite; and ½-1 percent opaque minerals. Accessory minerals are apatite, sphene, allanite, and zircon

Tdd DIORITE AND DIORITE PORPHYRY DIKES AND SILLS--Greenish-black to dark-grayish-green dikes and sills of fine- to medium-grained hypidiomorphic granular diorite. Steeply dipping dikes cut across both foliation and pegmatite dikes, and sills are concordant to but postdate the foliation. Some dikes and sills, particularly in the central parts, are coarse grained and superficially resemble Precambrian diabase. Dikes generally trend N. 25°-35° W., a few trend N. 30°-40° E. or N. 10° W.; a diorite sill is crosscut by a Ttd dike in sec. 4, T. 11 S., R. 12 E. Approximate rock composition is 38-55 percent euhedral to subhedral plagioclase (An_{40-70}, generally ½-2 mm long but as much as 5 mm long in centers of dikes and sills); ½-6 percent anhedral, interstitial to subhedral orthoclase (as much as ½ mm long); ½-5 percent interstitial quartz; 20-50 percent subhedral blocky to acicular hornblende (½-2 mm but as much as 8 mm long in centers of dikes and sills); as much as 2 percent remanent augite in hornblende grains; 9-20 percent anhedral biotite (½-1 mm across); ½-2 percent subhedral opaque minerals; <½-4 percent apatite as blocky grains and acicular crystals; trace to 1 percent sphene and accessory zircon

QUARTZ MONZONITE OF SAMANIEGO RIDGE AND RELATED ROCKS (Banks, 1976; Creasey and Theodore, 1975)--Includes diorite through granite compositions. The oldest and most mafic of at least three intrusive phases of the quartz monzonite of Samaniego Ridge is identified by the symbol Tsgd and occurs at Desert Peak and the Durham Hills. It also occurs in and to the north and east of the area mapped as pegmatite complex in the Tortolita Mountains and in the northeastern corner of the quadrangle, and at both of these localities it grades from quartz diorite and diorite into porphyritic quartz monzonite. In the southeastern corner of the quadrangle and in the Durham Hills, the oldest phase is intruded by a more leucocratic porphyritic quartz monzonite phase. In and west of the pegmatite complex, the oldest phase is intimately intruded by another possibly more equigranular quartz monzonite. Both the oldest phase and this second quartz monzonite are intensely metamorphosed and deformed as well as intruded by pegmatite dikes of two or more ages. The quartz monzonite contains garnet and muscovite, as well as sheared grains of the igneous minerals, and is petrologically equivalent to metamorphosed quartz monzonite in the Suizo Mountains. The relationship between the two younger quartz monzonite phases (metamorphosed and unmetamorphosed) is not known. Dikes of porphyritic quartz monzonite (Tsd) with large potassium feldspar phenocrysts are thought to be related to one of the younger phases and cut the older phase in both the Tortolita Mountains and Durham Hills

Tsd — DIKES OF QUARTZ MONZONITE PORPHYRY--Phenocrysts are 15-25 percent euhedral plagioclase (An_{15-25}, ½-3 mm long, partly glomerocrystic); ½-10 percent euhedral orthoclase (as much as 1½ cm long); 5-10 percent euhedral to resorbed quartz (½-2 mm across); 0-2 percent euhedral hornblende (as much as 2 mm long); and 2-10 percent euhedral biotite (as much as 3 mm across). Groundmass is grayish white to light pink and composed of 15-40 percent plagioclase, 30-50 percent potassium feldspar, and about 10 percent quartz. Accessory minerals are opaque minerals, apatite, zircon, and, at a few places, sphene

Tspc — PEGMATITE COMPLEX--Area of outcrop that is approximately 30-90 percent pegmatite dikes where erosional debris precluded rapid identification of the host rock. Pegmatites are granitic to quartz monzonitic in composition and are composed of albite-oligoclase, orthoclase-microcline, quartz, muscovite-biotite, with or without magnetite or garnet. Some plagioclase crystals are as long as 10 cm. Most dikes predate, but some postdate, cataclasis of the intrusive complex

Tspa — PEGMATITE AND APLITE DIKES--Individual pegmatite and aplite dikes. Aplite dikes are both cut by and widen into pegmatite dikes; some are porphyritic. Pegmatite dikes range in thickness from 5-10 cm to 3 or more meters and are concentrated in and near the pegmatite complex and near and parallel to margins of individual intrusive bodies. Aplites are composed of about one-third each of plagioclase (An_{10-25}), orthoclase, and quartz plus 1-3 percent biotite and magnetite. Accessory minerals are apatite, zircon, and allanite

Tsqm — QUARTZ MONZONITE OF SAMANIEGO RIDGE--Texture, grain size, and composition are variable; most commonly medium to coarse-grained porphyritic quartz monzonite with potassium feldspar phenocrysts as much as 5 cm long, but equigranular textures and granite and granodiorite facies or phases are not uncommon. One or more phases are locally garnet-bearing two-mica gneiss (indicated by parentheses enclosing symbol) and locally protomylonitic, mylonitic, or ultramylonitic rock (indicated by Greek letter μ). Rock in the gneissic and mylonitic exposures is strongly foliated and lineated and locally contains as much as 30 percent unmapped pegmatite dikes. Composition of undeformed quartz monzonite rock varies as follows: Subhedral to euhedral plagioclase (An_{15-25}), 25-40 percent; orthoclase, perthite, or microcline, 25-40 percent; quartz, 15-30 percent; biotite, 3-10 percent; hornblende, 0-2 percent; opaque minerals, <1-1 percent; accessory apatite, zircon, and locally abundant sphene. The gneissic quartz monzonite contains muscovite that replaces biotite; garnet; plagioclase; potassium feldspar; magnetite; and accessory apatite, zircon, and sphene. The grain size of the igneous minerals has been reduced by cataclasis. Potassium feldspar and apatite appear most resistant to cataclasis; plagioclase and magnetite are less resistant; and quartz, sphene, and biotite, least resistant

Tsgd — GRANODIORITE, QUARTZ DIORITE, MONZODIORITE, AND DIORITE--Composition and texture of unit vary from fine- and medium-grained hypidiomorphic granular diorite to medium-grained porphyritic granodiorite. Approximate rock composition is: Plagioclase (An_{30-50}), 35-65 percent; potassium feldspar (orthoclase and locally microcline), trace to 20 percent; quartz, 2-20 percent; hornblende (some with remanent pyroxene), 6-18 percent; biotite, 10-26 percent; opaque minerals, 1-4 percent; sphene, 1-4 percent; accessory apatite and zircon; and locally abundant epidote replacing mafic minerals. Foliation is present in most exposures and the rock is commonly gneissic. Highly folded schistose mylonitic equivalents occur in an east-west-trending strip south of the pegmatite complex in the Tortolita Mountains. This strip is predominantly mylonitic border phase rock and mylonitic pegmatite; on the north it grades into gneissic pegmatite and quartz diorite. Davis, Keith, Budden, and Kiven prefer that this strip be designated a schist without designation of the protolith pending further investigation, and Anderson considers it to be Pinal Schist

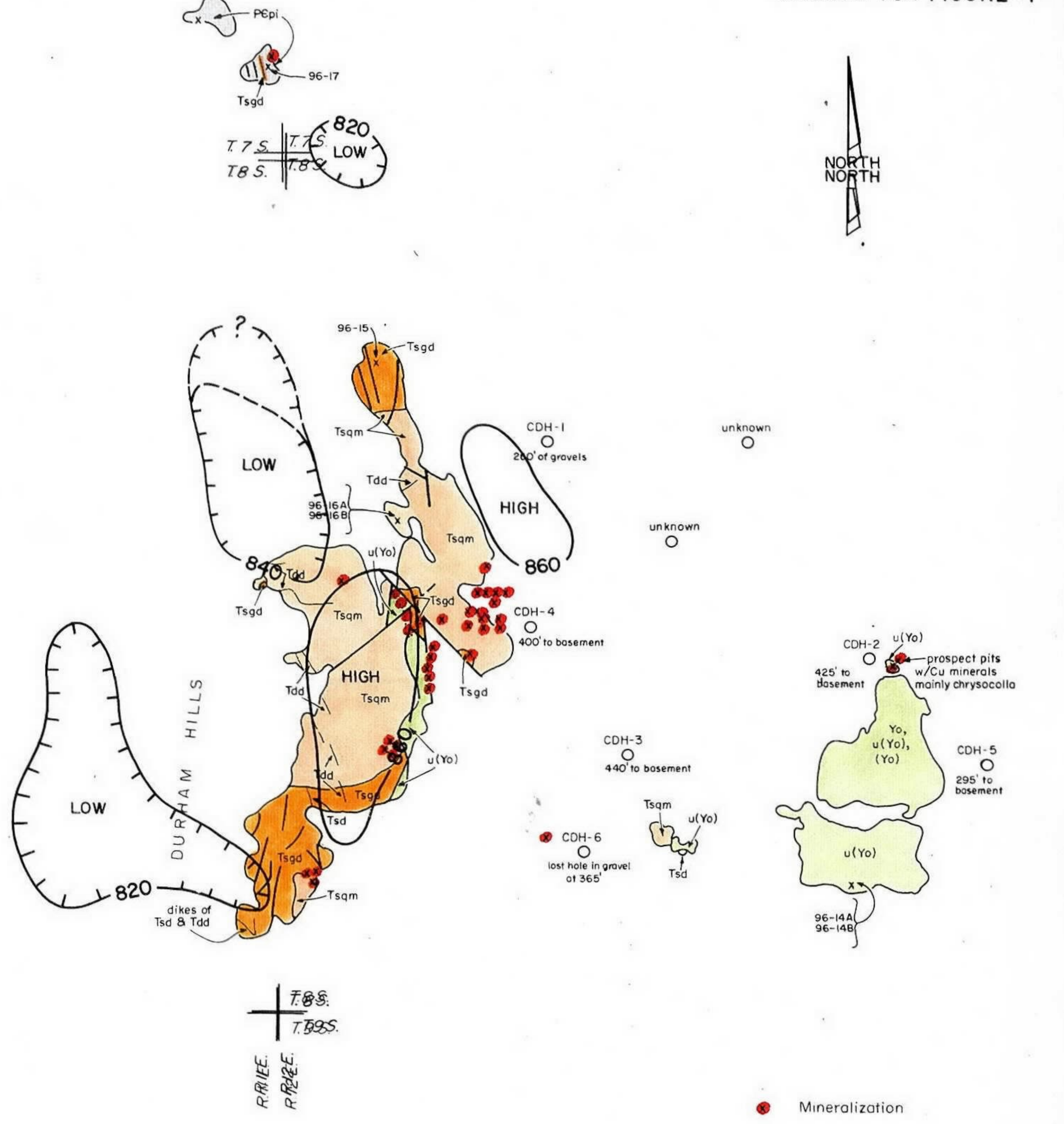
Yo ORACLE GRANITE OF PETERSON (1938) (Precambrian Y)--Coarse- to very coarse-grained porphyritic quartz monzonite to medium-grained hypidiomorphic quartz monzonite. Unit includes unmapped diabase, pegmatite, and aplite dikes. Aplite dikes are especially numerous northeast of Owl Head Buttes. Pegmatite dikes commonly contain schorl; in contrast, pegmatite dikes associated with the Tertiary intrusive complex rarely do. Potassium feldspar phenocrysts in exposures around Antelope Peak sometimes exceed 10 cm in length and grain size of groundmass is about 1 cm. East of Guild Wash, beneath the Apache Group, unit is medium-grained hypidiomorphic granular to medium-grained porphyritic. Overall grain size, crystal form, and composition of unit varies. Plagioclase (An_{20-40}, 20-40 percent of the rock) is generally subhedral to euhedral. Microcline phenocrysts are subhedral to euhedral and groundmass potassium feldspar is anhedral; together they make up 20-60 percent of the rock. Quartz and biotite are anhedral and compose 30-40 percent and 3-15 percent of the rock respectively. Magnetite is generally euhedral and constitutes <1 percent of the rock. Sphene, unlike sphene in the Tertiary rocks, is rare, metamict, and anhedral. Apatite, zircon, and,rarely, hornblende are accessory minerals, and biotite is in some places converted to muscovite as well as to ubiquitous chlorite. At the margins of the Tertiary plutons and also in inclusions in the plutons the Oracle Granite is progressively converted to augen gneiss and schistose mylonite. The mylonitic rocks are strongly foliated and tightly folded and except for their lack of variety resemble some facies of Pinal Schist. Banks, Dockter, and Briskey recognize that xenoliths of Pinal Schist might be present in exposures mapped as mylonitic Oracle Granite, particularly the one on the north flank of the Tortolita Mountains because of nearby outcrop of unequivocal Pinal Schist. However, such xenoliths were not recognized by variations in composition or foliation, and they feel that it is doubtful whether positive identification of such xenoliths could be made where their host rocks have been converted from coarse-grained igneous rock to schistose mylonite. Davis, Keith, Budden, Kiven, and Anderson originally mapped the strip of rocks shown as mylonitic Oracle Granite along the northern flank of the Tortolita Mountains as Pinal Schist, locally bounded on the north by sheared Oracle Granite. Although they now recognize that Oracle Granite can grade into schistose rocks, Davis, Keith, Budden, and Kiven feel that both alternative interpretations of these rocks are possible and prefer that this strip of rocks be mapped simply as schist without designation of the percursor rock, pending further investigations. Anderson considers that the southern half of this strip is Pinal Schist

μ Area of outcrop where unit is mylonitic or ultramylonitic and schistose

Xp PINAL SCHIST (Precambrian X)--Low- to medium-grade metasedimentary rocks (locally with recognizable sedimentary features) including spotted phyllite, siltstone, sandstone, and graywacke-arkose; includes unmapped dikes of diabase

FIGURE · I

OVERLAY FOR FIGURE · I



DURHAM HILLS AREA
GEOLOGIC & MINERAL RECONNAISSANCE
PIMA COUNTY, ARIZONA

J.D.S. 1:62,500, 1" ≈ 1 mile Nov. 1977

DURHAM HILLS AREA

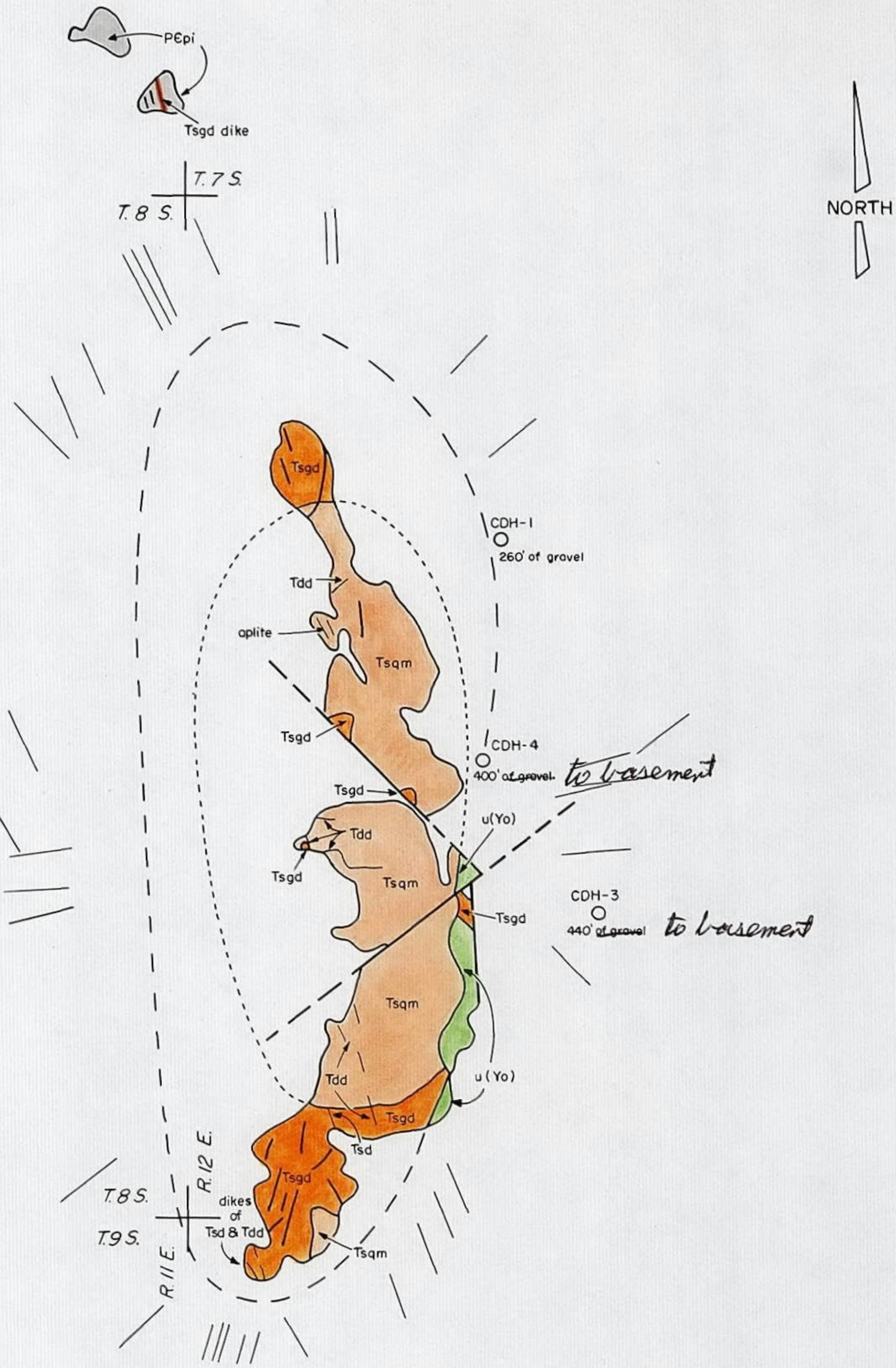
AEROMAGNETIC HIGHS & LOWS

PIMA COUNTY, ARIZONA

J.D.S. 1:62,500, 1" = 1 mile Nov., 1977

Tortolita Mtns, AZ
15' Quad

FIGURE · 2



DURHAM HILLS AREA
RECONSTRUCTED ALONG FAULT DISPLACEMENT
SHOWING FAVORED FRACTURE-DIKE SYSTEM DIRECTIONS
PIMA COUNTY, ARIZONA

J.D.S. 1:62,500, 1" ≅ 1 mile Nov., 1977