GEOLOGIC MAP OF THE IMPERIAL RESERVOIR QUADRANGLE, YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA

By
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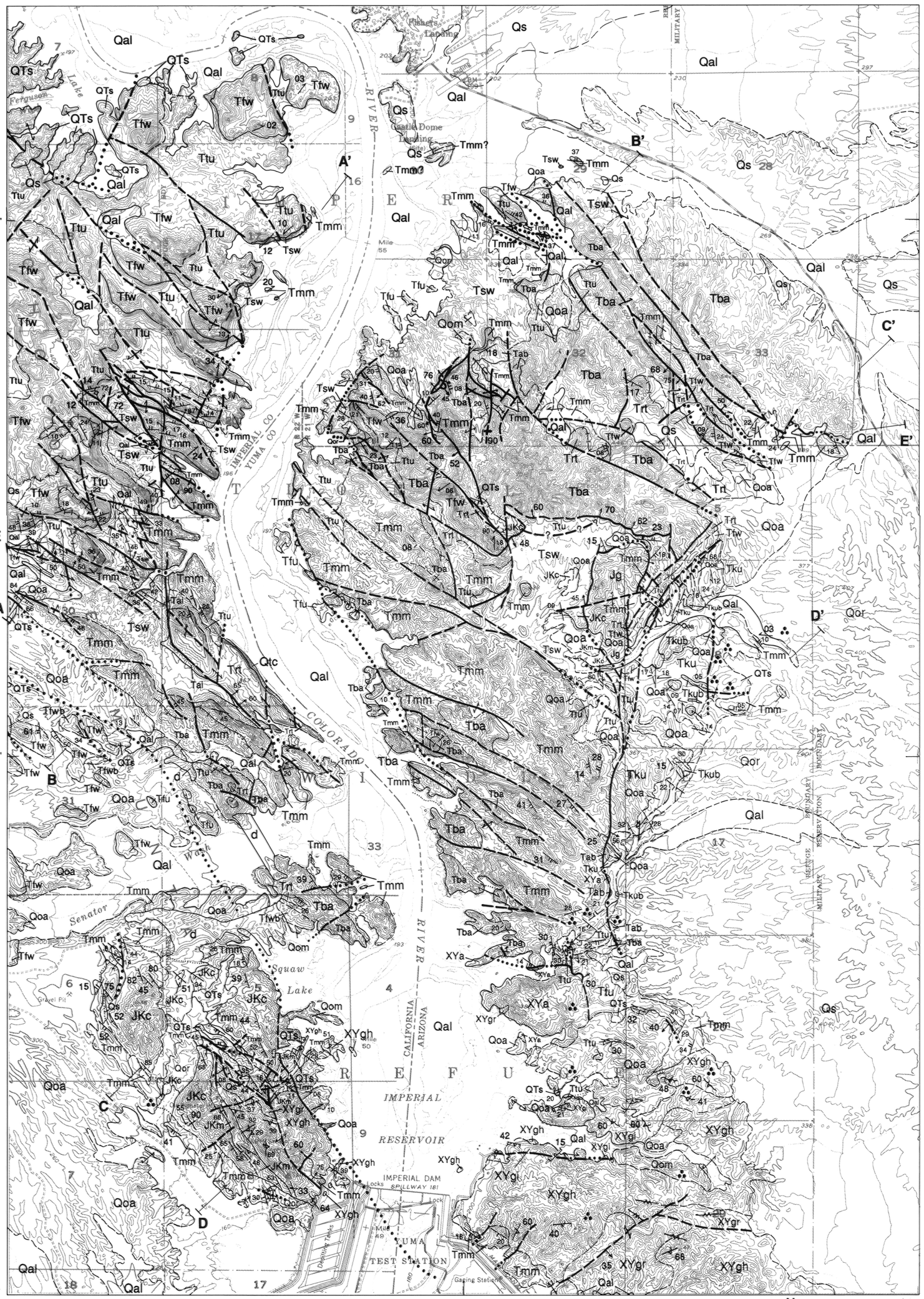


Geology Mapped in 1989-1990

Base from U.S. Geological Survey, 1955
Universal Transverse Mercator Projection

SCALE 1:24 000

1 ½ 0 1 MILE

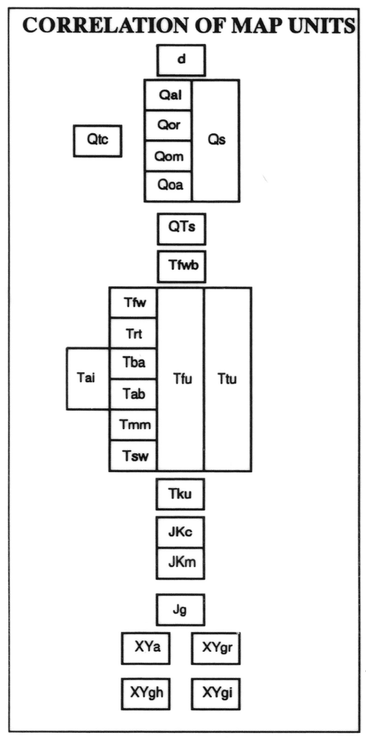
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

N MN 15°

EXPLANATION

CORRELATION OF MAP UNITS



DESCRIPTION OF ROCK UNITS

d — Disturbed surficial deposits (Recent). Land fill, concrete and rearranged alluvium around dams bounding Squaw Lake

Qs — undivided alluvium and old alluvium (Quaternary)

Qal — Alluvium (Quaternary). Unconsolidated sand and gravel, in modern stream channels. Includes fine-grained sand deposited by Colorado River and sand and gravel derived from local area. Unconformably overlies all older units.

Qtc — **Talus and colluvium (Quaternary).** Unconsolidated talus and colluvium on slopes below cliffs. Consists of locally derived angular cobbles and boulders with sparse sandy matrix.

Qor — **Old alluvium, river (Quaternary).** Tan very fine-grained, poorly indurated sandstone, with interbedded sandy conglomerate consisting of well rounded pebbles and cobbles of rocks exotic to region. Petrified wood locally present.

Qom — **Old alluvium, mixed (Quaternary).** Alluvium consisting of angular to sub-rounded volcanic and crystalline clasts derived from local area, mixed with well-rounded clasts exotic to region deposited by Colorado River, in a sandy matrix. Poorly indurated.

Qoa — **Old alluvium, locally derived (Quaternary).** Alluvium consisting of angular to sub-rounded volcanic and crystalline clasts derived from local area in sandy matrix. Poorly indurated.

Surface mantled with well rounded pebbles and cobbles deposited by Colorado River

QTs — **Conglomerate (Quaternary or Tertiary).** Moderately indurated polymict conglomerate; clasts up to 30 cm in diameter. Clasts include volcanic and crystalline rocks. Generally weakly to moderately indurated, and very poorly bedded. Generally overlies Tertiary and pre-Tertiary rocks on an angular unconformity. Erosional unconformity separates from younger alluvium. Generally mapped morphologically because of poor outcrop; occurs as deeply dissected old alluvial fans. Old soil horizons with red argillic horizon and thick calcic zones are rarely preserved. Clast size in conglomerate is generally coarser than in younger fans, but as distance from bedrock outcrop increases, this distinction is difficult to make.

Generic Marker bed. Generally cooling breaks in tuff units and flow tops in sequences of lava flows.

Ttu — **Unwelded tuff, undivided (Miocene and Oligocene)** White to light pink color, poorly welded to unwelded tuff. Nondescript white, with variable crystal content, including quartz, feldspar, biotite, +/-hornblende, and variable volcanic-lithic content.

Tfwb — Breccia. Monolithologic breccia composed of angular blocks of Tfw up to 2 m in diameter. Matrix is comminuted tuff or ash. Generally very poorly exposed. May be pyroclastic deposit or rock avalanche deposit.

Volcanic rocks of Ferguson Wash (Oligocene)

Tfu — Undivided tuff. Includes Ferguson Wash tuff, rhyolite tuff, Middle Mountains tuff and Senator Wash tuff.

Tfw — Ferguson Wash tuff member. Light grey, buff and light brown welded rhyodacite(?) tuff with prominent light tan fiamme and about 1 to 2% of crystals. Crystals <1 mm diameter, include biotite, hornblende, quartz, plagioclase and sanidine. Sparse volcanic rock fragment lithic fragments. Biotite commonly copper colored. Strongly welded tuff east of Hess mine is very similar to Middle Mountains tuff. NW of rhyolite tuff pinch-out, Ferguson Wash tuff probably overlies Middle Mountains tuff, but the two have not been differentiated in this area. Overlies Senator Wash tuff, Squaw Lake andesite and rhyolite tuff; overlain by sedimentary(?) or tuff breccia consisting of clasts of Ferguson Wash tuff, by Bear Canyon Conglomerate, or by Pebble Mountain Andesite. Thins rapidly across caldera margin(?) near Picacho road. Disappearance of strongly welded, ridge forming unit north of Ferguson Wash and south of Senator Wash suggests that the caldera margins extend to the ENE. $^{40}Ar/^{39}Ar$ analysis of sanidine (6 analyses of 3-5 crystals each) yields a date of 22.62±.07 Ma (S. M. Richard, unpublished data); $^{40}Ar/^{39}Ar$ of hornblende yielded a plateau date of 22.12± .06 Ma. Together these data are interpreted to indicate an extrusive age of about 22.5 Ma for the Ferguson Wash tuff member.

Trt — Rhyolite tuff member. Light grey crystal poor, stoney rhyolite tuff; crystals about 1mm diameter, 2-3 %; include sanidine, quartz, and sparse biotite. Sparse volcanic lithic fragments are present. Thick unwelded sections present at the NW termination of Hess Mine ridge at the western end of the outcrop belt, and in hills SE of Martinez Lake at the eastern end of the outcrop belt. Overlies Squaw Lake andesite or Middle Mountains tuff and overlain by Ferguson Wash tuff. Pinches out rapidly to NW and SE; unwelded sanidine-biotite tuff along SW margin of caldera is correlated with this tuff.

Tba — Mafic to intermediate volcanic rock member. Includes andesite, basaltic andesite and basalt lava flows and hypabyssal intrusive rocks. Mostly medium grey crystal-poor andesite, varies from aphyric to about 2% 1mm equant mafic phenocrysts, altered to iddingsite(?); massive to vesicular. In the Squaw Lake area this occurs as lava flows 10-30 m thick with red-altered basal flow breccias and highly vesicular zones. The vent area was probably in the hills south of Martinez Lake where a thick exogenous(?) dome complex is present. Depositionally overlies Middle Mountains tuff member and underlies the rhyolite tuff member.

Tab — Flow(?) breccia member. Massive breccia consisting of clasts of Tba andesite; matrix is comminuted or tuffaceous andesite.

Tmm — Middle Mountains tuff member. Dacite tuff, red brown when strongly welded, with 3-5% crystals of plagioclase, and minor quartz, biotite or hornblende and trace of pyroxene. Plagioclase crystals 1-2 mm, others < 1mm. Contains few lithic fragments; commonly lithophysal, especially in thick, densely welded sections east of Colorado River. Fiamme are similar in color to ash, thus very hard to see. Overlies Senator Wash tuff, overlain by lava flows of unit Tba or by the rhyolite tuff unit.

Tsw — Senator Wash tuff member. Poorly welded rhyodacite tuff with abundant (3-5%) crystals of biotite, hornblende, plagioclase, and quartz. Abundant biotite and hornblende give outcrops a sparkling, speckled look. Upper part is more lithic rich, with clasts of Pre-Tertiary crystalline rocks and Winterhaven formation, and less crystal rich, but the crystal assemblage is similar in both the upper and lower parts. Generally white or buff color. Deposited on Mesozoic conglomerate (unit JKc) in hills east of Colorado River SE of Martinez Lake, otherwise base is not exposed in this quadrangle. Overlain depositionally by Middle Mountains tuff in outcrops along the Colorado River north of Imperial Dam. $^{40}Ar/^{39}Ar$ analysis of plagioclase from the Senator Wash tuff yielded a slightly disturbed spectra with a total gas date of 22.60 Ma (S. M. Richard, unpublished data). This date is indistinguishable from the age determined for the overlying Ferguson Wash tuff member (~22.62 Ma, sanidine, 22.12 Ma, hornblende). These data indicate that the volcanic rocks of Ferguson Wash were erupted over a short period of time at approximately 22.6 Ma.

Tku — **Kinter Formation (Paleogene).** Sandstone and conglomerate with sedimentary breccia lenses. Tan or light grey fine-grained, well bedded feldspathic sandstone, generally thin bedded, with plane laminations. Sedimentary breccia lenses (TKub) are matrix poor masses of shattered gneiss similar to unit XYgh.

JKc — **Conglomerate (Jurassic or Cretaceous).** Massive to poorly bedded cobble to boulder conglomerate. Clasts include various unmetamorphosed Paleozoic limestone and quartzite units, including Bolsa or Tapeats quartzite; also Mesozoic volcanic rocks, and Proterozoic(?) porphyritic granite. The unit depositionally overlies quartz-rich sandstone of the basal McCoy Mountains Formation, and probably correlates with the conglomerate member of McCoy Mountains Formation [Harding and Coney, 1985].The unit is overlain in angular unconformity by the Middle Mountains tuff.

JKm — **McCoy Mountains Formation (Jurassic or Cretaceous).** Sandstone, mudstone, and conglomerate; interbedded tan calcareous sandstone, vitreous white quartzite, maroon or purple fine-grained sandstone to mudstone, and sparse quartzite-cobble conglomerate. Beds are .5 to 2 m thick, and appear continuous for on the order of 100 m along strike. Unit is up to 90 m thick. The nature of the basal contact with heterogeneous gneiss (unit XYgh) is ambiguous; a calcareous sandstone-matrix conglomerate, with clasts of the gneiss and of quartzite much like that from the McCoy Mountains Formation may be a basal conglomerate, or a healed fault breccia. I favor interpretation as a disrupted depositional contact.

Jg — **Granitoids (Jurassic).** Includes moderately to intensely propylitically altered granodiorite, monzogranite, and sparse diorite. Typical granodiorite or monzogranite contains 1-2 cm long, pink K-feldspar in a groundmass of blocky 2-4 mm plagioclase, and 1-2 mm anhedral quartz, in a mat of very fine-grained biotite-epidote-chlorite giving the rocks a dark greenish grey color. Jurassic age is based on lithologic correlation with Trigo Peaks superunit [Tosdal and others, 1989]. All contacts with younger units are faulted in this quadrangle.

XYa — **Granite (Proterozoic).** Medium grained, equigranular, light pink tan granite, consisting of quartz, K-feldspar, plagioclase, and sparse biotite. Contacts are faulted against Oligocene tuffs and unconformably overlain by old alluvium.

XYgr — **Granitoid (Proterozoic).** East of Colorado River consists of coarse-grained, light grey monzogranite containing abundant 3-7 cm diameter, equant K-feldspar megacrysts, occasionally with white plagioclase rims, in a groundmass of .5-1 cm anhedral plagioclase and quartz with 2-3% biotite in 1-2 mm flakes. Proterozoic age of this rock is based on correlation with coarse grained granite at Pilot Knob. Overlain depositionally by Middle Mtns. tuff, and has gradational contacts into heterogeneous gneiss unit (XYgh). West of Colorado R iver is medium-grained equigranular granodiorite that resembles the coarse-grained monzogranite without the K-feldspar megacrysts.

XYgh — **Heterogeneous quartzo-feldspathic gneiss (Proterozoic).** Fine-grained quartz-plagioclase-biotite gneiss, with contorted compositional banding. Intruded by coarse-grained monzogranite (XYgr) and unconformably(?) overlain by McCoy Mtns. Formation and by Middle Mtns. tuff.

XYgi — **Orthogneiss (Proterozoic).** Ranges from coarse-grained augen gneiss to fine-grained quartz-feldspar-biotite gneiss with variations in strain. Contacts with heterogeneous gneiss are gradational.

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REFERENCES

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Tosdal, R. M., Haxel, G. B., and Wright, J. E., 1989, Jurassic geology of the Sonoran Desert region, southern Arizona, southeast California, and northernmost Sonora: Construction of a continental-margin magmatic arc, *in* J.P. Jenny, and S.J. Reynolds, editors, Summary of Arizona Geology: Tucson, Az., Arizona Geological Society Digest, V. 17, p. 397-434.

Symbols

wavy strike line indicates irregular foliation

broken strike line indicates approximate measurement

Primary foliation

upright — vertical — BEDDING; strike and dip

FLOW FOLIATION in igneous rocks

Tectonic foliations

COMPOSITIONAL BANDING

LAMINATED DIFFERENTIATED FOLIATION

LAMINATED DIFFERENTIATED FOLIATION with weak shape fabric

SCHISTOSITY

PROTOMYLONITE; S-TECTONITE

CLOSE DISJUNCT CLEAVAGE