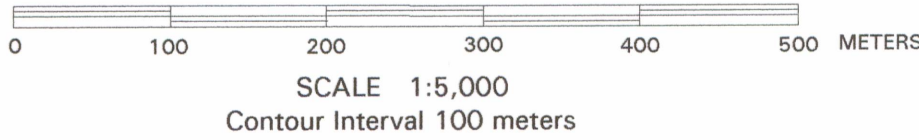


Base is an enlarged pre-print of the Saric 1:50,000 scale topographic map, now available as map H12A48, Instituto Nacional de Estadística Geográfica e Informática, México. Geologic mapping by R.G. Eppinger and P.K. Theobald, April, 1982.



GEOLOGIC MAP OF THE LOS TAMALES CHALCOPYRITE-MOLYBDENITE STOCKWORK, NORTHERN SONORA, MEXICO  
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**EXPLANATION**

**Post-stockwork rocks:**

- Qal** Unconsolidated alluvial deposits (Holocene)
- Qls** Unconsolidated landslide deposits (Holocene). Hummocky topography and disoriented angular blocks and surficial deposits
- Qlq** Lag quartz deposits (Holocene). Surface cover of white quartz vein fragments
- rd** Rhodacite. Prominent feldspar, amphibole, and less-commonly, euhedral biotite phenocrysts suspended in a fine-grained, well indurated gray matrix. Matrix commonly contains glass. Found as dikes cutting most other rocks
- gr** Granite. Medium-grained, locally friable, granitic rock. Biotite commonly in books, locally as tabular hexagons or prismatic pseudomorphs after amphibole. Appears to contain more feldspar than quartz. Generally exhibits propylitic or argillic alteration; clay after feldspar, when present, is very prominent. Cuts stockwork veins
- sy** Syenite. A fine- to medium-grained, feldspar-rich, quartz-poor, light-colored rock. Difficult to distinguish from the granite (gr), into which it may grade. Cuts stockwork veins
- qm** Quartz monzonite. A rock similar to the granite, but containing more quartz. Locally propylitically altered. Cuts stockwork veins
- lp** Latite porphyry. Fine-grained, biotite-rich, quartz-poor rock with feldspar (plagioclase?) phenocrysts. Propylitically altered. Found as dike-like masses that cut stockwork veins

**Stockwork:**

- Quartz stockwork. Criss-crossing white quartz veins varying from 0.5 to 1 cm thickness. Mineralized with pyrite (or its pseudomorphs), chalcopyrite, and lesser molybdenite. Commonly contains secondary copper minerals azurite and malachite. Stockwork veins are most commonly found in the granodiorite

**Pre-stockwork rocks:**

- fp** Feldspar porphyry. Large feldspar phenocrysts, very prominent on weathered surfaces, in a fine-grained gray matrix. Locally cut by stockwork veins
- rp** Rhyolite porphyry. Medium-grained, with rarely euhedral to more commonly angular or rounded (resorbed?) quartz phenocrysts in a feldspar-rich matrix with some muscovite. Seen only at one locality, capping a small hill. Locally cut by white quartz veins
- fe** Felsite. Light-colored, very fine-grained felsic rock. Generally found as shattered mounds, commonly with shattered quartzite at its border. Could be a fine-grained variant of the rhyolite porphyry
- gd** Granodiorite. Fine- to medium-grained, generally poorly indurated rock of varied composition. Locally contains large pink feldspars and chloritized biotite. Extensively cut by stockwork veins
- qms** Quartz-mica schist. Fine- to medium-grained rock with local quartz phenocrysts and local disseminated, segregations or clots of biotite. Locally exhibits foliation and sericitic alteration. Weathered surfaces typically limonite-stained. Cut by stockwork veins. Confined to east side of the main north-south trending fault
- qzt** Quartzite. Generally isolated masses containing well-rounded sand-size quartz grains. Locally cut by quartz veins

Contact. Dashed where inferred  
Fault. Dashed where inferred, dotted where concealed  
Breccia zone.  
Site where azurite or malachite was observed.  
Arrow, if present, indicates presence of minerals along pathway  
Prospect  
Road.  
Drainage.  
Major topographic contour

**CORRELATION**

Qal	Qls	Qlq				
rd						
gr	?	sy	?	qm	?	lp
fp	?	rp	?	fe		
gd						
qms	?	qzt				

A cooperative mineral exploration program was conducted in the late 1970's and early 1980's in a portion of the Sonoran Desert of northern Mexico by the Mexican Consejo de Recursos Minerales and the U.S. Geological Survey. The program included reconnaissance-scale collection of stream-sediment, heavy-mineral-concentrate, water, and rock samples. Follow-up studies in several areas included more detailed sampling and geologic mapping. The Los Tamales area was identified initially by a well water sample highly anomalous in Ag, Co, Cu, Mo, Ni, SO<sub>4</sub>, and U (Erdman and others, in press). In November, 1981 more detailed geochemical sampling was undertaken (Turner and others, 1984), followed in April, 1982 by mesquite sampling and geologic mapping. The map presented here is a result of 5 days of field mapping. Descriptions and rock names given are based on field relationships, and are used without the benefit of follow-up petrographic work, whole-rock chemical analyses, or age determinations.

The study area occurs within a northwest-trending Jurassic magmatic arc that extends across northern Sonora and southern Arizona. The plutonic, volcanic, and related sedimentary rocks of the arc are locally overlain by Cretaceous strata, are intruded by Late Cretaceous granodioritic plutons, have been affected by Late Cretaceous to early Tertiary regional metamorphism, and are intruded by Tertiary garnet-bearing two-mica granites (Haxel and others, 1984; Anderson and Silver, 1986).

Geologic mapping of an approximately 1 km<sup>2</sup> area at Los Tamales revealed the presence of a quartz stockwork containing chalcopyrite, molybdenite, and related secondary minerals. The stockwork mainly cuts a medium-grained, compositionally varied, but chiefly granodioritic body (gd). Other pre-stockwork rocks include quartz-mica schist (qms), minor feldspar porphyry (fp), rhyolite porphyry (rp), and quartzite (qzt). The stockwork-bearing granodiorite is cut and segmented by an areally extensive, medium-grained biotite granite (gr). The granite is commonly propylitically and argillically altered. Other post-stockwork rocks include minor quartz monzonite (qm) and syenite (sy) bodies; and latite porphyry (lp) and rhodacite (rd) dikes. The quartz monzonite and syenite, found in the northeast part of the mapped area, may be compositional variants of the biotite granite (gr). The main structural feature is a large north-northwest-trending fault that generally controls the major drainage in the area and, where exposed, cuts pre- and post-stockwork intrusive rocks.

Secondary copper minerals (principally malachite and azurite) were observed as coatings on outcrops of pre- and post-stockwork rocks. The outcrop pattern of the chalcopyrite-molybdenite quartz stockwork and sites where secondary copper minerals were observed are shown on the map. The stockwork and visible secondary copper minerals extend beyond the mapped area. A small prospect was found in the south-central part of the mapped area, as well as three exploratory drillholes from a 1970's drilling program by Cia. Esplumil (results unknown).

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