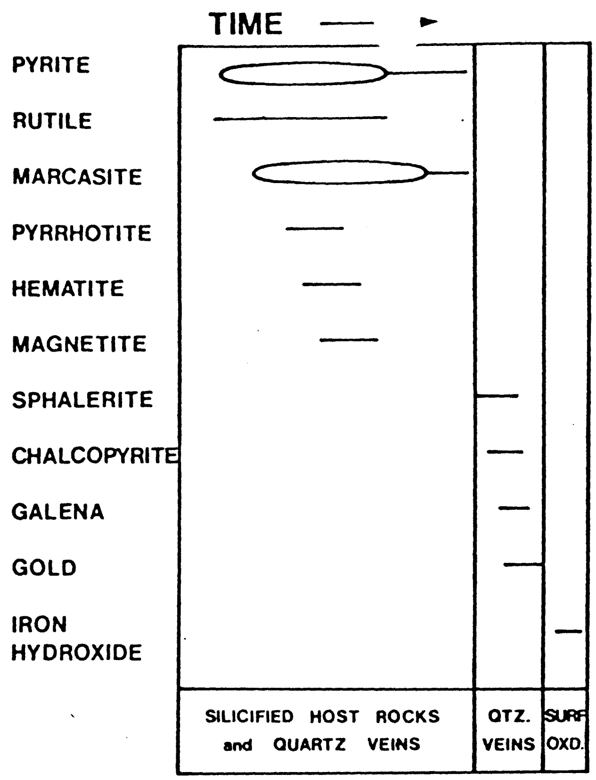

FIGURE 9. Paragenetic line diagram for the Cinola gold deposit's opaque minerals.

sedimentary rocks, and in silicified shales. An earlier phyllic zone could have been present around the intrusion, but the pervasive nature of the phyllic alteration makes recognition of any early alteration stage very difficult if not impossible.

Except for alteration of phenocrysts in andesitic pebbles in conglomerate, chlorite seem to be limited to the contact zone of the porphyritic rhyolite, where the mineral is finely disseminated with quartz, illite and kaolinite. Chlorite might represent: (1) an alteration product of a glassy chilled margin of the rhyolite intrusion or (2) a mineral phase related to early hydrothermal alteration.

Iron hydroxides are present on surface exposures and up to 20 m in depth in drill holes. They form pale yellow to reddish brown fine-grained earthy material filling and lining boxwork cavities and veinlets. They result from oxidation of pre-existing sulphide minerals, principally pyrite and marcasite.

Ore Mineralogy

Opaque minerals recognized in the Cinola deposit are listed in Table 4, with an indication of their approximate abundances in 60 specimens examined in detail. Mineralized rock contained from 0.5 to 10% opaque minerals, with an average of about 3% (by volume). Two general mineral associations are present in the deposit (Figs. 9 and 12): pyrite-marcasite in silicified host rocks and pyrite-marcasite-sphalerite-chalcopyrite-galena and native gold in quartz veins.

Pyrite and marcasite are the most common metallic minerals. Four generations of pyrite are present. In order of decreasing age they are: (1) "raspberry-like" pyrite, rarely observed and possibly of sedimentary origin, (2) fine-grained melnikovitic pyrite occurring as coatings and fissure fillings in pebbles of conglomerates, (3) well-developed single crystals or crystal clusters in the coarse fraction and cement of the

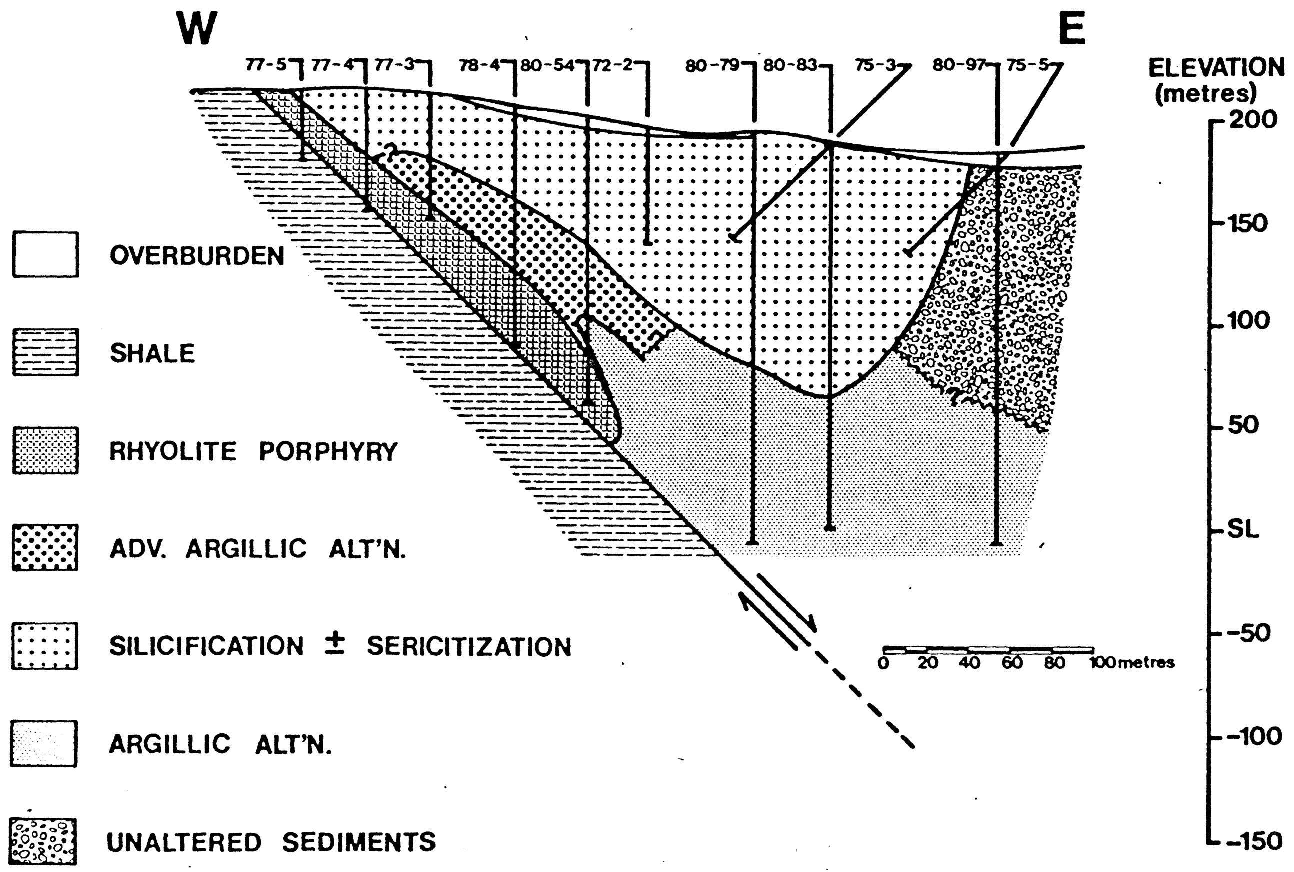

FIGURE 10. Cross section showing distribution of alteration minerals of the Cinola gold deposit. Argillic alteration indicates that the sediment is composed of more than 30% clays (illite and kaolinite). Grades in the argillic alteration zone are less than .4 g/tonne. Advanced argillic alteration signifies that silicification is superimposed on argillic alteration. The rhyolite porphyry and the shale within a few metres of the fault contact are silicified, sericitized and gold-bearing.

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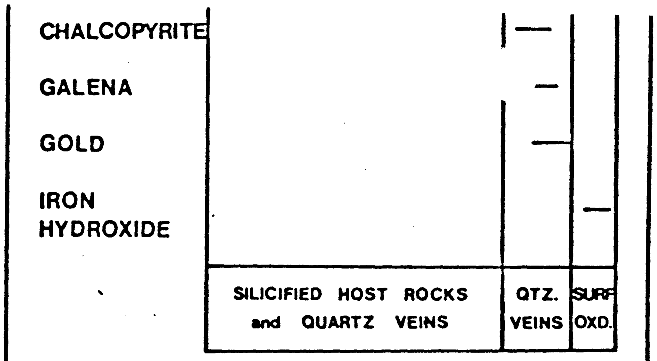

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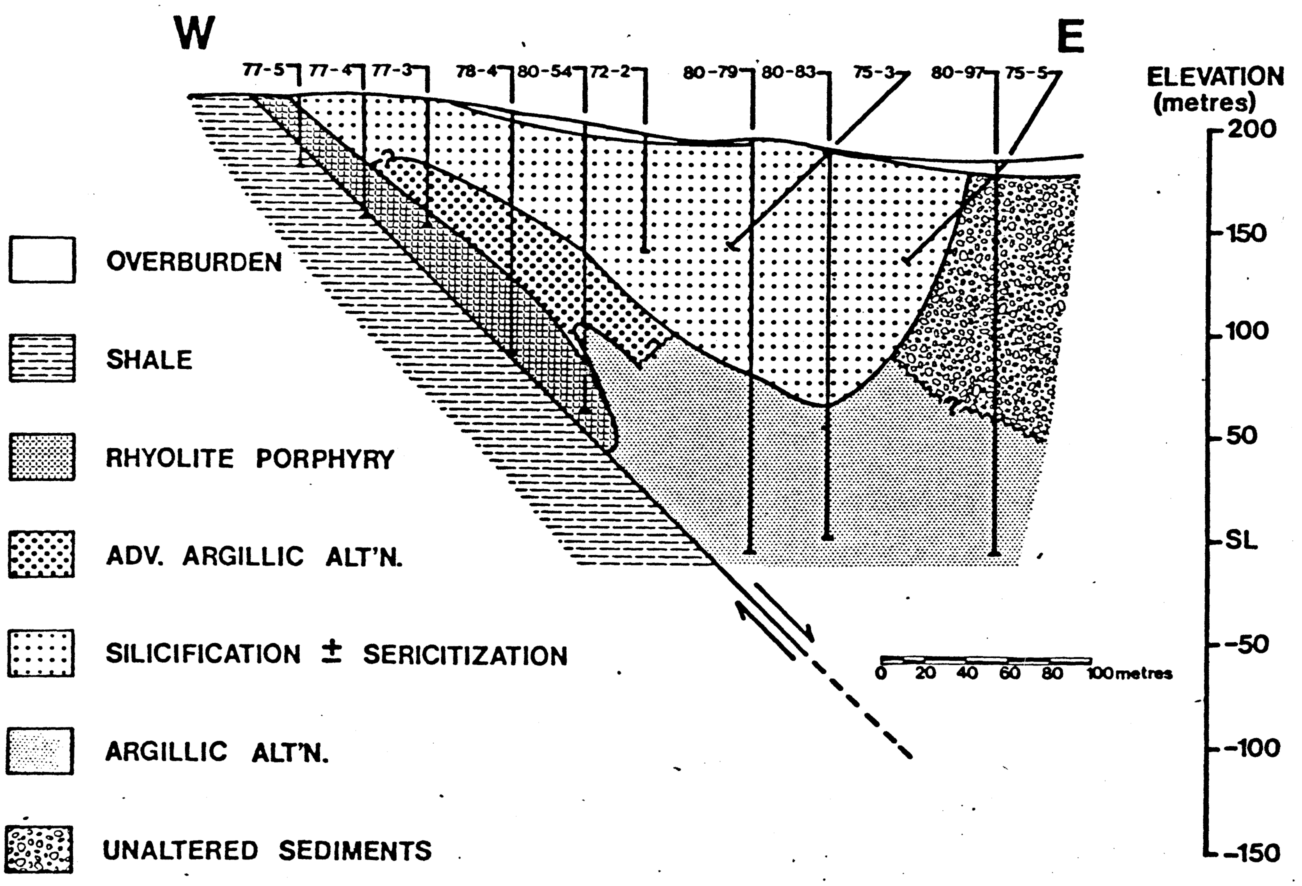

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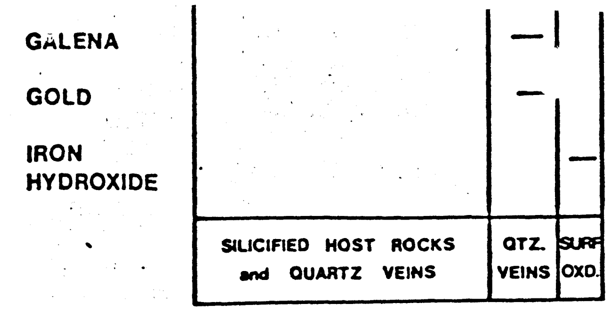

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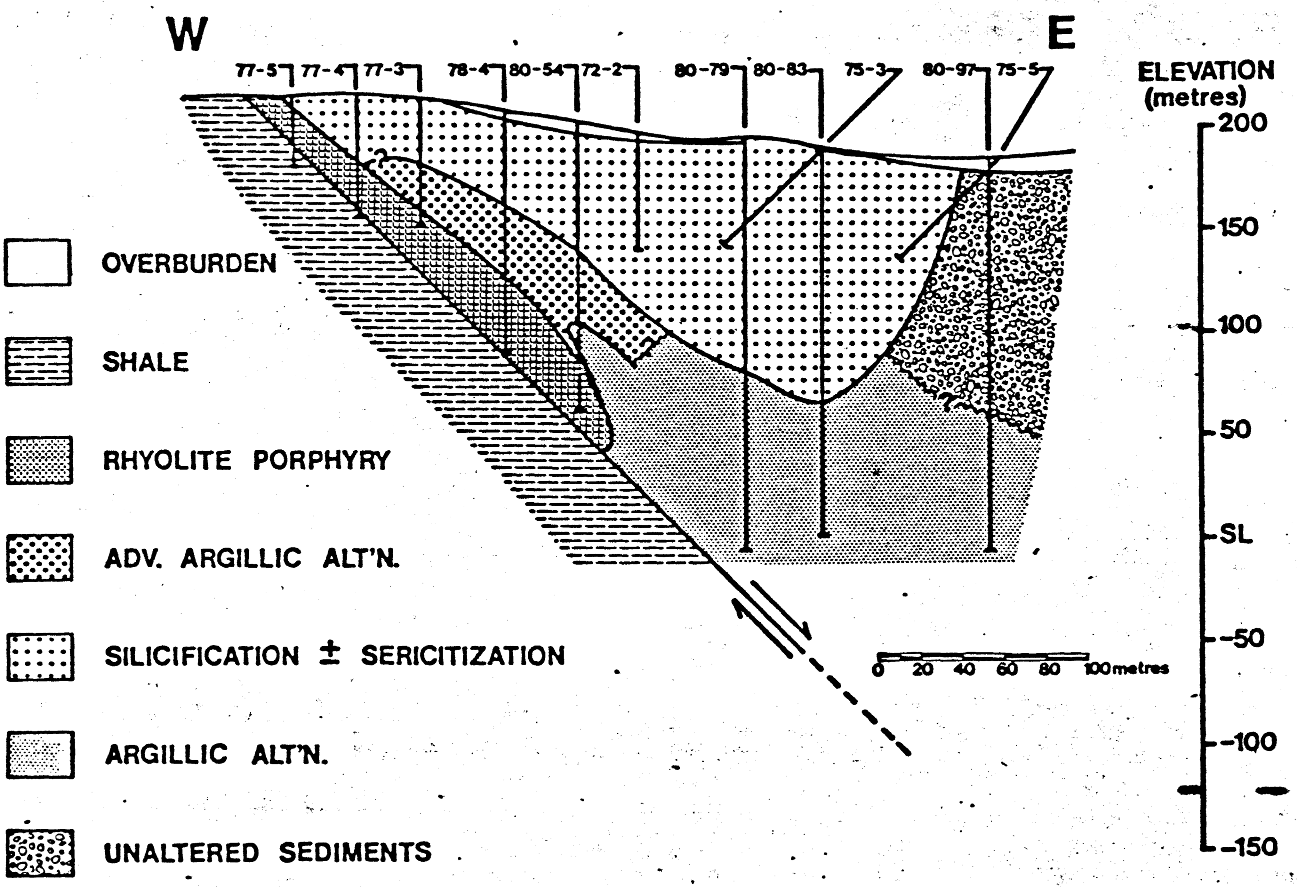

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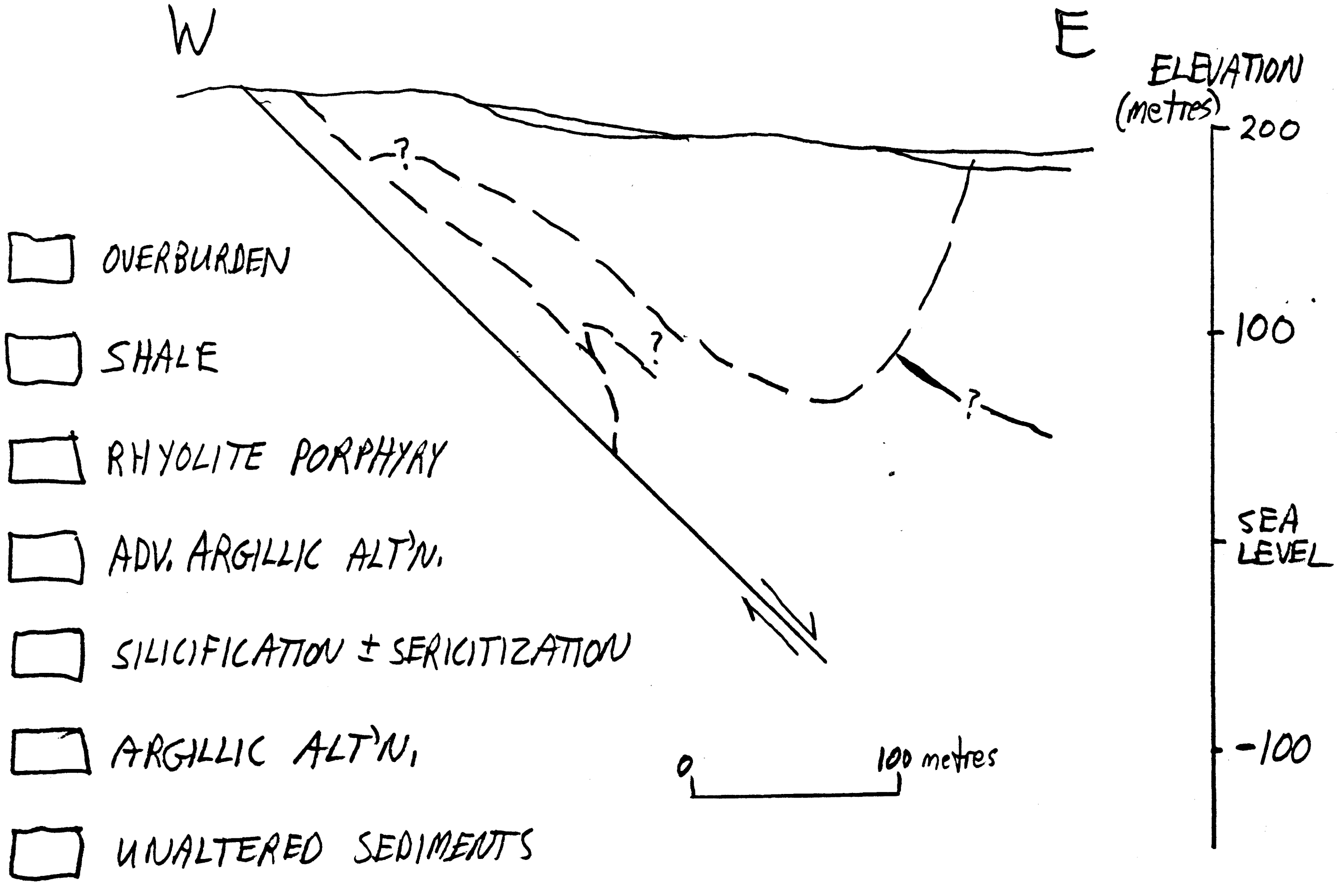
CINOLA - Alteration



silicified sedimentary rocks, and (4) pyrit quart ns and vugs, where it is disseminated or foi layers in cryptocrystalline quartz. Pyrite and marcasite occur individually or together. Individual grains range from .01 to 4 mm. Sulphide rims around pebbles in the conglomeratic host consist of disseminated pyrite grains (.001 to .05 mm). Marcasite commonly forms groups of small lath-shaped crystals and in places has the characteristic coxcomb form. Quartz, pyrite and marcasite have filled spaces in wood fragments. Graphite was observed rarely with the organic matter. In conglomerate, pyrite and marcasite are distributed through both the matrix and pebbles, indicating a deposition subsequent to the formation of the sediment. No definite correlation can be obtained between sulphide minerals and gold abundances (Fig. 8).

Inclusions of pyrrhotite, hematite and rarely magnetite and rutile were observed in pyrite grains. Five pyrite-marcasite grains were analyzed with the electron microprobe and in one grain there is 1.1 weight per cent arsenic. No arsenopyrite has been identified in the deposit and the high arsenic content can probably be attributed to solid solution of arsenic in either or both of pyrite and marcasite.

Rutile occurs as lath-shaped disseminated grains or aggregates. Grains are relatively small; around .02 mm. No other metallic minerals are in contact with rutile, apart from abundant pyrite. Rutile could have been a primary mineral, as it is not found in quartz veins.

Small amounts of pyrrhotite are inclusions from .01 to .03 mm in diameter in pyrite and marcasite. Hematite occurs as finely disseminated grains (<.005 mm) in quartz veins, giving a brownish red colour to the quartz. Trace amounts of hematite are inclusions (.01 to 0.1 mm) in pyrite or marcasite. Magnetite is very rare and as anhedral to euhedral grains from .02 to .3 mm in size included in pyrite and on one sample as an inclusion in cinnabar. Mercury minerals (cinnabar and tiemannite, HgSe) were observed in one quartz vein sample. Cinnabar is present as .01- to .05-mm disseminated patches in quartz. "Framboidal-like" pyrite is associated with cinnabar in several places.

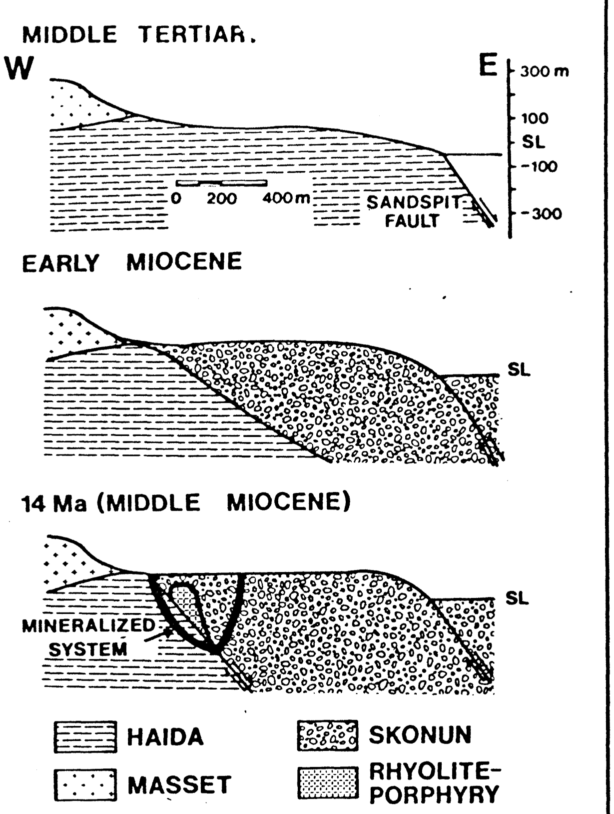


FIGURE 11. Schematic sequence in the development of the Cinola gold deposit. Erosion of the Haida shales during early Miocene is speculative. Emplacement of rhyolite porphyry is thought to have initiated thermal convection of pore water from the Skonun Formation and led to development of the mineralized system. See text for details.

Sphalerite is present only rarely, but is the most abundant sulphide mineral after pyrite and marcasite. It is encountered only in quartz veins generally in contact with pyrite, marcasite, chalcopyrite, galena and gold. Grains are generally irregular and their size varies from .01 to .02 mm. Sphalerite has been observed with inclusions of pyrite, chalcopyrite, galena and quartz, but many grains are clear of inclusions. Molecular per cent FeS in sphalerite obtained from seven electron microprobe analyses ranges from 11 to 25, indicating that sphalerite in the Cinola deposit is iron-rich. Chalcopyrite is less abundant than sphalerite and is closely associated with sphalerite either as inclusions or as simple composite or monominerallic sulphide grains. Grain size is comparable to sphalerite. All chalcopyrite grains are irregular. Thin veinlets of chalcopyrite cross-cut sphalerite grains. Rounded inclusions of native gold in chalcopyrite were observed in a few places. Galena is very rare and is in polymineralic aggregates with sphalerite, chalcopyrite and gold; grains are .01 to 0.1 mm in size. One veinlet of galena was seen cross-cutting a sphalerite grain. From 20 to 23 molecular per cent Se was recorded in three electron microprobe analyses of galena grains, so the mineral is actually in the galena-clausthalite solid solution series. Native gold occurs in three principal ways: (1) micron-gold in all the rock types that have undergone silicification (quartz veins included), (2) as monominerallic grains in quartz veins and (3) included in chalcopyrite in quartz veins. The third association is found only locally. The visible gold grains (>10 μm) are very irregular, with some as large as 500 μm. Inclusions of gold

TABLE 3. Analytical data and K/Ar model ages, Cinola gold deposit

Sample Identification	Rock Type	%K $\pm\sigma^b$	^{40}Ar (rad) / ^{40}Ar (total)	^{40}Ar (rad) (10^{-7}cm^3 STP/g)	Apparent Age (ma)^c
22065 M[a]	Silicified Rhyolite Porphyry	1.19 ±0.04	.532	6.522	14.0 ±0.6
7906 DO1	Silicified Rhyolite Porphyry	5.31 ±0.12	.440	29.22	14.1 ±0.6
7805 DO1	Silicified Shale (Haida Formation)	2.19 ±0.04	.505	14.85	17.4 ±0.5

a, Results provided courtesy of N.C. Carter and G.G. Richards
b, error is one standard deviation (laboratory measurement error)
c, constants used for model age calculations: $\lambda_\alpha = 0.581 \times 10^{-10}$ year^{-1}
$\lambda_\beta = 4.96 \times 10^{-10}$ year^{-1}
^{40}K/K $= 1.167 \times 10^{-4}$