

MINERALOGY AND SULFUR ISOTOPES OF
THE CUPRIFEROUS SULFIDE ORES AT THE
RAUL MINE, PERU

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The Raul Mine, situated within the Coastal Mesozoic Belt of Central Peru, consists of stratabound pyrite-chalcocopyrite ores in Upper Cretaceous andesitic volcanics and marine sedimentary rocks. The host rocks and ores are metamorphosed to the greenschist facies.

The 800 + m stratigraphic sequence of the area can be divided into four units, each characterized by a predominant lithology, type of mineralization, and range in $\delta^{34}\text{S}$ sulfide mineral values.

Unit	Host Rocks	Ore Mineralogy	Ore Occurrence	$\delta^{34}\text{S}(\%)$
Top	I Siltstone/ minor tuffs	cp + py \pm mt \pm po	thin layers to bedding	+6 \pm 5
	II Lavas	cp + py	disseminations	+10 \pm 2
	III Tufts/lavas	cp + py	anastomosing stringers	+15 \pm 5
Base	IV Graywacke/ minor tuffs	cp + py \pm mt	diss. in bands	+5 \pm 2

These characteristics suggest that the ores formed during the same period as the host rocks and that the mineralization was related to submarine exhalative activities.

There is a strong correlation between the $\delta^{34}\text{S}_{\text{H}_2\text{S}}$ values of the mineralizing hydrothermal solutions and the intensity of volcanism. During the period of intense volcanic activities (Units II & III), $\delta^{34}\text{S}_{\text{H}_2\text{S}}$ values were near the $\delta^{34}\text{S}$ value of seawater (+20‰). Decreasing $\delta^{34}\text{S}_{\text{H}_2\text{S}}$ values characterize periods of less active volcanism (Units I & IV). These observations suggest that the source of sulfur in the ores was largely seawater sulfate, which underwent various degrees of reduction during deep circulation through hot volcanic rocks.

GEOLOGIC SETTING OF THE THERMO KGRA
(KNOWN GEOTHERMAL RESOURCE AREA),
BEAVER COUNTY, UTAH

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Thermo KGRA contains some of the hottest springs in Utah. The springs are along two NNE-trending en echelon lines of travertine mounds that rise about 15 m above the valley floor 7 km north of the western Black Mountains. The adjacent Black Mountains consist mostly of andesitic mudflow breccia of the 26-22 m.y.-old Mount Dutton Formation overlain by dacitic cones, lava flows and volcanic mudflow breccia of the 21-19 m.y.-old Horse Valley Formation. A deeply eroded

dome of rhyolite forms two small hills, flanked by Bonnevillite shoreline gravels, 3 km east of the hot springs. The Thermo dome is part of an east-west belt of small, isolated rhyolite plugs and flows of Pleistocene to middle Miocene age that extend from east of Kingston, in the Sevier Plateau, west to the Staatz-Blawn Mountain mine area, in the Wah Wah Range. K-Ar dating of some rhyolites of this belt is underway. Mineralization, hydrothermal alteration, and geophysical lineaments occupy the same belt, which is probably part of the greater Marysvale-Pioche mineral belt. Most major faults in the northern Black Mountains and southern Mineral Mountains strike northeast, but east-west faults are locally common, even though they are rare elsewhere in this part of the Great Basin. The travertine mounds and most hot springs lie along faults of the northeast set, but faults of the east-west set cut Quaternary sediments immediately east of the hot springs. Thermo hot springs thus is at the site of intersecting, nearly orthogonal young faults. If the rhyolite dome is young, it may be a source of geothermal heat.

A RAPID ON-SITE ELECTRODE TECHNIQUE
FOR DETERMINING COPPER IN SOIL
FOR GEOCHEMICAL EXPLORATION

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The cupric ion selective electrode when employed with a suitable buffer system allows rapid, accurate determination of cold-HCl extractable copper in soils on an exploration site. Forty-three samples were collected along a 470-meter traverse over a known copper anomaly in northern Georgia. Determinations of cold-HCl extractable copper were made using the U.S.G.S. biquinoline field technique and using a cupric-ion selective electrode and buffer system. The results were compared to determinations obtained in the laboratory from a modified U.S.G.S. atomic absorption technique that employs hot HNO_3 digestion. The pattern of high copper values obtained from the electrode technique corresponded much more closely to the atomic absorption data than did the results obtained from the colorimeter technique. The values for copper obtained by the electrode were consistently closer to the atomic absorption analysis than were those from the colorimetric technique. These initial field tests indicate that the cupric ion selective can give useful, reliable, results when used to delineate a geochemical anomaly.