

Rajite, naturally occurring cupric pyrotellurite, a new mineral

S. A. WILLIAMS

Phelps Dodge Corporation, Douglas, AZ 85607 USA

SUMMARY. Rajite was found at Lone Pine, New Mexico, by R. A. Jenkins. It occurs as small (1.5 mm) crystals in rhyolite with mackayite, and may be a pseudomorph after teineite. Analysis gave CuO 18.4, 15.3, 18.0; TeO₂ 73.7, 79.8, 79.1; rem. (respectively) 7.9, 2.4, 2.3. Some CaO in samples 2 and 3: 2.5, 0.6%. This gives CuTe₂O₅, identical to the artificial compound prepared by Moret *et al.* (1969). Easily soluble in dilute acids; readily fusible.

Monoclinic $P2_1/c$ with $a = 6.866$ Å, $b = 9.314$, $c = 7.598$, $\beta = 109.1^\circ$. Strongest lines 3.064(10), 4.654(8), 3.348(8), 3.111(7), 2.744(7), 3.793(6B), 2.844(5), 2.796(5). With $Z = 4$, $\rho_{\text{calc}} = 5.77$ g/cm³.

Crystals Duesbury green (RHS-131D), $H = 4$, $\rho_{\text{meas}} = 5.75$ g/cm³. Pleochroic in greens $\gamma > \beta > \alpha$; $\alpha = 2.115$, $\beta = 2.135$, $\parallel [010]$, $\gamma = 2.26$, $\alpha: [001]$ 22° in obtuse β , $2V_\gamma = 40^\circ$.

THIS new mineral was found by R. A. Jenkins at Lone Pine, Catron County, New Mexico. Lone Pine is a small gold-mining camp that in the past produced gold from siliceous ores carrying pyrite and native tellurium (Ballmer, 1932). Rajite was discovered, not at the main workings, but at a nearby prospect. One portion of the waste dump of this prospect was littered with small pieces carrying the new mineral. They appear to have occurred in outcrop immediately beneath the waste pile. Several dozen pieces were found, comprising an estimated 3-4 g of material. Excepting this locality, no copper minerals of any kind were found elsewhere in the district.

The rajite occurs in a breccia of varied volcanic fragments, usually rhyolite vitrophyres, and the breccia has been intensely silicified, obliterating earlier textures in both the fragments and breccia matrix. The quartz is very fine grained, resembling chert, but coarser quartz occurs as drusy surfaces on open fractures. It is in these that rajite crystals occur, along with tiny mackayite grains. Usually rajite occurs as sprays of bladed to tabular crystals up to 1.5 mm in maximum dimension, but some bundles of more prismatic crystals comprise pseudomorphs suspected to have been crystalline teineite originally. Occasionally rajite is partly or wholly altered to an olive-green mineral, or the

same compound in the form of a pale yellowish powder.

Physical properties. Crystals are a bright Duesbury green (RHS-131D) with pale whitish-green streak and a resinous lustre, which is dull if alteration has begun. The Mohs hardness is 4 and crystals are brittle, tending to spall into cleavage plates (on {010}) under pressure. Examination in both long and short wavelength ultraviolet light produced no response. Even the very best single crystals found were totally unsuitable for optical goniometry. Such crystals, although free-standing, have strongly curved faces. However, in transmitted light they show uniform extinction and no sign of surface corrosion. The measured specific gravity (Berman Balance) is 5.75 ± 0.06 at 22°C .

Chemistry. Preliminary spectrographic analysis showed major Te, Cu, and minor Ca. Three samples were analysed by wet methods for Cu, Ca, Mg, Zn, Cl, and Te. No determinable quantities of Cl, Zn, and Mg were found; results for other constituents are presented in Table I. After dissolution, quartz was noted as an impurity but was not measured.

TABLE I. *Chemical analysis of rajite*

	1	2	3	4	5
CuO	18.4%	15.3%	18.0%	18.05%	19.95%
CaO	—	2.5	0.6	1.06	0.246
TeO ₂	73.7	79.8	79.1	80.96	80.05
Rem.	(7.9)	(2.4)	(2.3)		

1. On 1024 μg . 2. On 1480 μg . 3. On 547 μg .

4. Average analysis after correcting for rem. and corresponding oxide ratios., M. Duggan, analyst.

5. Theory for CuTe₂O₅.

The values in Table I given as 'rem.', calculated by difference, seem entirely reasonable. Further microchemical tests for sulphate, tellurate, and halogens were negative. The absence of Te⁶⁺ was also confirmed during the chemical analysis. Water was sought but not found by the Penfield method.

No weight loss was suffered, even upon ignition. Rajite fuses readily to a syrupy brown slag.

The mineral is readily soluble in cold 1:7 HNO₃ or 1:6 HCl.

TABLE II. *X-ray powder data for rajite Cr-K α_1 = 114-mm camera*

<i>I</i>	<i>d</i> _{meas}	<i>d</i> _{calc}	<i>hkl</i>	<i>I</i>	<i>d</i> _{meas}
3	6.485	6.488	100	$\frac{1}{2}$	2.481
8	4.654	4.657	020	1	2.438
6B	3.793	{ 3.783	120	1	2.383
		{ 3.814	111	1	2.351
3	3.648	3.646	12 $\bar{1}$	1	2.244
3	3.586	3.590	002	1	2.223
2	3.429	3.434	11 $\bar{2}$	2	2.164
8	3.348	3.349	012	3	2.091
1	3.243	3.244	200	2	2.054
2	3.199	3.197	21 $\bar{1}$	3	2.034
7	3.111	3.111	121	1	1.990
10	3.064	3.064	210	1	1.960
3	2.932	2.931	20 $\bar{2}$	1	1.908
5	2.844	{ 2.850	031	1	1.870
		{ 2.843	022	2	1.844
5	2.796	{ 2.796	21 $\bar{2}$	1	1.822
		{ 2.800	130	1	1.798
7	2.744	2.744	13 $\bar{1}$	2	1.763

+ 10 additional lines to $d = 1.499$, $I < 3$.

X-ray data. The powder data for rajite are presented in Table II, and they agree remarkably well with data published by Moret *et al.* (1969) for artificial CuTe₂O₅. Some of the lines not reported for the natural mineral were judged present but unmeasurably faint upon comparison with published data for CuTe₂O₅. The powder data were used to refine cell constants which had been previously found by rotation and Weissenberg photographs taken about $[b]$ and $[a]$. The resulting cell is monoclinic $P2_1/c$ with $a = 6.866$ Å, $b = 9.314$, $c = 7.598$, $\beta = 109.1^\circ$. If $Z = 4$, the calculated density is 5.77 g/cm³.

Optics. In thin section rajite could be confused with cesbronite. Since crystals are tabular on {010}, they give parallel extinction in any view normal to $[b]$, but elongation is thus either negative or positive. Bladed crystals exhibiting maximum birefringence, those viewed along $[b]$, show near-parallel extinction, for $[a]$ is the usual axis of elongation and $\gamma \wedge [100] = 3^\circ$. The c -axis makes an angle of $+22$ with α (in β), and $\beta = b[010]$. Pleochroism is not strong, in watery greens, with $\gamma > \beta > \alpha$. Both inclined dispersion and dispersion of the optic axes are negligible.

Indices of refraction were measured for NaD using S-Se melts: $\alpha = 2.115$, $\beta = 2.135$, $\gamma = 2.26$. The $2V_\gamma$ (measured) is 40° .

Discussion. Rajite and (probably) mackayite are the only pyrotellurites presently known. The existence of rajite may be favoured by the following conditions: rapid leaching of cations, acid waters, and relatively low (+) Eh. These conditions appear consistent with occurrence of rajite virtually at the surface in extremely rugged and dry country. Using the same argument, the likelihood of finding pyrotellurates in nature seems remote indeed.

Rajite is named for the initials of Robert Allen Jenkins, mineralogist/geologist for Phelps Dodge Corporation. He first found the new species and called it to my attention. The mineral name and data have been approved prior to publication by the Commission on New Minerals and Mineral Names, IMA.

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REFERENCES

- Ballmer (G. J.), 1932. *Am. Mineral.* **17**, 491-2.
 Moret (J.), Philippot (P.), and Maurin (M.), 1969. *C.R. Acad. Sci. Paris*, **269**, 123-5.

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