Canadian Mineralogist
Vol. 18, pp. 525-527 (1980)

PARAREALGAR, A NEW POLYMORPH OF AsS, FROM BRITISH COLUMBIA

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ABSTRACT

Pararealgar is a new polymorph of realgar, described from two localities in British Columbia: Mount Washington, Vancouver Island, and the Gray Rock property, Lillooet district. The mineral has also been found at other localities in North America and Europe. Pararealgar occurs as powdery to granular fine-grained aggregates that replace realgar. At the Gray Rock property, pararealgar is associated with stibnite and is intimately mixed with α–AsS. Associated minerals at Mount Washington are stibnite, tetrahedrite, arsenopyrite, duranusite, arsenic, arsenolite, α–AsS, sulfur, lepidocrocite and pyrite. Pararealgar is yellow to orange-yellow with a vitreous to resinous lustre, a bright yellow streak, Mohs hardness 1–1½, uneven fracture and no apparent cleavage. The measured density is 3.52(5) g/cm^3 and the calculated density is 3.499 g/cm^3. Indices of refraction are greater than 2.02. The mineral is anisotropic with a high birefringence, and internal reflections are gold to orange-red. Results of electron-microprobe analyses average As 69.81, S 29.97, total 99.78, corresponding to $As_{0.997}S$, calculated on S = 1. Pararealgar is monoclinic, *a* 9.929(4), *b* 9.691(6), *c* 8.503(3) Å, β 97.06(2)°, *Z* = 16, space group *Pc* or *P2/c*.

Keywords: pararealgar, new mineral description, arsenic sulfide, Mount Washington deposit, Gray Rock property, British Columbia.

SOMMAIRE

Le pararéalgar, nouvelle forme polymorphe du réalgar, a été découvert en deux endroits de la Colombie britannique (au mont Washington sur l'île de Vancouver et à la propriété Gray Rock dans le district de Lillooet) ainsi qu'ailleurs en Amérique du nord et en Europe. Il forme des agrégats finement grenus ou pulvérulents qui remplacent le réalgar. A Gray Rock, il est associé à la stibnite dans un mélange avec α–AsS; au mont Washington, stibnite, tétraédrite, arsénopyrite, duranusite, arsenic, arsénolite, α–AsS, soufre, lépidocrocite et pyrite lui sont associés. C'est un minéral de densité élevée (D_{mes} 3.52(5), D_{calc} 3.499), à l'éclat vitreux ou résineux, jaune à jaune-orange, jaune brillant dans la rayure, de dureté (Mohs) 1-1½, à cassure inégale et sans clivage, dont les indices de réfraction dépassent 2.02. Anisotrope, fortement biréfringent, il montre des réflexions internes or à rouge-orange. La microsonde électronique donne: As 69.81, S 29.97, total 99.78, d'où $As_{0.997}S$ (S=1). Le pararéalgar est monoclinique, *a* 9.929(4), *b* 9.691(6), *c* 8.503 (3) Å, β 97.06(2)°, *Z* = 16, groupe spatial *Pc* ou *P2/c*.

(Traduit par la Rédaction)

Mots-clés: pararéalgar, espèce minérale nouvelle, sulfur d'arsenic, gisement du mont Washington, propriété Gray Rock, Colombie britannique.

INTRODUCTION

A specimen used in a study of duranusite from the Mount Washington copper deposit, British Columbia (Roberts *et al.* 1979), was found to contain a mineral that occurs with realgar and resembles orpiment, but that had an unidentifiable X-ray powder-diffraction pattern. At the time, the amount of the unidentified phase available was insufficient for further study. Through the courtesy of Mr. S.F. Leaming of the Cordilleran Geology Division, Geological Survey of Canada, several more specimens, most containing variable amounts of the unidentified phase, were obtained from the same locality. Subsequent study has confirmed that this phase is a new mineral chemically identical to, but crystallographically distinct from, realgar.

Soon after the study was initiated, a search through reserve ore specimens at the Geological Survey of Canada showed that the same mineral, identified by X-ray powder diffraction, is also present in stibnite–realgar specimens donated by Mr. Leaming in 1965, from the Gray Rock property, British Columbia. At this second locality, realgar has altered to a mixture of α–AsS and the new mineral.

More recently, pararealgar has been identified by its X-ray powder-diffraction pattern in two realgar specimens from the National Mineral Collection, Geological Survey of Canada: specimen 16058 from the Golconda mine, Humboldt County, Nevada, U.S.A., and specimen 61578 from Siwash Creek, Kamloops district, British Columbia. In both specimens realgar is replaced by pararealgar, which had been misidentified as orpiment. Pararealgar has also been reported from the Lengenbach quarry, Switzerland (E. Niggli, pers. comm. 1980).

Several AsS polymorphs have been reported in the literature. Realgar, β–AsS, is common and widespread in many arsenic-bearing deposits. Clark (1970) identified the high-temperature polymorph, α–AsS, occurring naturally with realgar in the ore at Mina Alacran, Chile. The inversion of realgar to α–AsS was studied by Roland (1972), who published X-ray-diffraction data for synthetic α–AsS. Hall (1966) noted the presence of thin films of orange-yellow material coating museum specimens of realgar; previously considered to be a mixture of orpiment and arsenolite, this alteration material was synthesized and reported by Hall to be a low-temperature AsS polymorph, which he designated as γ–AsS.

The mineral described in this paper is yet another polymorph of arsenic monosulfide. This new mineral and the name pararealgar, in allusion to its chemical identity to realgar, were approved by the Commission on New Minerals and Mineral Names, I.M.A. Type specimens are preserved in the National Mineral Collection, Geological Survey of Canada, under catalogue numbers 61566 (Mount Washington) and 61567 (Gray Rock). Pararealgar from other localities was not used for the description of the new mineral.

Occurrence and Physical Properties

Pararealgar is described from two localities, the Mount Washington copper deposit, Comox district, Vancouver Island, British Columbia (49°46′ N latitude, 125°18′ W longitude), and the Gray Rock property, head of Truax Creek, Bridge River area, Lillooet district, British Columbia (50°48′ N, 122°42′ W). At both occurrences, pararealgar is a widespread but uncommon mineral that partly or wholly replaces realgar in stibnite-bearing quartz veins. Associated minerals at Mount Washington include realgar, stibnite, tetrahedrite, arsenopyrite, duranusite, arsenic, arsenolite, α–AsS, sulfur, lepidocrocite and pyrite. At the Gray Rock property, the associated minerals are stibnite, realgar and α–AsS. Here the realgar appears to have altered to a mixture of α–AsS and pararealgar, with the latter predominating.

Pararealgar occurs most commonly as powdery to granular aggregates that replaced realgar. In some cases the aggregates appear to be aligned in subparallel fashion to form polycrystalline crusts. Observed maximum grain-size does not exceed 0.02 mm in the rare massive material, with most grains being an order of magnitude smaller. No individual crystals or crystal faces were seen.

The mineral varies from bright yellow for the opaque powdery patches to orange-yellow and orange-brown for the more translucent crystalline material. Pararealgar has a vitreous to resinous lustre, a bright yellow streak and an estimated Mohs hardness of 1 to 1½. The mineral is brittle, showing an uneven fracture with no apparent cleavage, and is nonfluorescent under ultraviolet light. The measured density is 3.52(5) g/cm^3, determined by Berman balance on 1.82 mg of hand-separated material slightly contaminated by α–AsS. Calculated density is 3.499 g/cm^3. Pararealgar is insoluble in cold or hot water, concentrated HCl, H_2SO_4 or HNO_3, but reacts instantly in 40% KOH solution, forming a dark brown powdery precipitate.

Although the fine grain-size and polycrystalline nature of pararealgar aggregates did not permit accurate measurement of indices of refraction, all are greater than 2.02. For the same reasons, no conclusions can be made regarding pleochroism. In thin section the mineral is anisotropic with a high birefringence; in polished grain mounts, pararealgar is too highly transmitting to permit the determination of reflectance data. Internal reflections range from gold to orange-red, with gold and orange shades predominant.

Chemical Composition

Electron-microprobe analyses were performed on a MAC instrument equipped with a KEVEX energy-dispersive spectrometer. Accelerating voltage was 20 kV with a specimen current of 10 nA. Counting time was 100 seconds with a slightly defocused beam. With a natural realgar of known composition as a standard, two analyses of pararealgar from Mount Washington gave an average of As 69.81, S 29.97, total 99.78 wt. %, corresponding to $As_{0.997}S$ on the basis of S = 1. The ideal formula is AsS. No other element with an atomic number greater than 11 was detected in the energy-dispersive spectra. All analytical data were processed using a modified version of the EMPADR VII computer program (Rucklidge & Gasparrini 1969).

X-Ray Studies

X-ray single-crystal studies using the precession camera established that the symmetry of pararealgar is monoclinic; space group choices are *Pc* (7) or *P*2/*c* (13). Precession photographs were of poor quality; diffraction nodes were always streaked and diffuse, indicating the polycrystalline nature of the material.

TABLE 1. PARAREALGAR X-RAY POWDER DATA*

I/I_o	d_{meas}(Å)	d_{calc}(Å)	$hk\ell$
91	5.56	5.59	$\bar{1}11$
100	5.14	5.13	111
29	4.90	4.93	200
		4.85	020
78	3.75	3.75	$\bar{1}12$
27	3.44	3.47	112
		3.45	$\bar{2}20$
		3.42	$\bar{2}02$
50	3.299	3.298	$\bar{2}21$
3	3.184	3.182	022
33	3.105	3.105	221
51	3.025	3.026	$\bar{2}02$
30	2.905	2.921	$\bar{1}31$
		2.889	212
71	2.795	2.794	$\bar{2}22$
18	2.525	2.524	231
28	2.445	2.450	302
11	2.377	2.375	312
30	2.278	2.280	$\bar{2}23$
11	2.208	2.209	232
2	2.106	2.115	$\bar{1}33$
		2.101	042
6	2.069	2.071	$\bar{4}21$
22	2.030	2.032	$\bar{2}04$
16	1.976	1.975	313
11	1.862	1.862	$\bar{3}33$
6	1.744	1.748	$\bar{2}51$
10	1.710	1.710	$\bar{4}04$
11	1.682	1.682	530

*Sample from Mount Washington copper deposit, Comox District Vancouver Island, B.C. Debye-Scherrer 114.6mm powder film no. 61997, Ni-filtered CuKα radiation (λ 1.54178Å).

Intensities calculated from diffractometer trace. Pattern indexed with a 9.929, b 9.691, c 8.503Å, β 97.06°.

Nevertheless, the space-group extinction conditions could be deduced from zero- and upper-level photographs.

The refined unit-cell parameters, based on 16 diffraction lines between 3.746 and 1.682 Å for which unambiguous indexing was possible, are a 9.929(4), b 9.691(6), c 8.503(3) Å, β 97.06(2)°, V 812.03 Å^3, $Z = 16$. The indexing was facilitated by using the single-crystal photographs. A fully indexed powder pattern is presented in Table 1. It should be noted that the diffraction lines at 5.56, 3.025 and 2.905 Å may be greatly strengthened by preferred orientation, particularly if insufficient care is taken in grinding the sample.

Discussion

Pararealgar is a new structural modification of AsS. Comparison of its cell parameters and X-ray powder-diffraction pattern with those of other AsS polymorphs shows that pararealgar is structurally most closely related to the high-temperature α–AsS phase described by Clark (1970) and synthesized by Roland (1972). However, the phase relationships of pararealgar with α–AsS and realgar are far from clear. Pararealgar has not been synthesized, and its associations in nature further confuse the issue. At the Mount Washington locality, pararealgar occurs as a monomineralic alteration of realgar, apparently forming at very low temperatures and pressures, whereas at the Gray Rock property, realgar is partly replaced by a mixture of pararealgar and α–AsS approximately in a 9:1 ratio. If pararealgar does indeed form at close to atmospheric conditions, its intimate association with the high-temperature α–AsS phase in the Gray Rock assemblage cannot be explained at present by the authors.

Owing to the similar physical appearance and mode of occurrence of the two minerals, pararealgar has been misidentified as orpiment on several specimens at the Geological Survey of Canada. Further occurrences of pararealgar are likely to be found on re-examination of other realgar-bearing mineral assemblages. Pararealgar has a deeper, more orange color than orpiment, and X-ray powder-diffraction data allow reliable distinction of pararealgar from orpiment or any other AsS polymorph.

Acknowledgements

We are indebted to S.F. Leaming for generously providing most of the study material, to R.I. Thorpe for the examination of pararealgar in reflected light, and to R.N. Delabio and E.J. Murray for additional X-ray-diffraction work. G.Y. Chao, D.C. Harris, Associate Editor J.L. Jambor and two referrees contributed useful comments; the library at Brown University, Providence, Rhode Island, provided a copy of H.T. Hall's Ph.D. thesis.

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Received September 1980, revised manuscript accepted October 1980.