Arsendescloizite
a new mineral from Tsumeb

by **Paul Keller**
Institut für Mineralogie und Kristallchemie
Universität Stuttgart
Pfaffenwaldring 55
D-7000 Stuttgart, West Germany

and **Pete J. Dunn**
Department of Mineral Sciences
Smithsonian Institution
Washington, DC 20560

ABSTRACT

Arsendescloizite, $PbZn(OH)(AsO_4)$, was found as yellow tabular crystals intergrown in rose-like aggregates in tennantite ore from Tsumeb, Namibia, associated with willemite, chalcocite, mimetite, quartz and goethite.

Microprobe analysis gave **PbO** 52.3, **ZnO** 18.5, **FeO** 0.3, **As_2O_5** 26.5, **H_2O**(TGA) 2.9, sum 100.5 percent. Cell contents for As = 1 are: $Pb_{1.06}(Zn_{1.03}Fe_{0.02})_{\Sigma 1.05}H_{1.46}As_1O_{5.34}$ ideally $PbZn(OH)(AsO_4)$ for which $D_{calc.}$ = 6.57 g/cm³. Slightly soluble in hot HNO_3.

X-ray single crystal study showed it to be orthorhombic, $P2_12_12_1$, *a* 6.075(2), *b* 9.358(2), *c* 7.634(2) Å, Z = 4. The strongest lines in the X-ray powder diffraction pattern are: 3.23(10)(102), 2.88(10)(031,210), 2.60(8)(131), 1.559(8)(313,251,060), 4.23(6)(111), 2.09(6)(231), 1.656(6)(331,143,233)Å.

Crystals are tabular on {001}. Observed forms are {001}, {011}, {101} and {111}. Color pale yellow, transparent. Luster subadamantine, brilliant. Streak white. Hardness (Mohs) about 4. Biaxial negative, 2V about 30(5)°, dispersion $r > v$, with α 1.990(5), β 2.030(5), γ 2.035(5). Optical orientation: $X = b$, $Y = a$, and $Z = c$.

The name is for the chemical and crystallographic relations to descloizite, which is the vanadium analog of this mineral.

OCCURRENCE

Arsendescloizite was brought to our attention by Wolfgang Bartelke, who submitted for identification a pale yellow mineral looking like adamite or tsumcorite. Surprisingly, the powder diffraction pattern was nearly identical with that of descloizite. However, there was no trace of vanadium, so we became convinced that we were dealing with a new species, probably the arsenic analog of descloizite.

Arsendescloizite was found as a secondary mineral on a matrix of copper ore consisting mainly of tennantite, $(Cu,Fe)_{12}As_4S_{13}$, and chalcocite, Cu_2S. The new mineral is associated with willemite, Zn_2SiO_4, in water-clear prismatic crystals, with euhedral chalcocite crystals, corroded mimetite $[Pb_5Cl(AsO_4)_3]$, quartz, and goethite [∞-FeOOH], in order of abundance. The observed sequence of deposition, from the oldest to the youngest, is:

chalcocite → quartz → mimetite → arsendescloizite → goethite → willemite

Unfortunately, we have no information about which part of the mine our specimens came from.

PHYSICAL and OPTICAL PROPERTIES

Arsendescloizite crystals are tabular on {001}, up to 0.1 x 0.4 x 0.5 mm in size and intergrown as rose-like aggregates (Fig. 1). Observed forms are {001}, {011}, {101}, and {111} (Fig. 2). The new mineral is pale yellow with a brilliant subadamantine luster. The streak is white and the hardness (Mohs) is about 4. No cleavage was observed.

Arsendescloizite is optically biaxial negative, 2V about 30(5)°, dispersion $r > v$. The indices of refraction are α 1.990(5), β 2.030(5), and γ 2.035(5), with the optical orientation $X = b$, $Y = a$, and $Z = c$. Calculation of the Gladstone-Dale relationship using the constants of Mandarino (1976) and the calculated density yields a value

Figure 1. **Arsendescloizite: tabular crystals intergrown in rose-like aggregates. Size: 3 mm wide. Collection of W. Bartelke; photo by J. Weber.**

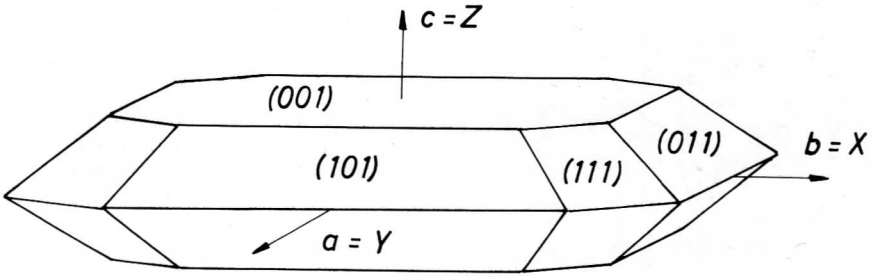


Figure 2. **Arsendescloizite: idealized drawing with faces and optical orientation.**

of K_C = 0.152, in good agreement with the value calculated for physical properties, K_P = 0.155.

X-RAY DIFFRACTION STUDY

A small fragment of a euhedral crystal was examined by Weissenberg and precession techniques and finally measured with an automatic four-circle diffractometer.

Arsendescloizite is orthorhombic; systematic absences show the space group to be $P2_12_12_1$. The unit cell parameters are a = 6.075(2), b = 9.358(2), and c = 7.634(2) Å. For Z = 4 and the ideal formula, the calculated density is $D_{calc.}$ = 6.57 g/cm³. A powder diffraction pattern (Table 1) was obtained using a 114.6-mm-diameter Debye-Scherrer camera and Fe$K\alpha$ X-radiation without standards. The calculated d values and the indices are derived from four-circle diffractometer data. The intensities I/I_o were estimated visually.

Table 1. **Indexed powder pattern for arsendescloizite, PbZn(OH)(As⅞₄), Fe-$K\alpha$ radiation, camera diameter 114.6 mm. Intensity I/I_o is estimated.**

$d_{obs.}$ (Å)	I/I_o	$d_{calc.}$ (Å)	hkl
5.09	4	5.088	110
4.67	5	4.680	020
4.23	6	4.238	111
3.98	1	3.990	021
3.54	2	3.535	012
3.33	2	3.336	121
3.23	10	3.231	102
3.04	3	3.037	200
2.88	10	2.889, 2.887	210, 031
2.70	4	2.703	211
2.66	5	2.659	122
2.60	8	2.608	131
2.55	1	2.549	220
2.46	2	2.456	013
2.42	2	2.417, 2.415	221, 032
2.30	4	2.303	212
2.24	5	2.237, 2.236	041, 023
2.10	1	2.099, 2.098	141, 123
2.09	6	2.092	231
1.970	1	1.972	033
1.911	2	1.909	400
1.877	5	1.876	133
1.850	2	1.854	240
1.788	5	1.789, 1.789, 1.787	150, 302, 114
1.764	3	1.767	024
1.720	4	1.723	043
1.678	1	1.681	052
1.668	1	1.671, 1.667	322, 242
1.656	6	1.658, 1.657, 1.654	331, 143, 233
1.618	4	1.620, 1.616	152, 204
1.559	8	1.562, 1.560, 1.560	313, 060, 251

CHEMICAL ANALYSIS

Arsendescloizite was chemically analyzed using an ARL-SEMQ electron microprobe with an operating voltange of 15 kV and a beam current of 0.15 μA. The results were corrected for background, backscatter, fluorescence and absorption using the MAGIC-4 computer program. The standards used were: synthetic olivenite for As, synthetic ZnO for Zn, synthetic PbO for Pb, and analyzed hornblende for Fe. The new mineral was checked for the presence of elements with atomic number greater than 9 by electron microprobe wavelength-dispersive scan but none were found except those reported in Table 2.

Table 2. **Electron microprobe analysis of arsendescloizite, PbZn(OH)(AsO_4), H_2O by TGA, in weight percent.**

	Analytical	No. of atoms		Theoretical	No. of atoms	
FeO	0.3	Fe	0.02	–		
ZnO	18.5	Zn	1.03	18.99	Zn	1.00
PbO	52.3	Pb	1.06	52.09	Pb	1.00
As_2O_5	26.5	As	1.00	26.82	As	1.00
H_2O	2.9	H	1.46	2.10	H	1.00
		O	5.34		O	5.00
Total	100.5			100.00		

The water content was determined with a thermobalance using a 6.8 mg sample of arsendescloizite. There is a 2.9 weight percent water loss at a mean temperature of 530° C. The heating rate was 10° C/minute.

Arsendescloizite is slightly soluble in hot HNO_3.

The empirical formula was calculated on the basis of As = 1 because the water determination may not be of high accuracy, in view of the very small sample weight. The result is:

$$Pb_{1.06}(Zn_{1.03}Fe_{0.02})_{\Sigma 1.05}H_{1.46}As_1I_{5.34}$$

and idealized: **PbZn(OH)(AsO_4)**.

DISCUSSION

According to chemical composition alone, the new mineral could be the zinc analog of duftite, the lead analog of austinite, or the arsenic analog of descloizite. However, since the powder diffraction pattern of the new mineral is most similar to that of descloizite, it is named arsendescloizite. Also, there have been reported arsenic-containing descloizites from several localities (Palache, Berman and Frondel, 1951) with a maximum content of As_2O_5 7.13 weight percent (Bannister, 1933). Such arsenic-containing varieties of descloizite were named "araeoxene" by Von Kobell in 1850 (Strunz, 1970). Arsendescloizite is the pure end member of a possible solid solution series with descloizite. Surprisingly, the analyzed arsendescloizite contains no vanadium, copper or calcium.

NAME and TYPE SPECIMENS

The name is for the chemical and crystallographic relationship to descloizite, which is the vanadium analog of this mineral.

The Commission on New Minerals and Mineral Names, I.M.A., has approved the new mineral and its name prior to publication. Type material will be deposited in the Institut für Mineralogie und Kristallchemie, Universität Stuttgart, D-7000 Stuttgart 80, Federal Republic of Germany, and in The Smithsonian Institution, Washington, D.C. 20560.

ACKNOWLEDGMENTS

We thank Wolfgang Bartelke, Mainz, for the generous loan of specimens, H. Hess, Stuttgart, for the diffractometer measurement, J. Weber, Mamaroneck, for the photomicrograph.

REFERENCES

BANNISTER, F. A. (1933) The identity of mottramite and psittacinite with cupriferous descloizite. *Mineralogical Magazine,* **23**, 376.

MANDARINO, J. A. (1976) The Gladstone-Dale relationship, Part I: Derivation of new constants. *Canadian Mineralogist,* **14**, 498.

PALACHE, C., BERMAN, H., and FRONDEL, C. (1951) *The System of Mineralogy,* 7th Ed., Vol. II, 811. John Wiley and Sons, New York.

STRUNZ, H. (1970) *Mineralogische Tabellen,* 323, Akademische Verlagsgesellschaft, Leipzig.

w:w:re:ar

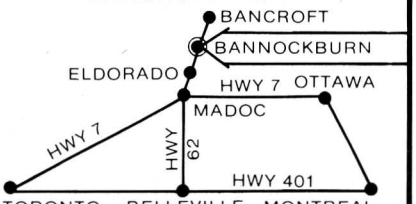
LIDSTROMS
Box 518
Prineville, Ore. 97754
(503-447-7104)

Now
Wholesale
Exclusively
by appointment only

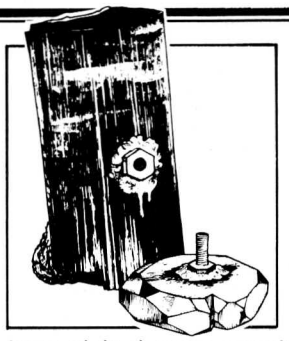
Upper Canada Minerals
Specializing in Canadian Minerals
Patrick and Barbara Collins
Suite 102B, 150 Metcalfe St.
Ottawa, Ontario, Canada K2P 1P1
Tel: (613) 238-5497
(open Tuesday-Saturday 9:30 to 5:30)

TOPAZ-MINERAL EXPLORATION
DEPT. M
1605 HILLCREST
GRAND HAVEN, MI. 49417
WORLD-WIDE MINERALS
PSEUDOMORPHS
LIST

BANCROFT AREA



FINE MINERALS
HAWTHORNEDEN
RR #1, Eldorado
Ontario, Canada K0K 1Y0
(613-473-4325) Frank & Wendy Melanson



JEWEL TUNNEL IMPORTS
WHOLESALE ONLY

Each year I spend two to four months traveling the world in search of specimens for my dealers. Usually I buy them directly in the various mining districts. Few dealers have visited more countries or do business in as many as I do.

Hmm . . ., that does make me better off than them, doesn't it?? Perhaps my insecurity stems from my already legendary pile of empty Kaopectate bottles. Anyway, BUY! BUY!! BUY!!! I've got a lot of stuff!

See me or my toadies at the following shows:

DETROIT

* RARE FACETED GEMS FOR THE ???
* NICE BOXES TO PUT THEM IN
* AGATE MARBLES & EGGS FOR THOSE FEW DEGENERATES AMONG YOU
* A HARD WAY TO GO FOR DEADBEATS
* LIST ON REQUEST
* ENJOY!

ROCK H. CURRIER
1212 S. MAYFLOWER AVE.
ARCADIA, CALIFORNIA 91006 (near L.A.)
213-357-6338

HANSEN MINERALS
Dr. Gary R. Hansen
1223 Port Royal, St. Louis, Missouri 63141

Mineralogical specimens
for museums, private collectors
Reference sets
Investment Gemstones

Azurite, Touissite mine, Morocco. New price list available

Office — 314-569-0842
Residence — 314-432-2882