NOTES AND NEWS

DISCUSSION OF "THE FORMULA OF JORDANITE"

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Richmond[1] has suggested alternative new formulae for jordanite, calculations from which do not satisfactorily fit the observed density. In recent correspondence he has stated his density value of 6.32 is probably too low, because of inaccuracies in his method. At his suggestion and my request Dr. Harry Berman of Harvard University kindly determined the density of one of the crystals (weight 11.83 mg.) used by Professor Palache, and obtained the value 6.38 ± 0.01. Since Jackson determined the density of but one of his samples analyzed (Table 1, column 1), and since that was the one richer in lead, it may be assumed tentatively that the material on which he ran his other analysis had a density of about 6.38 (column 2). Columns 3 and 4 show the resulting calculated cell contents. If M_0 be taken at an intermediate value, calculations on the analysis of column 1 lead to the results shown in column 5 with 44 atomic positions in the unit cell. These can most reasonably be distributed as $Pb_{14}As_7S_{23}$. The composition calculated from this formula is shown in column 6. It does not fit the analyses as well as does Richmond's preferred formula (column 7), but it probably lies within the

TABLE 1

	1	2	3	4	5	6	7
Pb	69.22	69.03	13.75	13.64	13.7	69.69	69.20
As	12.42	12.50	6.82	6.83	6.8	12.60	12.46
S	18.36	18.47	23.57	23.59	23.5	17.71	18.34
Totals	100.00	100.00	44.14	44.06	44.0	100.00	100.00
D	6.413	$6.38 \pm .01$			6.39	6.49	6.54
M_0	4115	4094			4102	4163	4195

1. Analysis of jordanite from Binnenthal by Jackson, recalculated from 99.12 to 100%. V_0 value assumed as 1058.
2. Analysis of jordanite from Binnenthal by Jackson, recalculated from 99.71 to 100%. V_0 value assumed as 1058. Density value given is that determined by Berman.
3. Atomic content of unit cell from #1.
4. Atomic content of unit cell from #2.
5. Atomic content of unit cell from #1 assuming $M_0 = 4102$.
6. Calculated composition of $Pb_{14}As_7S_{23}$ (Fisher).
7. Calculated composition of $Pb_{14}As_7S_{24}$ (Richmond).

[1] Richmond, W. E., this journal, **23,** 830 (1938). In Table 3 the density for $Pb_4As_2S_$ should be 6.56, not 5.63.

limits of analytical errors. Consideration of observed versus calculated compositions for $Pb_{14}As_7S_{23}$ indicates that 2.1% of the S occupies some of both the Pb and As positions of the Binnenthal jordanite; this is not unreasonable, since the S atoms are smaller than the others. Making these assumptions, the calculated density of jordanite (column 5) agrees well with the observed values. Since the molecular weight of $Pb_{14}As_7S_{24}$ is 4195, whether computed just from a table of atomic weights or from Jackson's analysis (column 1) taking M_0 at a value such that there are just 45 atoms in the unit cell, there is no possibility of assuming replacements in Richmond's formula that would make the calculated density of 6.54 check the observed value.

The formula $Pb_{13}As_7S_{23}$ (Richmond's second choice) is definitely unsatisfactory, not only because of the discrepancies in molecular weight and density, but also because it would seem to demand that part (3.0%) of the large Pb atoms occupy the positions of the distinctly (say 18%) smaller As; moreover it does not very satisfactorily represent the chemical analysis. This raises the question of whether jordanite and meneghinite[2] can be dimorphous. The writer agrees with Richmond that this cannot be answered on the basis of published data; new experimental work is required to substantiate or disprove the suggested new formulae of both minerals. The available data on meneghinite are too unsatisfactory to yield to the sort of analysis here applied to jordanite.

Summary. The old formula of jordanite ($Pb_4As_2S_7$) is equivalent to $Pb_{14}As_7S_{24\frac{1}{2}}$. Richmond proposed that the S value be decreased to 24. Because of the reasons given above, the writer suggests that 23 S more probably represents the ideal crystal.

[2] *Ibid.*, p. 827.