American Mineralogist
Vol. 57, pp. 269–272 (1972)

MINERALOGICAL NOTES

NEW DATA ON GRIPHITE[1]

DONALD R. PEACOR AND WM. B. SIMMONS JR., *Department of Geology and Mineralogy, The University of Michigan, Ann Arbor, Michigan 48104*

ABSTRACT

Griphite from the Sitting Bull and Riverton Lode pegmatites has been reexamined. The poor quality of X-ray diffraction photographs usually obtained for griphite is shown to be caused by metamictization owing to the presence of U. The space group is $P2_1/a\bar{3}$. This is consistent with McConnell's (1942) suggestion that griphite is isotypic with garnet.

Griphite is a pegmatitic phosphate mineral which has been described as occurring only in four localities: Mt. Ida, Australia (Jaffe, 1946); Riverton Lode, Harney City (Headden, 1891); Sitting Bull pegmatite, Custer, South Dakota (Roberts and Rapp, 1965); Turkestan, U.S.S.R. (Ginzburg, 1952). McConnell (1942) obtained Debye-Scherrer photographs of material from the Riverton Lode and showed that they were similar to those of garnets. The patterns indicated that griphite is cubic, with $a = 12.26$ Å. McConnell further showed that the unit cell contents, $8[(Na, Al, Ca, Fe)_3Mn_2(PO_4)_{2.5}(OH)_2]$ are consistent with griphite being isotypic with garnet. The X-ray diffraction results were ambiguous however, in part since several reflections are not permitted by the garnet space group, *Ia3d*. There was also some question regarding the presence of possible impurities such as hausmannite. Powder photographs obtained by other investigators generally show at most only a few weak diffuse peaks. For example, Jaffe reports that the Mt. Ida material gives no peaks, except after heating to 300–500°C. He also determined that these specimens were radioactive.

In order to better define the nature of griphite, particularly with respect to symmetry, we have examined material from two South Dakota localities. Mr. Willard Roberts and Dr. David Garske recently directed us to the Sitting Bull pegmatite, where previously unstudied griphite occurs in masses up to six feet in diameter. This

[1] Contribution No. 302, from the Mineralogical Laboratory, Department of Geology and Mineralogy, The University of Michigan, Ann Arbor, Michigan 48104.

TABLE 1. X-RAY DIFFRACTION POWDER DATA FOR GRIPHITE FROM THE RIVERTON LODE

hkl	d(calc)Å	heated[1] d(obs)	I	unheated[2] d(obs)	I
311	3.69	3.68	1		
222	3.53	3.51	1		
230	3.39	3.37	15	3.32	20
400	3.06	3.04	30	3.07	25
410,322	2.96	2.95	30	2.98	30
411	2.88	2.86	5		
420	2.73	2.73	100	2.75	100
421	2.67	2.66	5		
422	2.495	2.487	30		
511,333	2.352	2.347	10		
250,432	2.270	2.265	15		
440	2.161	2.148	1		
441,522	2.128	2.123	1		
600,442	2.037	2.030	5		
610	2.009	2.006	15	2.00	30
611,532	1.983	1.975	1		
630	1.822	1.818	10		
444	1.764	1.765	10		
632	1.746	1.741	1		
640	1.695	1.692	15		
721,552,633	1.663	1.659	1		
642	1.633	1.630	20		
731,553	1.591	1.589	5		
650,643	1.565	1.564	5		
651,732	1.552	1.549	5		
800	1.528	1.528	5		
821,742	1.471	1.468	10		
660,822	1.440	1.441	1		
831,743	1.421	1.419	1		
832,654	1.393	1.392	2		
840	1.367	1.366	2		

[1]Powder heated 22 hours in vacuum at 530°C. FeKα; 114.6 mm diameter camera; intensities visually estimated.

[2]Powder diffractometer, unheated sample. CuKα.

material is moderately radioactive and displays the glassy and resinous appearance typical of metamict species. Powder diffractometer patterns of these specimens generally showed only a single broad peak with $d = 2.75$ Å. Riverton Lode material obtained from the University of Michigan mineralogical collections gave only four other reflections (Table 1). In order to determine the distribution of radioactive elements, we obtained autoradiographs of both Sitting Bull and Riverton Lode griphite. These gave uniform exposures over the whole specimen, indicating that the radioactive elements are essential constitutents of the griphite, rather than being present in a second phase. Qualitative X-ray fluorescence scans show the presence of a small amount of U. Previously published wet chemical analyses gave satisfactory total weight percents, but did not yield U. It must, therefore, be present in only very small amounts.

Precession and Weissenberg photographs were obtained for both Riverton Lode and Sitting Bull material. The specimens from the Riverton Lode were first heated in air. Results from both are the same, and show that griphite is cubic with $a = 12.20$ Å, as previously proposed by McConnell on the basis of Debye–Scherrer photographs. However extinctions are consistent only with space group $P2_1/a\bar{3}$ (T_h^6). Powdered material from the Riverton Lode was heated in vacuum for 22 hours at 530°C, and used to obtain a FeKα Debye–Scherrer photograph. Data obtained from this photograph is given in Table 1. As expected for a recrystallized metamict mineral, the number and resolution of lines is greatly improved over those of unheated specimens. The indexing of the lines is also consistent with space group $P2_1/a\bar{3}$. Least-squares refinement of the Debye–Scherrer data, using a single error function proportional to $\cos^2 \theta$, yielded the value $a = 12.222 \pm 0.004$ Å.

The space group $P2_1/a\bar{3}$, although different than that of garnet

TABLE 2. EQUIVALENCE OF THE EQUIPOINTS FOR THE GARNET ($R_3''M_2'''(SiO_4)_3$) STRUCTURE ($Ia3d$) WITH THOSE OF GRIPHITE ($P2_1/a\bar{3}$)

Atom	$Ia3d$ equipoints		$P2_1/a\bar{3}$ equipoints		x	y	z
R''	24c	222	24d	1	∿ 1/8	∿ 0	∿ 1/4
M'''	16a	$\bar{3}$	4a	$\bar{3}$	0	0	0
			4b	$\bar{3}$	1/2	1/2	1/2
			8c	$\bar{3}$	∿ 1/4	∿ 1/4	∿ 1/4
P	24d	$\bar{4}$	24d	1	∿ 3/8	∿ 0	∿ 1/4
O	96h	1	24d	1	∿ .04	∿ .04	∿ .65
			24d	1	∿ .29	∿ .90	∿ .29
			24d	1	∿ .54	∿ .54	∿ .15
			24d	1	∿ .79	∿ .40	∿ .79

(*Ia3d*), is nevertheless consistent with a garnet-type structure. The equivalence in atom positions is shown in Table 2. The precise nature of the crystal structure and formula of griphite can be determined only with additional methods of analysis, however. A crystal-structure analysis is now being undertaken to resolve the ambiguities remaining in the nature of the crystal structure and formula.

References

Ginzburg, A. J, (1952) Griphite in pegmatites of the Turkestan Range. *Dokl. Akad. Nauk S.S.S.R.* **84**, 1045–1048.

Headden, W. P. (1891) A new phosphate from the Black Hills of South Dakota. *Amer. J. Sci.* **41**, 415–417.

Jaffe, H. W. (1946) A new occurrence of griphite. *Amer. Mineral.* **31**, 404–461.

McConnell, D. (1942) Griphite, a hydrophosphate garnetoid. *Amer. Mineral.* **27**, 452–461.

Roberts, W. L., and G. Rapp (1965). *Mineralogy of the Black Hills.* Espe Printing Co., Rapid City, South Dakota.

American Mineralogist
Vol. 57, pp. 272–276 (1972)

BERYL FROM THE OXFORD MINE, TROUP COUNTY, GEORGIA

Dennis Radcliffe,[1] *Department of Geology, University of Georgia, Athens, Georgia*

AND

Arthur C. Bailey, Jr., *Department of Geology, The University of Tennessee, Knoxville, Tennessee*

Abstract

A survey of the literature indicates wide variation in chemistry and associated cell constants of common beryl. Computer refinement of selected crystals shows that the variation in cell constants are due at least in part to calculations based on non-unique X-ray reflections. Eighteen reflections of common beryl can be uniquely indexed. Least squares computations on the eighteen peaks leads to only slightly differing cell constants. These average $a = 9.216$ Å, $c = 9.197$ Å.

Beryl from the Oxford Mine shows distinct variations in crystal morphology including aquamarine exhibiting fractures filled with a second generation of beryl

[1] Present Address: C–E Minerals, 4020 Lexington Road, Athens, Ga. 30601.