X-ray study of woodruffite from Sandur ore deposits, Mysore State, India.

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Summary. The mineral woodruffite, which has so far been reported from only one locality, Sterling Hill, New Jersey, has been found to occur in the Sandur area. Its physical and chemical characters are given. Indexing of the X-ray powder photograph shows that the mineral is most probably tetragonal with a 8·42, c 9·28 Å.

FRONDEL (1953) gave the name woodruffite to the manganese hydroxide mineral from Sterling Hill, New Jersey, containing nearly 14 % ZnO. So far this mineral has not been reported from any other locality. X-ray study of the manganese ores from the Sandur ore deposits (Naganna, 1962*a*) has shown the presence of woodruffite in this area along with such minerals as cryptomelane, lithiophorite, pyrolusite, ramsdellite, jacobsite, manganite, braunite, psilomelane, hydrohausmannite, and vredenburgite (an intergrowth of jacobsite and hausmannite).

The mineral woodruffite constitutes the massive type of ore associated with pyrolusite and cryptomelane; the mineral has a dark brownish-grey colour in hand specimen and gives a brown streak. The sp. gr. is 4·01 and the microhardness is $5\,\mu$ = 1707 kg/mm^2, $10\,\mu$ = 1020 kg/mm^2, $15\,\mu$ = 744 kg/mm^2 (Naganna, 1962*b*). The polished mineral under polarized light looks uniformly fine grained with light grey to yellowish grey colour. Anisotropism is very clear and a very feeble bireflexis is noticed. The reflecting power is about 26 % in green light in air.

Though X-ray powder data for the mineral were reported both by Frondel (1953) and by Ramdohr (1956), the lines were not indexed. The X-ray powder lines for the mineral from Sandur area have been indexed

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and are given in table I; woodruffite is most probably tetragonal with cell dimensions a 8·42, c 9·28 Å, and axial ratio c/a 1·103.

Chemical analysis of the mineral (Naganna, 1962*c*) gave: MnO_2 68·29, MnO 8·46, ZnO 9·42, BaO 0·62, MgO 0·48, CaO none, K_2O 0·08, Na_2O 0·04, Fe_2O_3 0·89, Al_2O_3 0·96, SiO_2 1·28, H_2O^- 0·83, H_2O^+ 8·48; sum 99·84 %.

TABLE I. X-ray powder data for woodruffite. Fe–$K\alpha$ radiation, camera diameter 114·6 mm; intensities estimated visually. a 8·42, c 9·28 Å.

hkl	$d_{calc.}$	$d_{obs.}$	*I.*	*hkl*	$d_{calc.}$	$d_{obs.}$	*I.*
001	9·29 Å	9·34 Å	5	500	1·684 Å	1·69 Å	4
*		7·00	1B	333	1·671	1·68	2
*		4·86	½	423	1·609	1·61	3
002	4·64	4·66	10	225	1·575	1·57	1
012	4·07	4·08	3	315	1·523	1·52	2
112	3·66	3·64	3	522	1·482	1·48	5
003	3·09	3·08	2B	442	1·418	1·42	3
130	2·66	2·66	6	523	1·396	1·40	3
023	2·49	2·48	6	443	1·342	1·34	3
032	2·40	2·39	3	541	1·303	1·30	3
004	2·33	2·32	2	416	1·220	1·22	1
114	2·16	2·16	3	516	1·129	1·13	1
040	2·11	2·12	3	526	1·100	1·10	1
005	1·857	1·86	4	612	1·050	1·05	1
105	1·813	1·81	3				

* Cryptomelane lines.

Taking the formula as $(Zn,Mn)_2Mn_5O_{12}.4H_2O$, there are two such units per unit-cell, leading to a calculated specific gravity of 3·98, in good agreement with the observed value.

Since in the powder data *hkl*, *hk*0, 0*kl*, *hhl*, *h*00, and 00*l* reflections are present in all orders, the unit cell must be primitive and belong to one of the space groups: $P\bar{4}$, $P4$, $P4mm$, $P422$, $P4/mmm$, $P4/m$, $P\bar{4}2m$, or $P\bar{4}m2$. The reflections 200, 211, 202, 221, 311, 104, and 214 were identified on the powder diagrams given by Frondel and by Ramdohr.

References.

FRONDEL (C.), 1953. Amer. Min., vol. 38, p. 761.

NAGANNA (C.) 1962*a*. Min. Mag., vol. 32, p. 170.

—— 1962*b*. Determination of the microhardness of the manganese oxide minerals from Sandur ore deposits, Mysore State, India. Silikáty (Prague), vol. 6, p. 207.

—— 1962*c*. Mineralogy of the manganese ores from Sandur ore deposits, Bellary Dt., Mysore State, India. Doctorate thesis submitted to the faculty of Natural Sciences, Charles University, Prague.

RAMDOHR (P.) 1956. Die Manganerze: Symposium sobre yacimientos da manganeso, XX *congreso geologico internacional, Mexico*, vol. 1, p. 19.