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GITTINSITE, A NEW CALCIUM ZIRCONIUM SILICATE FROM THE KIPAWA AGPAITIC SYENITE COMPLEX, QUEBEC

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ABSTRACT

Gittinsite is a new calcium zirconium silicate mineral found in pegmatitic lenses in a regionally metamorphosed agpaitic syenite complex at the Kipawa River, Villedieu Township, Témiscamingue County, Québec. It forms chalky, grey-white fine-grained intergrowths with apophyllite that are commonly associated with vlasovite. Other associated minerals are eudialyte, fluorite, graphite, calcite, apatite, opal, agrellite, clinoamphibole, mosandrite, pectolite, microcline and thorite. Colorless in thin section, gittinsite is biaxial negative with $2V_\alpha$ = 30(10)°, n_α 1.720(2), n_β 1.736(2), n_γ 1.738(2), extinction on (010) being nearly parallel to the *X* direction, at an angle of 5–10° to elongation (*c*). Electron-microprobe analysis gave CaO 18.4, ZrO_2 40.3, SiO_2 40.8, total 99.5%. The empirical formula calculated for 7 oxygen atoms is $Ca_{0.98}Zr_{0.98}Si_{2.03}O_7$ or, ideally, $CaZrSi_2O_7$. Gittinsite is monoclinic, *a* 6.878(4), *b* 8.674(4), *c* 4.697(2) Å, β 101.74(4)°, *Z*=2, space group *C*2/*m* by analogy with thortveitite (*PDF* 19–1125). The calculated density for $CaZrSi_2O_7$ is 3.624 g/cm³.

Keywords: gittinsite, new mineral, calcium zirconium silicate, agpaitic syenite complex, Kipawa River, Québec, optical properties, electron-microprobe analysis, X-ray diffraction.

SOMMAIRE

La gittinsite, minéral nouveau, est un silicate de calcium et zirconium. On la trouve dans des lentilles pegmatitiques d'un complexe syénitique agpaïtique à métamorphisme régional près de la rivière Kipawa (canton de Villedieu, comté de Témiscamingue, Québec). Elle forme avec l'apophyllite de fines intercroissances crayeuses d'un blanc grisâtre associées d'ordinaire à de la vlasovite, mais aussi à d'autres espèces: eudialyte, fluorine, graphite, calcite, apatite, opale, agrellite, clinoamphibole, mosandrite, pectolite, microcline et thorite. Incolore en lame mince, la gittinsite est biaxe négative, $2V$ 30(10°), n_α 1.720(2), n_β 1.736(2), n_γ 1.738(2); son extinction, presque parallèle à *X*, fait un angle de 5 à 10° avec l'allongement (*c*). Une analyse à la microsonde donne: CaO 18.4, ZrO_2 40.3, SiO_2 40.8, total 99.5. La formule empirique calculée sur 7 atomes d'oxygène est $Ca_{0.98}Zr_{0.98}Si_{2.03}O_7$, d'où la formule idéale $CaZrSi_2O_7$. Monoclinique, *a* 6.878(4), *b* 8.674(4), *c* 4.697(2) Å, β 101.74(4)°, *Z* = 2, groupe spatial *C*2/*m*, la gittinsite est l'analogue de la thorveitite (*PDF* 19–1125). La densité calculée est de 3.624.

(Traduit par la Rédaction).

Mots-clés: gittinsite, nouvelle espèce, silicate de calcium et de zirconium, complexe syénitique agpaïtique, rivière Kipawa, Québec, propriétés optiques, analyse à la microsonde, diffraction X.

INTRODUCTION

In a description of the occurrence of vlasovite $Na_2ZrSi_4O_{11}$ in the alkalic complex at the Kipawa River, Villedieu Township, Témiscamingue County, Québec, Gittins *et al.* (1973) reported the presence of a new unnamed mineral found as an alteration along vlasovite cleavages. The mineral occurs as radiating sheaves of prismatic crystals 0.1–0.3 mm in length, too small to permit the determination of optical and physical properties; the authors did note that the crystals have very low birefringence. Electron-microprobe analyses showed that the mineral has an ideal composition of $CaZrSi_2O_7$.

In 1975 and 1976 the senior author collected suites of mineral specimens from the Kipawa River complex and noted the presence of some grey–white egg-shaped pods, up to 2 cm in size, in eudialyte-rich pegmatite lenses. In a preliminary study of this material (Plant & Roberts 1979), examination of thin sections of the pods, using incident light, revealed a eutectic-like fine grained intergrowth of two phases with different reflectivities. Lenses of coarser grained material are present within the pods and consist of the same two phases found in the matrix (Fig. 1). Quantitative microprobe analysis showed that the higher reflectivity phase is stoichiometric $CaZrSi_2O_7$ and that the second phase has a

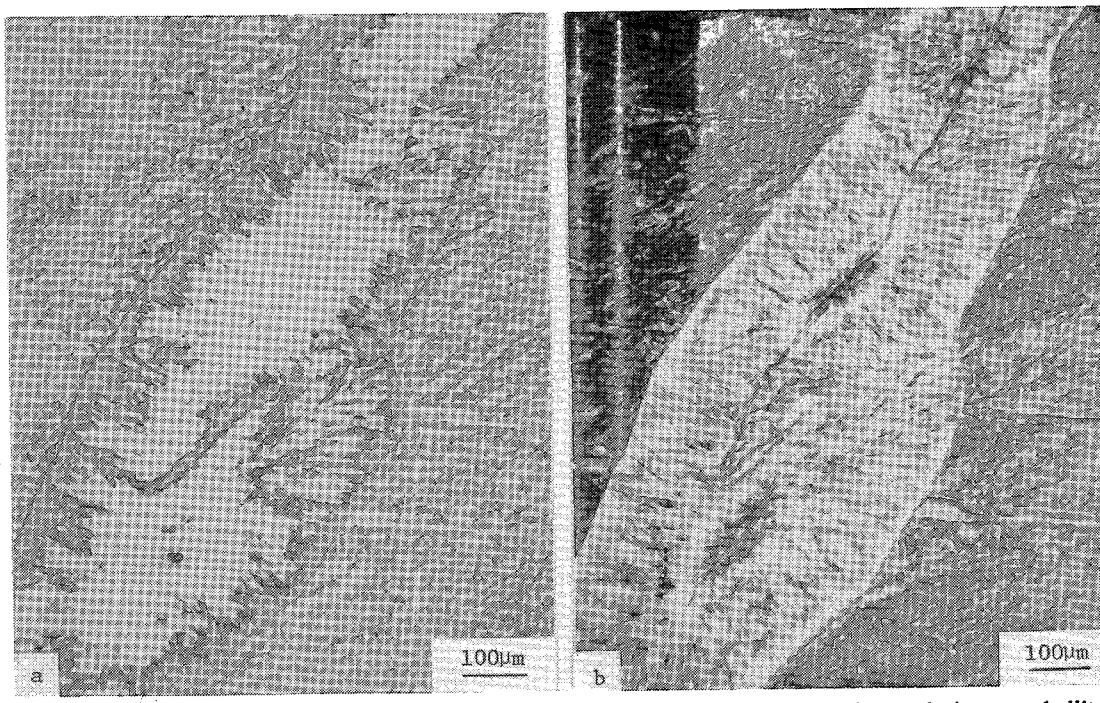

FIG. 1. (a) Reflected light view of relatively coarse grained lens of gittinsite with enclosing apophyllite, in fine grained intergrowth of the same two minerals. (b) Same view, transmitted light.

composition consistent with that of an apophyllite. Subsequent X-ray-diffraction study of the intergrowth confirmed the identity of the apophyllite and yielded approximate crystallographic data for the $CaZrSi_2O_7$. Additional specimen material has since been obtained, permitting a more detailed study of the unnamed phase and its eventual characterization as the new mineral gittinsite.

Gittinsite (git'-tin-sīt) has been named for Professor John Gittins, Department of Geology, University of Toronto, who first noted its occurrence and reported it as an unidentified mineral. Dr. Gittins is well known for his contributions to the petrology of alkalic rock complexes. Both the mineral and the mineral name were approved prior to publication by the Commission on New Minerals and Mineral Names, I.M.A. Holotype material is preserved in the National Mineral Collection, Geological Survey of Canada, Ottawa, under catalogue number 19558. Additional type material will be deposited with the Department of Mineralogy and Geology, Royal Ontario Museum, Toronto, and the Department of Geology, University of Toronto.

OCCURRENCE

Gittinsite is a very rare mineral found in eudialyte-rich pegmatitic lenses in a regionally metamorphosed agpaitic syenite complex at the Kipawa River, Villedieu Township, Témiscamingue County, Québec, latitude 46°48'30" N, longitude 78°30'20" W. [Geographic coordinates given in Gittins *et al.* (1973), Aarden & Gittins (1974) and Gittins *et al.* (1976) are not accurate.] The geology of the complex is poorly known; descriptive summaries are given in Gittins *et al.* (1976) and Aarden & Gittins (1974).

Gittinsite is always found in intimate association with apophyllite and commonly, but not invariably, with vlasovite. Other closely associated minerals are eudialyte, fluorite, graphite, calcite, apatite and opal. The names "apophyllite" and "apatite" are used in the absence of complete analyses of these minerals. From their associations, they are likely to prove to be the fluorine-rich members of both groups. Occurring within the same pegmatite lens are agrellite, mosandrite, microcline, pectolite, thorite and clinoamphibole.

Physical and Optical Properties

Gittinsite occurs as fibrous to radiating masses intimately associated with apophyllite (Fig. 1), in round pods with an observed maximum dimension of 2 cm and along cleavage planes in vlasovite. No orientation relationship is apparent between gittinsite and vlasovite. The gittinsite–apophyllite intergrowths are chalky white in color with an estimated Mohs hardness of 3½–4. The maximum length of individual gittinsite fibres is approximately 0.1 mm, with a length-to-width ratio approaching 50:1. The small grain-size and intergrown nature of the mineral precluded the determination of most physical properties, including measured density. Calculated density for stoichiometric $CaZrSi_2O_7$ is 3.624 g/cm³.

In thin section with transmitted light, gittinsite is colorless. In reflected light, it has a noticeably higher reflectance than that of apophyllite. Gittinsite is optically biaxial negative, $2V_\alpha = 30(10)°$, n_α 1.720(2), n_β 1.736(2), n_γ 1.738(2). The fibres show nearly parallel extinction with the principal vibration direction X at an angle of 5–10° to the elongation c, and Z and Y nearly perpendicular to it. Calculated from the chemical composition, the Gladstone–Dale constant $K_C = 0.210$, and from the calculated density and measured indices of refraction, $K_P = 0.202$.

Chemical Composition

A chemical analysis was obtained with a Materials Analysis Company electron microprobe, operating with an accelerating voltage of 20 kV and a specimen current of 0.03 μA on zircon. Using synthetic diopside (for Ca and Si) and zircon (for Zr) as standards, analysis of gittinsite gave CaO 18.4, ZrO_2 40.3, SiO_2 40.8, total 99.5%, comparable with the analysis in Gittins *et al.* (1973). No other elements with atomic number greater than 10 were detected in energy-dispersive spectra. The empirical formula of gittinsite, calculated on the basis of 7 oxygen atoms, is $Ca_{0.98}Zr_{0.98}Si_{2.03}O_7$ or, ideally, $CaZrSi_2O_7$.

X-Ray Powder Diffraction

X-ray single-crystal determinations could not be made because of the small grain-size. The X-ray powder-diffraction pattern, however, was successfully indexed on a monoclinic cell, giving a 6.878(4), b 8.674(4), c 4.697(2) Å, β 101.74(4)°, $Z = 2$ by analogy with thortveitite, $Sc_2Si_2O_7$ (*PDF* 19–1125). X-ray data are given in Table 1. None of the derived Miller indices violate the requirements of space group $C2/m$. Gittinsite is considered to be the CaZr analogue of thortveitite, in which two Sc atoms occupy different structural sites.

TABLE 1. X-RAY DATA FOR GITTINSITE

I_{est}	d_{meas} Å	d_{calc} Å	hkl	I_{est}	d_{meas} Å	d_{calc} Å	hkl
6	5.32	5.32	110			1.680	150
4	4.62	4.60	001	7	1.677	1.674	132
1	4.35	4.34	020	<½	1.633	1.634	241
2	3.78	3.79	$\bar{1}11$	½	1.617	1.616	222 *
8	3.232	3.232	111	<½	1.605	1.604	151
10	3.155	3.155	021	½	1.577	1.578	042
8	3.026	3.026	$\bar{2}01$	1	1.572	1.572	331 *
8	2.660	2.660	220	½	1.552	1.553	151 *
2	2.483	2.482	$\bar{2}21$	1	1.532	1.533	003 *
½	2.385	2.385	131*			1.516	$\bar{2}03$
2	2.302	2.300	002*	2	1.514	1.513	$\bar{4}02$
5	2.226	2.225	131*			1.512	$\bar{2}42$
2	2.158	2.157	221*	~<½	1.486	1.486	401
½	2.134	2.134	$\bar{3}11$*			1.446	060
1	2.108	2.109	$\bar{2}02$*	2	1.446	1.445	023
2	2.032	2.032	022*			1.444	$\bar{3}12$
<½	1.998	1.997	112	<½	1.432	1.431	$\bar{2}23$
1	1.961	1.961	041*	1	1.413	1.414	113 *
4	1.898	1.897	$\bar{2}22$*	<½	1.389	1.390	$\bar{1}52$
1	1.814	1.812	$\bar{1}32$*			1.388	$\bar{3}13$
1	1.772	1.773	330*	2	1.375	1.377	$\bar{1}33$
½	1.755	1.752	$\bar{3}31$			1.373	350
2	1.741	1.741	202*				

114.6 mm Debye-Scherrer camera, CuKα radiation, Ni filter ($\lambda CuK\alpha$=1.54178 Å), film #60800, intensities estimated visually.

* lines used in unit-cell refinement, indexed with a 6.878 b 8.674 , c 4.697 Å, β 101.74°

Acknowledgements

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