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LOUDOUNITE, A NEW ZIRCONIUM SILICATE FROM VIRGINIA

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Abstract

Loudounite $NaCa_5Zr_4Si_{16}O_{40}(OH)_{11}\cdot 8H_2O$ is a new species from the Goose Creek quarry, Loudoun County, Virginia, where it occurs as green to colorless spherules associated with actinolite, chlorite and ancylite in diabase. Microprobe analysis yields: SiO_2 45.8, Al_2O_3 0.8, FeO 2.0, MgO 0.3, CaO 12.1, ZrO_2 25.7, Na_2O 1.3, K_2O 0.2 wt. %, with H_2O 11.8% by difference; total 100.0%. The strongest six lines in the X-ray powder-diffraction pattern [*d* in Å(I), b for broad] are 2.931(10b), 4.06(7b), 7.37(6), 5.81(5), 2.694(4) and 3.527(4). The Mohs hardness is approximately 5, the density is 2.48(3) g/cm³, and the streak is colorless. Loudounite is biaxial with wavy extinction and length-slow, and has indices of refraction α 1.536 and γ 1.550 (both $\pm$ 0.004). Loudounite has also been found at the Fairfax quarry, Centreville, Fairfax County, Virginia.

Keywords: loudounite, zirconium silicate, Virginia, diabase, new mineral species.

Sommaire

La loudounite $NaCa_5Zr_4Si_{16}O_{40}(OH)_{11}\cdot 8H_2O$ est une nouvelle espèce de la carrière Goose Creek, comté Loudoun (Virginie, E.-U.). Elle se présente en sphérules vertes à incolores, accompagnée d'actinote, chlorite et ancylite dans une diabase. L'analyse à la microsonde donne: SiO_2 45.8, Al_2O_3 0.8, FeO 2.0, MgO 0.3, CaO 12.1, ZrO_2 25.7, Na_2O 1.3, K_2O 0.2% et H_2O 11.8% par différence. Les cinq raies les plus intenses du cliché de poudre [*d* en Å(I), b raie large] sont: 2.931(10b), 4.06(7b), 7.37(6), 5.81(5), 2.694(4) et 3.527(4). La dureté de Mohs est approximativement 5, la densité 2.48(3), le trait incolore. La loudounite est biaxe, montre une extinction ondulante et un allongement positif et possède comme indices de réfraction α 1.536 et γ 1.550 ($\pm$ 0.004). La loudounite a également été observée à la carrière Fairfax, à Centreville, comté de Fairfax (Virginie).

(Traduit par la Rédaction)

Mots-clés: loudounite, silicate de zirconium, Virginie, diabase, nouvelle espèce minérale.

Introduction

During the identification of the minerals in several parageneses from the Goose Creek quarry, property of the Luck Company, some light green spherules were called to the authors' attention by Mr. George Brewer of Laurel, Maryland, who found the material and supplied all the specimens used in this study. Preliminary examination of the samples by X-ray diffraction indicated that these spherules are a new species, and subsequent study has verified that original observation. The new mineral species is named *loudounite* for Loudoun County in Virginia, where the mineral was found. Loudounite is pronounced loŭ-dŏn-ite, wherein the first syllable rhymes with the word *proud*. The mineral and the name were approved by the Commission on New Minerals and Mineral Names, IMA. Type material is preserved at the Smithsonian Institution, under catalogue number NMNH 149397.

Habit

Loudounite occurs as spherules composed of radiating fibrous crystals (Fig. 1). One observed spherule is 0.1 mm in diameter, but most are considerably smaller; the average spherule diameter is approximately 0.05 mm. Little can be said of the surface of these loudounite spherules because all those examined using SEM techniques are coated with parallel growths of ancylite of undetermined composition. These overgrowths, shown to be ancylite by X-ray-diffraction techniques, are not in any apparent epitactic orientation with respect to the underlying loudounite. Loudounite has been found in such spherical aggregates only; no other habit is known.

Physical and Optical Properties

Loudounite occurs as spherical, light green to white aggregates. The Mohs hardness is approx-

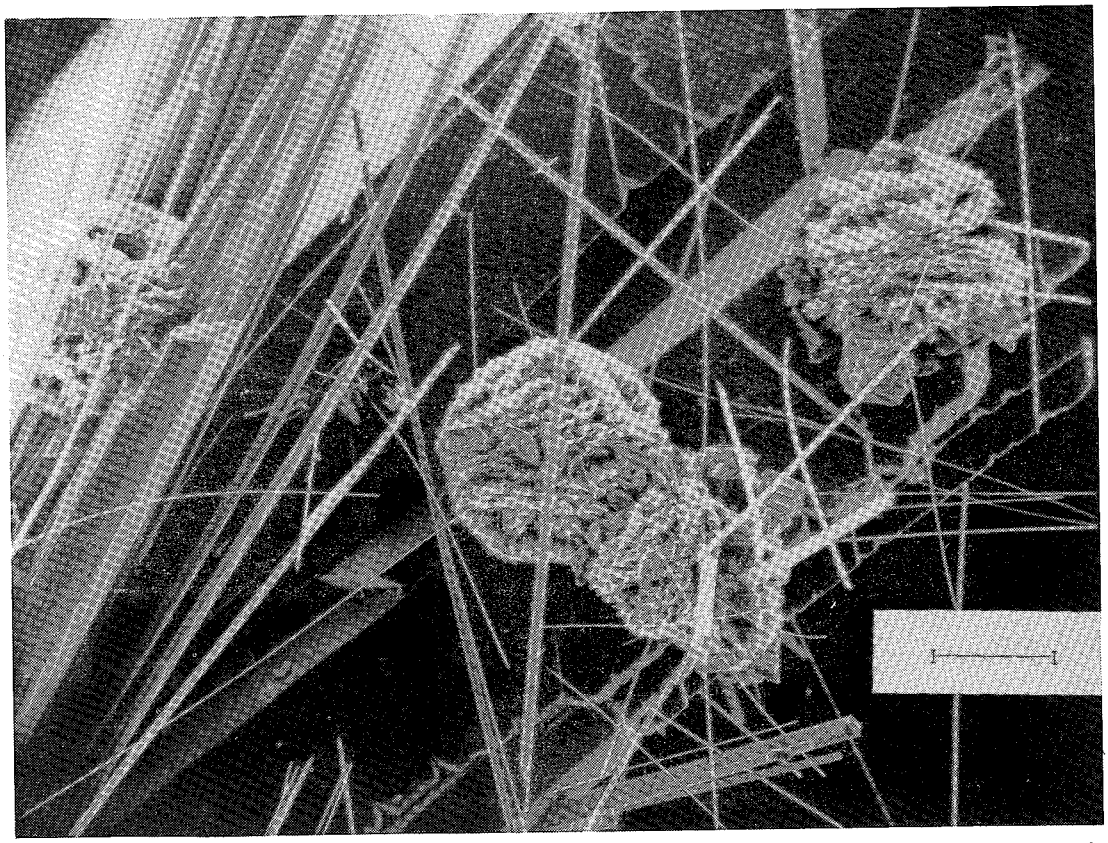

FIG. 1. Several spherulitic aggregates of loudounite with actinolite from Goose Creek. Scale bar is approximately 50 μm.

imately 5, but could not be determined with accuracy owing to the extremely small size of spherules and a coating of ancylite. The density, determined using heavy-liquid techniques, is 2.48(3) g/cm^3. The streak is colorless. No cleavage was observed. There is no discernible fluorescence in ultraviolet radiation.

Optically, loudounite is biaxial with wavy extinction. Fibrous fragments are length-slow. The indices of refraction, measured in sodium light, are α 1.536 and γ 1.550 (both $\pm$ 0.004). Loudounite is colorless in thin section and nonpleochroic. The extremely small crystal-size precluded the direct measurement of $2V$. Calculation of the Gladstone–Dale relationship, using the constants of Mandarino (1976), yields K_C 0.224 and K_P 0.219, which indicates excellent agreement between analytical and physical data (Mandarino 1979).

CHEMICAL COMPOSITION

Loudounite was chemically analyzed using an ARL–SEMQ electron microprobe utilizing an operating voltage of 15 kV and a sample current of 0.025 μA, standardized on brass. Hornblende (Si, Al, Fe, Mg, Ca and K) and zektzerite (Zr and Na) were used as standards. The data were corrected using a modified version of the *MAGIC*–4 computer program. A wavelength-dispersion scan by microprobe indicated the absence of elements with atomic number greater than 9, except those reported herein. A scan by ion-microprobe mass spectrometer indicated the absence of any light elements (except O and H). The absence of carbonate was verified by an acid test. Water could not be determined directly owing to extreme paucity of material; it was calculated by difference. The resultant composition is presented in Table 1 and yields the following chemical formula, calculated on the basis of 26 cations: $(Na_{0.85}K_{0.09}Ca_{0.06})_{\Sigma 1.00}(Ca_{4.31}Fe_{0.56}Mg_{0.15})_{\Sigma 5.02}Zr_{4.22}(Si_{15.44}Al_{0.32})_{\Sigma 15.76}O_{40}(OH)_{10.70} \cdot 7.92 H_2O$ or ideally, $NaCa_5Zr_4Si_{16}O_{40}(OH)_{11} \cdot 8H_2O$. The excess of Zr is problematical. Although the

TABLE 1. CHEMICAL COMPOSITION OF LOUDOUNITE

	Loudounite	$NaCa_5Zr_4Si_{16}O_{40}(OH)_{11}\cdot 8H_2O$
SiO_2	45.8 %	47.89
Al_2O_3	0.8	
FeO**	2.0	
MnO	tr.	
MgO	0.3	
CaO	12.1	13.96
ZrO_2	25.7	24.54
Na_2O	1.3	1.54
K_2O	0.2	
H_2O	11.8*	12.07
Total	100.0	100.00

* water by difference; ** Total Fe as FeO.
Values expressed as weight %.
Accuracy of data: ±4% of the amount quoted for major elements. Data obtained by microprobe.

sum of (Zr+Si+Al) is equal to 19.98 atoms, suggesting that this small amount of Zr might proxy for Si/Al in tetrahedral sites, Zr usually is in octahedral co-ordination in silicate structures (Bayer 1974).

We note that in the original description, lemoynite (Perrault *et al.* 1969) was attributed a chemical composition similar to loudounite but it has a distinctly different powder-pattern. The subsequent crystal-structure determination (Le Page & Perrault 1976) provided the simplified formula $(Na,K)_2CaZr_2Si_{10}O_{26}\cdot 5\text{–}6H_2O$, which is quite different from that of loudounite, particularly in the Zr:Si ratio. We emphasize here that the loudounite formula is tentative: exact interpretation will require a structure analysis.

X-Ray Powder-Diffraction Data

Single crystals of loudounite were not found. The X-ray powder-diffraction data were obtained using a 114.6-mm-diameter Gandolfi camera, a polycrystalline ball-mount, Cu$K\alpha$ radiation, and NBS silicon as an internal standard. The data are presented in Table 2.

Occurrence

Loudounite occurs at the Goose Creek quarry, Loudoun County, Virginia. Two adjacent quarries have had the same name. Loudounite was found in 1980 in the newer of these, which has been operated continuously since it opened in 1972 as a source of road metal derived from Triassic diabase, described by Shannon (1924). Goosecreekite $CaAl_2Si_6O_{16}\cdot 5H_2O$ was recently described from this locality (Dunn *et al.* 1980).

On the holotype specimen, loudounite occurs on epidote crystals up to 1.0 mm that encrust a thin seam of microgranular chlorite on altered diabase. Loudounite is followed in this assemblage by prismatic crystals of stilbite up to 3 mm across. Other specimens have loudounite spherules similar to the holotype, but with a coating of ancylite. The assemblages are varied but, in most cases, loudounite crystallized last; it followed actinolite and chlorite, which were preceded by assemblages containing epidote, albite, zircon, quartz and prehnite. A few specimens have calcite coatings on loudounite. Although it occurs in very tiny aggregates and is thus volumetrically rare at the type locality, loudounite has been found at many places within the quarry and seems to be broadly distributed among several parageneses.

Subsequent to the description of the type material from Goose Creek, loudounite was found at the Fairfax quarry, Centreville, Fairfax County, Virginia, by Mr. George Brewer. At Centreville, loudounite occurs in diabase. It formed on massive prehnite, upon which are euhedral crystals of quartz, apophyllite and apatite with minor titanite and tiny spherules of loudounite. Although these loudounite spherules were not examined using SEM techniques, they do have druse coatings of microcrystals visually indistinguishable from the ancylite coatings on the Goose Creek paragenesis. Hence, loudounite may be coated with ancylite at both localities.

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TABLE 2. X-RAY POWDER DIFFRACTION DATA FOR LOUDOUNITE

d (meas.)	I/Io	d (meas.)	I/Io
7.37	6	2.304	2
5.81	5	2.267	2
5.11	1	2.176	3
4.87	1	2.129	1
4.56	3	2.078	2
4.36	3	2.029	2
4.06	7b	1.834	3
3.61	1	1.821	3
3.527	4	1.791	1
3.446	1	1.765	3
3.220	1	1.720	3
3.063	1	1.610	2b
2.931	10b	1.598	2b
2.862	1	1.569	3
2.694	4	1.526	3
2.585	1	1.420	2
2.471	2	1.379	3
2.414	2	1.341	3

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