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GARNETS OF THE HYDROGROSSULAR – „HYDROANDRADITE" – „HYDROSCHORLOMITE" SERIES

INTRODUCTION

At present, according to existing nomenclature only two mineral species: hibschite and katoite belonging to hydrogarnet with common crystal chemistry formulae $Ca_3Al_2(SiO_4)_{3-x}(OH)_{4x}$ are distinguished within the garnet group. In these hydrogarnets isomorphism is revealed according to the scheme $4(OH)^- \Leftrightarrow (SiO_4)^{4-}$. Hibschite and katoite are the names used for members with Gr ≥ 50% and Gr < 50%, respectively, in the isomorphic series $Ca_3Al_2(SiO_4)_3$ - $Ca_3Al_2(OH)_{12}$ (Rinaldi & Passaglia, 1989). "Hydrogrossular" is a group name of the hibschite-katoite series (Fleischer & Mandarino 1995). Majority of known garnets have a negligible amount of (OH) groups in their composition. The used names „hydrograndite", „hydroandradite" (Amthauer & Rossman 1998), „hydropyrope" (Milman et al. 2000) denote hydration varieties of garnet are not approved by IMA. Attempts were made to submit for consideration "hydroandradite" and "hydroschorlomite" in CNMMN IMA as new minerals, but without success (I. Pekov, personal communication). The garnet samples investigated by authors contain considerable amount of (OH) groups, and therefore they decided to use the "hydroandradite" and "hydroschorlomite" names.

OBJECTS, METHODS AND RESULTS OF INVESTIGATION

Hydrogrossulars are rock-forming minerals of rodingite-like rocks of the Wiluy deposit, Yakutia. Evolution of composition and morphology of hibschite from achtarandite pseudomorphs was described earlier (Galuskina et al. 2001). Andradite and schorlomite with considerable amount of hydrogarnet component were discovered recently in diopside-chlorite rocks of the Wiluy River. Ti-Fe hydrogarnets form zones in metacolloidal aggregates (Fig. 1) and spherulites. Idiomorphic crystals up to 15 μm were found in association with perovskite and titanite in the cavities of diopside pseudomorphs after high-Al pyroxene. Hydrogrossular in these formations is an early mineral. Hydroandradite and hydroschorlomite, as a rule, formed later than hydrogrossular. Hydroandradite substitutes hydrogrossular and

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grows epitaxially on it. Hydroschorlomite is the latest mineral in this series; it also grows epitaxially on hydroandradite (Fig.1).

Composition of hydrogarnets and X-ray mappings were obtained by means of scanning microscope Philips XL30 ESEM/TMP with analytical equipment EDAX and microprobe analyzer Cameca SX-100 using natural standards.

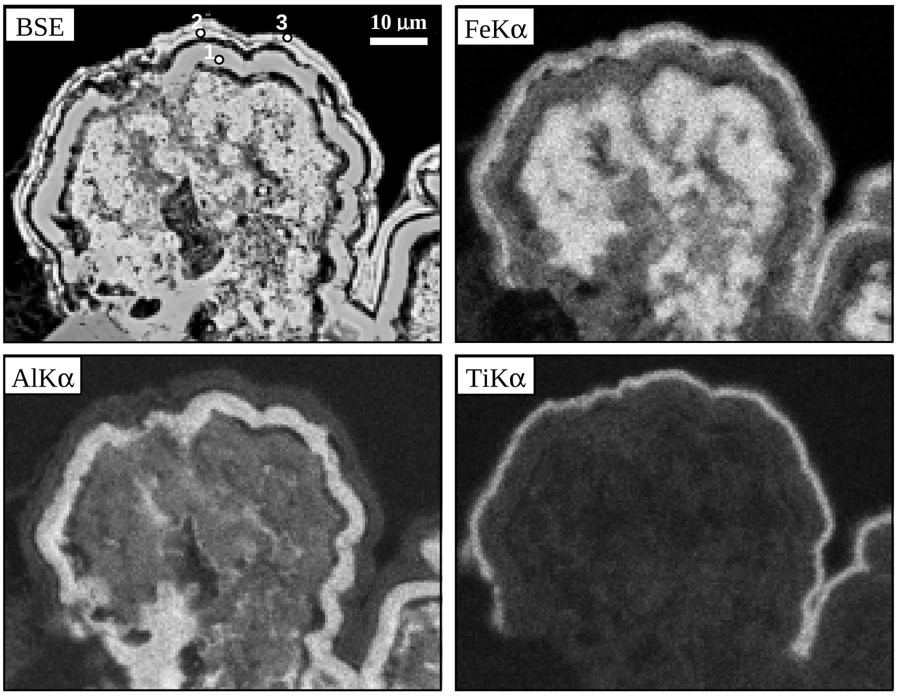

Fig. 1. Metacolloidal aggregate of hydrogarnets with later hydroschorlomite zone. Points of analyses are indicated on BSE image.

More typical compositions of hydrogarnets from rodingite-like rocks are given below:

1) $Ca_3(Al_{1.47}Fe^{3+}_{0.35}Ti^{4+}_{0.09}Mg_{0.07})_{1.98}Si_{2.58}H_{1.71}O_{12}$ (an. 1, Fig. 1)
2) $Ca_3(Al_{0.30}Fe^{3+}_{1.38}Ti^{4+}_{0.22}Mg_{0.12})_2(Si_{2.83}Fe^{3+}_{0.03}H_{0.49})O_{12}$ (an. 2, Fig. 1)
3) $Ca_3(Al_{0.20}Fe^{3+}_{0.91}Ti^{4+}_{0.84}Mg_{0.04})_{1.99}(Si_{2.18}H_{2.51})O_{12}$ (an. 3, Fig. 1)
4) $Ca_3(Al_{0.08}Fe^{3+}_{0.98}Ti^{4+}_{0.94}Mg_{0.02}Mn_{0.03})_2(Si_{2.09}Fe^{3+}_{0.05}H_{3.00})O_{12}$ – single crystal in association with perovskite and titanite.

DISCUSSION

Hydrogarnet is a common name used for garnets characterized by the presence of OH groups. Generally accepted names with the prefix “hydro” are used in classification of hydrogarnets. The described hydrogarnets belong to the following series:

1. grossular – hydrogrossular $Ca_3Al_2(SiO_4)_3$ – $Ca_3Al_2(H_4O_4)_3$,
2. andradite – hydroandradite $Ca_3Fe_2(SiO_4)_3$ – $Ca_3Fe_2(H_4O_4)_3$,
3. schorlomite – hydroschorlomite $Ca_3Ti^{4+}{}_2[(Fe^{3+}O_4)_2(SiO_4)]$ – $Ca_3Ti^{4+}{}_2[(H_3O_4)_2(H_4O_4)]$,
4. morimotoite – hydromorimotoite $Ca_3(Ti^{4+}R^{2+})(SiO_4)_3$ – $Ca_3(Ti^{4+}R^{2+})(H_4O_4)_3$, where R^{2+} is Mg, Fe^{2+}.

Interpretation of hydrogarnet composition is easy if they represent members of the hydrogrossular and hydroandradite series because of very simple substitution: $(SiO_4)^{4-} \Leftrightarrow (H_4O_4)^{4-}$. Composition of the Ti-hydrogarnets is more difficult for explanation, as H can be incorporate into the garnet structure by the two main different schemes of substitution:

1) usual hydrogarnet type of substitution: $(SiO_4)^{4-} \Leftrightarrow (H_4O_4)^{4-}$,
2) and hydroschorlomite type of substitution: $R^{3+}(SiO_4)^{4-} \Leftrightarrow Ti^{4+}(H_3O_4)^{5-}$ (Khomenko et al. 1994).

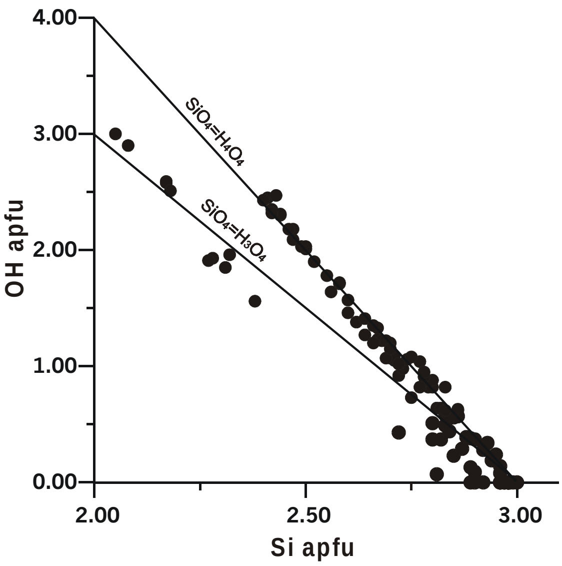

Fig. 2. Character a substitution of hydrograndite and Ti-hydrogarnets in

Different character of linear dependence for different type of substitution between Si and OH-groups is displayed on the Si-OH graph (Fig. 2). Composition of hydrogrossular and hydro-andradites changes along the line corresponding to the hydrogarnet isomorphism of normal type. Ti-hydrogarnet group lies on the line corresponding to the the substitution according to scheme: $R^{3+}(SiO_4)^{4-} \Leftrightarrow Ti^{4+}(H_3O_4)^{5-}$.

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