HYDROXYAPOPHYLLITE IN HORNFELS BENEATH THE DULUTH COMPLEX, NORTHEASTERN MINNESOTA

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ABSTRACT

Hydroxyapophyllite has been found in metasedimentary hornfels at a depth of 637 metres of a 653-m-long drill core through the Partridge River intrusive complex. The occurrence of hydroxyapophyllite is restricted to zones laden with xenoliths of graphic granite, which suggests that the hydroxyapophyllite formed as a reaction product distinct from the deuteric alteration of the overlying troctolite and gabbro. The mineral shows the forms {001} and {010}; it is found in association with radiating crystals of natrolite and minor chabazite.

Keywords: hydroxyapophyllite, Minnesota, Partridge River intrusive complex, Duluth Complex, deuteric alteration.

INTRODUCTION

Hydroxyapophyllite K_{Ca_4Si_8O_{26}(OH)}\cdot 8H_2O and fluorapophyllite K_{Ca_4Si_8O_{26}F}\cdot 8H_2O have been defined by Dunn et al. (1978) as the end members of the apophyllite series. Apophyllite occurs mostly in cavities in basalts and related rocks, commonly in association with zeolite minerals. Less commonly, it occurs in hydrothermal veins with Cu-sulfide mineralization, as in the Lake Superior copper district. We follow the nomenclature of Dunn et al. in describing an unusual occurrence of hydroxyapophyllite in the Duluth Complex, in drill core DDH-371 (T60N, R12W, northeastern Minnesota). The geology of the Duluth Complex was recently summarized by Weiblen & Morey (1980) and by Weiblen (1982).

The specimen described in this report occurs in a vug in metasedimentary hornfels. The zone of hornfels consists of xenoliths of the underlying Virginia Formation in the Partridge River intrusive complex (Fig. 1a) some 637 metres below the surface. The hydroxyapophyllite is associated with zeolites such as chabazite and natrolite. The hydroxyapophyllite-bearing hornfels occurs with fragments of graphic granite in which feldspar is an exsolution perthite (Fig. 1b); the fragments are interpreted as xenoliths of the Archean basement. This restricted occurrence suggests that the hydroxyapophyllite formed as a reaction product distinct from the deuteric alteration of the overlying troctolite and gabbro. The footwall metasedimentary Virginia Formation occurs here at a depth of 653 m.

X-RAY ANALYSIS

X-ray powder-diffractionometer data (Table 1) were gathered using a Philips diffractometer equipped with a theta-compensating slit. Ni-filtered Cu radiation and 1°/min scan rate were employed. A least-squares refinement of the powder-diffraction data assuming the constraints of the tetragonal space-group gave the following cell-dimensions: \(a = 8.978(3)\) Å, \(c = 15.906(9)\) Å. The cell volume is 1282(1) Å\(^3\), and the \(c/a\) axial ratio is 1.772.

CHEMISTRY

Quantitative analyses of hydroxyapophyllite were performed on the University of Michigan ARL EMX electron microprobe (wavelength dispersion) using PET, LIF and TAP crystal spectrometers (Table 2). The operating conditions were: accelerating voltage 12 kV, sample current 0.015 \(\mu\)A, beam diameter 1–2 \(\mu\)m, counting time 22 to 30 seconds. Adularia was used as a standard for K, Al and Si, hornblende for Fe, clinopyroxene for Ca, albite for Na, and fluoride for F. The standard error for F is about 0.1 wt.%
and that for other elements is about 0.03 wt.%. The matrix correction of the raw data was made using the program EMPADR VII (Rucklidge & Gaspar-rini 1969).

We have normalized the chemical composition to Al + Si = 8, with OH = 0.53 based on charge balance to obtain the formula: \((K_{0.91}Na_{0.04}Ca_{3.98})(Si_{7.97}Al_{0.03})(F_{0.35}OH_{0.53})O_{20} \cdot 7.74H_2O\). The composition of the Duluth hydroxyapophyllite agrees well with that reported for hydroxyapophyllite formed in a similar environment in the Ransko gabbro-peridotite massif (Némec 1982).

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REFERENCES


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