Hydrous species in Al-bearing apophyllite: the verification of the substitution of Si4+ + H2O for Al3+ + H3O+

Naoya Ishida[1]; Mitsuyoshi Kimata[2]; Norimasa Nishida[3]

[1] Division of Geoscience, Univ. of Tsukuba; [2] Institute of Geoscience, University of Tsukuba; [3] RFCST, Univ. of Tsukuba

http://www.geo.tsukuba.ac.jp/Mineralogy_Web/Kimata_Labo/index.html

The chemical compositions and hydrous species of seven different fluorapophyllites have been investigated using EMPA, TG-DTA, Micro-Raman spectroscopy and ^{1}H MAS NMR spectroscopy. Three fluorapophyllites contain aluminum of 0.4, 0.6, 0.9 wt%, respectively and substitute Si^{4+} for Al^{3+}. Al-bearing fluorapophyllites indicate more water contents than the other Al-free ones: the former contents of 16.9-17.3 wt% and the latter contents of 16.6 wt%. The Micro-Raman spectroscopic analysis indicates that Al-bearing fluorapophyllites have significantly higer peaks of 3100 and 3360 cm^{-1} than Al-free ones. ^{1}H MAS NMR measurements indicate the chemical shifts of 1.63 and 2.10 ppm in Al-bearing fluorapophyllites, but these shifts are not visible in Al-free ones. Thus, Al-bearing fluorapophyllites should contain a different hydrous species. Therefore, the following coupled substitution is suggested: Si^{4+} + H_2O for Al^{3+} + H_3O^{+}. This substitution makes a hydrous fluid more alkaline, where fluorapophyllite crystallizes. Al-bearing fluorapophyllite plays an important role in crystallizing the zeolite minerals in alkaline fluids.