

Mid-IR bands of synthetic calcic amphiboles of tremolite-pargasite series and of natural calcic amphiboles

KIYOTAKA ISHIDA,^{1,*} DAVID M. JENKINS,² AND FRANK C. HAWTHORNE³

¹Department of Environmental Changes, Graduate School of Social and Cultural Studies, Kyushu University, 4-2-1 Ropponmatsu, Chuo-ku, Fukuoka 810-8560, Japan

²Department of Geological Sciences and Environmental Studies, State University of New York at Binghamton, Binghamton, New York 13902-6000, U.S.A.

³Department of Geological Sciences, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada

ABSTRACT

Mid-IR spectra (4000–400 cm⁻¹) of synthetic calcic amphiboles in the tremolite-pargasite series and of various natural calcic amphiboles have been investigated. The pargasite substitution, a combination of the Tschermak (= [⁴Al⁶Al⁶Mg₁⁴Si₁]) and edenite (= [⁴Al¹Al¹Na⁴Si₁^A□₁]) substitutions, causes the following features in the region 1200–600 cm⁻¹. (1) Weak [⁴Al-O stretching bands appear at 895 and 815 cm⁻¹ that are distinct from the 955 and 925 cm⁻¹ Si-O stretching bands in tremolite. (2) There is a reduction in the intensity and frequency of the Si-O-Si symmetric bending band (=“chain breathing” mode) at 750 cm⁻¹ in tremolite, and there is an appearance of medium-strong composite bands having a weak shoulder on the high-frequency side near 690 cm⁻¹. These bands are assigned to Si-O-Al deformation bands. (3) Two OH-libration bands at 690 and 650 cm⁻¹ become weak and broad composite bands from 720 to 610 cm⁻¹. And (4) because the intensity and frequency of the band at 640 cm⁻¹ in tremolite is affected neither by deuteration nor by the pargasite substitution, this band is ascribed to O-^[T2]Si-O bending. Even in pargasite, most T2 sites are occupied by Si, so that the O2-^[T2]Si-O4 bending mode will be dominant in this amphibole. The same behavior occurs for the synthetic fluoro-gallian tremolite-pargasite series but with larger downward frequency shifts—Ga-O stretching bands appear at 880 and 780 cm⁻¹, and an Si-O-Ga bending band appears at 605 cm⁻¹. The major T-O-T and O-T-O deformation bands in synthetic amphiboles are readily apparent in natural calcic amphiboles whose compositions are near the tremolite-pargasite join.

Keywords: Mid-IR, calcic amphibole, tremolite, pargasite, deuteration