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

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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 ($=^{[4]}Al^{[6]}Al^{[6]}Mg_{-1}{}^{[4]}Si_{-1}$) and edenite ($=^{[4]}Al^{[A]}Na^{[4]}Si_{-1}{}^{[A]}\square_{-1}$) substitutions, causes the following features in the region 1200–600 cm^{-1}. (1) Weak $^{[4]}$Al-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