American Mineralogist, Volume 67, pages 1005–1006, 1982

The IR spectra of ordered amesites

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In recent years a considerable effort has been directed to the understanding of the cation distribution in amesites, *i.e.,* 1:1 layer silicates with the maximum amount of tetrahedral and octahedral Al-substitution. Thus, amesite can be considered as the end member of the serpentine minerals with the ideal chemical composition $(SiAl)(Mg_2Al)O_5(OH)_4$.

Based on the differences observed in the IR patterns of several natural and synthetic amesites, Serna *et al.* (1977) suggested that some specimens (including that from Chester, Massachusetts, Brindley *et al.,* 1951), had an ordered distribution of tetrahedral cations. This was supported mainly by the presence of two absorption maxima for the hydroxyl groups at 3615 and 3410 cm^{-1}, assigned to inner and outer hydroxyls, respectively, as well as by an absorption at around 800 cm^{-1} (Fig. 1a), assigned to "isolated" Al tetrahedra. Other amesites which presented three broad absorption maxima for the hydroxyls and two absorption bands around 800 cm^{-1} were considered to be disordered. Because of the presence of these features in the IR spectrum of the Saranovskoye amesite, this sample was considered to be either disordered or contaminated with some chloritic material (Serna *et al.,* 1977). In contrast to other disordered amesites, only a small indication of an absorption band at about 600 cm^{-1} (characteristic of serpentine minerals) was observed in the Saranovskoye sample which suggests that it is a 14Å polymorph.

The first detailed structural study on Saranovskoye amesite was carried out in the ideal $P6_3$ space group by Steinfink and Brunton (1956) who found no cation ordering in tetrahedral or octahedral positions. However, refinement of the Saranovskoye amesite structure in triclinic symmetry ($P1$) (Anderson and Bailey, 1981), as well as that of an amesite from Antarctica (Hall and Bailey, 1979) showed that there is almost complete ordering of the tetrahedral and octahedral cations. The IR spectra of these amesites (samples kindly provided by S.W. Bailey) are shown in Figures 1b and c. A complete analogy is observed between these IR patterns and that of the Chester sample. The lattice vibrations (1200–200 cm^{-1}) have the same position (±5 cm^{-1}) and relative intensity for the three samples. Vibrations associated with the hydroxyl groups give two absorption bands whose position and sharpness are consistent with the Mg_2Al octahedral ordering obtained in the crystal refinement. The band at 3615 cm^{-1} is attributed to inner hydroxyls while the other hydroxyl band centered at about 3410 cm^{-1} has been assigned to outer hydroxyl groups which are hydrogen bonded between the layers (Serna *et al.,* 1977). The presence of some shoulders below 3400 cm^{-1} are most likely related to differences in chemical composition among the amesites (Brindley *et al.,* 1951; Hall and Bailey, 1979; Anderson and Bailey, 1981).

It can be concluded that: (1) Some chloritic material was present in the sample of Saranovskoye amesite examined by Serna *et al.* (1977). (2) The IR spectra of amesites do not require further interpretation as suggested by Anderson and Bailey (1981). (3) A fair knowledge of cation ordering in amesites can be obtained by IR spectroscopic determinations. However, differences in the ordering patterns observed between the Antarctica and the Saranovskoye (Urals) amesites by X-ray crystal refinements do not seem to be reflected in the IR spectra.

0003–004X/82/0910–1005$02.00

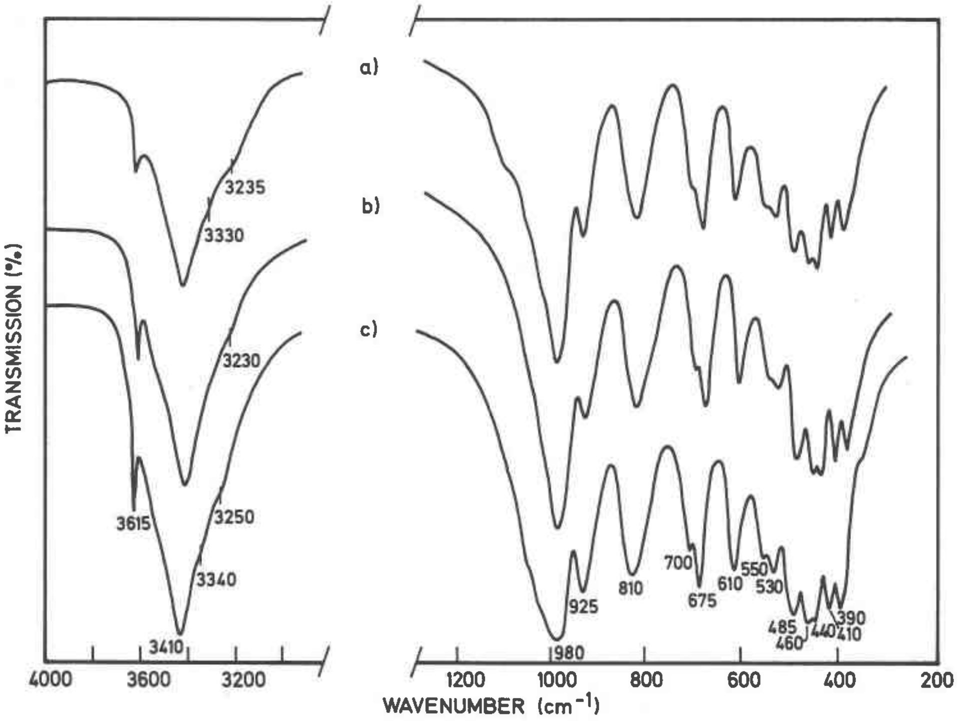

Fig. 1. Infrared spectra of ordered amesites from: (a) Chester, Massachusetts (b) Antarctica (c) Saranovskoye (Urals).

Acknowledgments

Appreciation is expressed to S. W. Bailey for providing Antarctica and Saranovskoye (Urals) amesites on which X-ray single crystal determinations have been carried out. Journal Paper 8959, Purdue University Agricultural Experiment Station, West Lafayette, Indiana 47907.

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Manuscript received, March 23, 1982;
accepted for publication, May 3, 1982.