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## INFRA-RED ABSORPTION DATA FOR SERPENTINE MINERALS\*

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As a result of recent x-ray and electron diffraction studies of serpentine minerals (1) (2) (3) (4), samples were available of each of the known structural and morphological varieties of this group of minerals. It seemed worth while, therefore, to record their infra-red absorption spectra. Measurements were made with a Perkin-Elmer model 21 double-beam spectrometer using an NaCl prism. The finely powdered minerals were intimately mixed with powdered KBr using 0.75 mg. of mineral and 300 mg. of KBr, and were pressed into transparent discs under vacuum. A reference disc of pure KBr was prepared in a similar manner. The powdered materials were dried at 110° C. for 15 hr. and stored in a desiccator prior to weighing and efforts were made to reduce water-adsorption from the atmosphere to a minimum and to equalize the adsorptions on the two discs by using similar preparatory techniques. When measurements were made on different days, new KBr blanks were prepared.

The following minerals were studied:

1. Chrysotile, silky fibers, Transvaal, (ref. 3, p. 135)
2. Chrysotile, splintery fibers, Zermatt, (ref. 3, p. 135)
3. 1-layer ortho-serpentine (lizardite), massive, Snarum, Norway, (ref. 3, p. 135)
4. 1-layer ortho-serpentine (lizardite), platy, Cornwall, (ref. 3, p. 135)
5. 6-layer ortho-serpentine, massive, Unst, Shetland Isles, (ref. 3, p. 136; ref. 4)
6. 6-layer ortho-serpentine, fibrous, Unst, Shetland Isles, (ref. 3, p. 136; ref. 4)
7. Antigorite (picrolite), fibrous, Shipton, Quebec, (ref. 3, p. 136)
8. Antigorite, platy, Glen Urquhart, Scotland, (ref. 3, p. 136)

The absorption curves are shown in Fig. 1. In constructing this composite diagram, all essential features of the curves were carefully reproduced, but owing to small lateral displacements, the wavelengths cannot be read accurately from this diagram. The absorption maxima are listed separately in Table 1.

## DISCUSSION

Certain general results emerge from consideration of the data in Fig. 1 and Table 1. Since it is obviously difficult and unreliable to resolve the composite absorption bands in the 9–11  $\mu$  range into separate peaks, no

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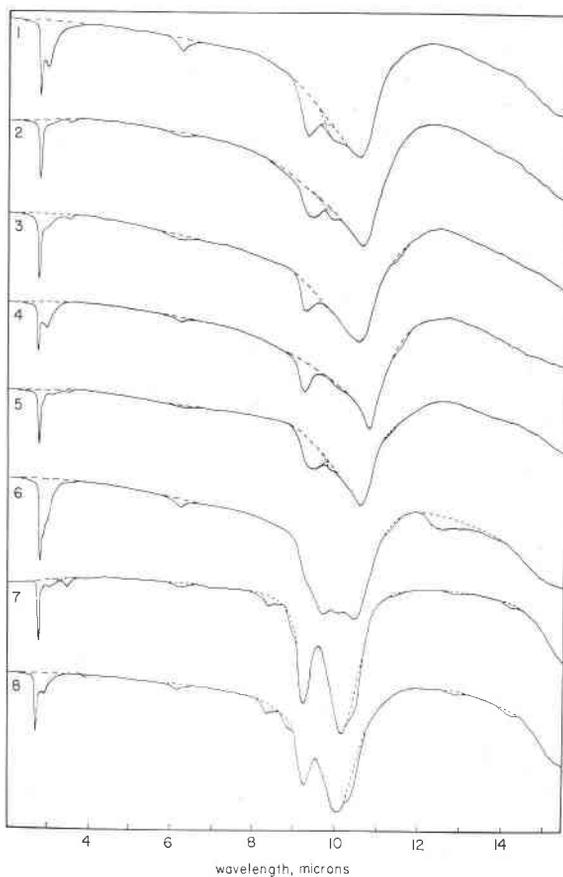


FIG. 1. Infra-red absorption curves for serpentinite minerals. (1) Silky chrysotile, (2) Splintery chrysotile, (3) 1-layer ortho-serpentine, massive, (4) 1-layer ortho-serpentine, platy, (5) 6-layer ortho-serpentine, massive, (6) 6-layer ortho-serpentine, fibrous, (7) antigorite, fibrous, (8) antigorite, platy.

attempt has been made to assign specific intensity values, such as strong, medium, weak, etc., to the data in Table 1. Tentative base lines are shown for some of the peaks in Fig. 1 by means of dashed lines.

Curves 7 and 8 for two antigorites, one a fibrous form and the other platy, are closely similar to one another but appreciably different from the curves for the other serpentinites. The term "antigorite" is used for a mineral with the structural characteristics of the mineral from Antigorio, in particular, the long  $a$  parameter, usually in the range 33–45 Å (see ref. 3). It appears that the infra-red data may serve to distinguish an antigorite from other serpentinite minerals. The antigorites show two



prominent peaks at about 9.25 and 10.15  $\mu$  as compared with three less well resolved peaks at about 9.30, 9.90 and 10.50  $\mu$  for other serpentines. The antigorites have only a weak absorption at about 10.5  $\mu$ , and no obvious absorption peak at 9.90  $\mu$ .

The similarity of the absorption curves for chrysotiles with tubular crystal lattices, and for the 1-layer and 6-layer ortho-serpentines with normal lattices is evident, but surprising in view of the different lattice types.

It was considered possible that water might be retained within or between the elementary tubular elements of chrysotile and thus give rise to characteristic differences in the "hydroxyl" range of the spectrum, 2.7–3.0  $\mu$ . The peak at about 2.75  $\mu$  is almost constant in shape, magnitude and position. The peak at about 2.95–3.00  $\mu$  is variable in magnitude but the variation has no obvious connection with lattice type. It is thought that this peak is related, in part at least, to adsorbed water and that the variability reflects changes in adsorption due to the precise way in which the specimens were prepared. When the mineral powder was purposely given additional opportunity to adsorb water vapor, the 3.0  $\mu$  peak was much enhanced. It would be necessary to regulate specimen preparation with extreme care before differences in the 3.0  $\mu$  peak from one sample to another could have any significance. On the other hand, the 2.75  $\mu$  peak seemed largely insensitive to precise specimen preparation and is probably related to hydroxyl units in the lattice structures.

#### ACKNOWLEDGMENT

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