MEASUREMENT OF FAR-INFRARED ABSORPTION FOR AMORPHOUS SILICATES BETWEEN 27 AND 400 μm

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ABSTRACT. The far-infrared extinction of various silicates was measured in the 27 - 400 μm range of wavelength. The SiO_2 content of our samples distributes between 45 and 100 weight (wt.)%. There is no distinct absorption band in the far-infrared region and the extinction decreases in proportion to $\lambda^{-1.4}$.

1. INTRODUCTION

Amorphous silicates have been considered as one of the candidates minerals for circumstellar, interstellar and cometary grains. Recently, some celestial objects have been observed in detail. For instance, the dust emission around HII region shows a $\lambda^{-1.8\pm0.2}$ dependence (Ward-Thompson and Robson,1990) and for comet P/Halley sharp features were discovered (Herter et al.,1987). However, there are very few laboratory data of far infrared spectra, except synthesized amorphous silicates and glassy bronzite, for candidates minerals. The synthesized amorphous silicates show a $\lambda^{-1.25}$ or $\lambda^{-1.5}$ dependence (Day, 1976), but glassy bronzite shows a λ^{-2} dependence (Dorschner et al.,1988). The study of far infrared spectra of amorphous silicates is required because it is not known whether there are features or not in the far infrared region and how is the spectral index n (assuming a λ^{-n} far infrared absorption law).

In this report we will show the far infrared spectra of various amorphous silicates. The purpose of our measurements of the far infrared spectra is as follows:

(1) are there features or not in the far infrared region ?
(2) the examination of the spectral index n.
(3) the effects of SiO_2 content on the extinction.

2. EXPERIMENTS

Samples are various amorphous silicates with different SiO_2 contents : two synthetic glasses (fused quartz - 100 % <SiO_2 wt.>, basalt glass - 45.2 %) and four natural glasses (obsidian - 75.5 %, tektite - 72.6 %, sanukite - 63.9 %, kilauea volcanic glass - 49.1 %). The SiO_2 content distributes from 100 to 45 wt.%.

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Fused quartz and basalt glass are obtained from Toshiba Ceramic Co.,Ltd. and Nihon Itaglass Co.,Ltd. respectively. The localities of natural glasses are as follows; Tokachi, Hokkaido, Japan for obsidian, Thailand for tektite, Goshikidai, Kagawa-prefecture, Japan for sanukite and Mt. Kilauea, Hawaii Island for kilauea volcanic glass.

The method of the measurements is the same as that discribed by Koike and Shibai(1990). We measured transmissions of each polyethylene sheets with the BOMEM fourier infrared spectrophotometer at ISAS between 28 and 400 μm in wavelength. Mass extinction coefficients κ are deduced from transmission T;

$$\kappa = \frac{S}{M} \ln \frac{1}{T}$$

where S is the surface area and M is sample mass.

4. RESULT

The results are drawn in Figs. 1 - 6, with together previous data for mid-infrared region (Koike et al.,1987), and they are condensed into Fig.7. The extinction spectra of amorphous silicates are compared with those of chemical synthesized amorphous silicates obtained by Day (1976) drawn in Figure 7.

As for the absorption band, only sanukite shows remarkable absorption band at about 47 μm. On the other hand, obsidian and sanukite show very broad band at about 50 $\sim$ 150 μm and about 110 μm respectively. Tektite, kilauea volcanic glass and basalt glass show no feature and their extinction curves decrease slowly as $\lambda^{-1.2} \sim \lambda^{-1.4}$. As for a λ-dependence, the extinction of fused quartz shows a λ^{-2}-dependence. Five other amorphous silicates show don't have constant spectral index n, but show the extinction of a $\lambda^{-1.4}$ dependence at about 100 μm region. The synthetic amorphous silicates show a $\lambda^{-1.25}$ or $\lambda^{-1.5}$ -dependence for wavelength 100$\sim$300 μm (Day,1976). As for the effect with SiO_2 content, the extinction increases as decreasing the SiO_2 content of samples. The extinctions of all samples except fused quartz decrease to nearly same values at about wavelength of 400$\sim$500 μm and are about one order higher than those of fused quartz.

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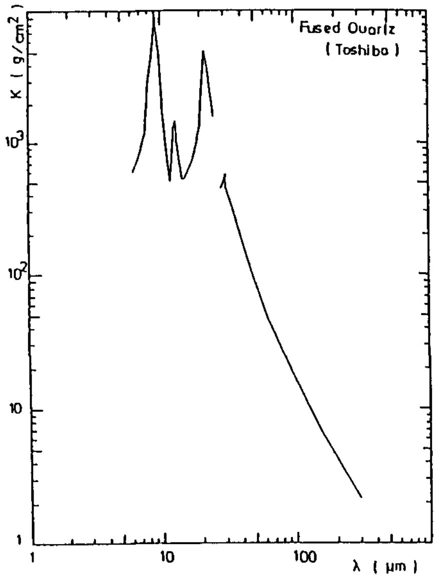

Fig.1. Mass extinction coefficient of fused quartz.

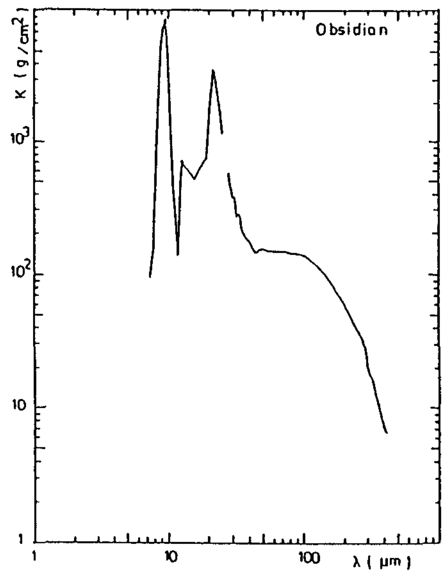

Fig.2. Mass extinction coefficient of obsidian.

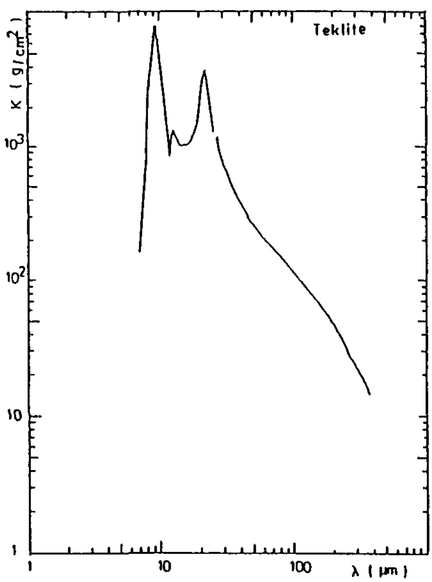

Fig.3. Mass extinction coefficient of tektite.

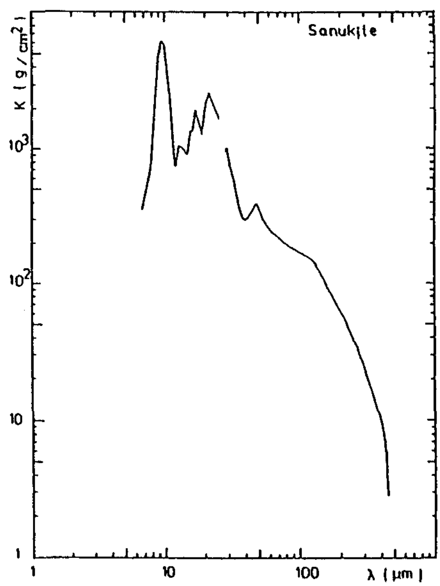

Fig.4. Mass extinction coefficient of sanukite.

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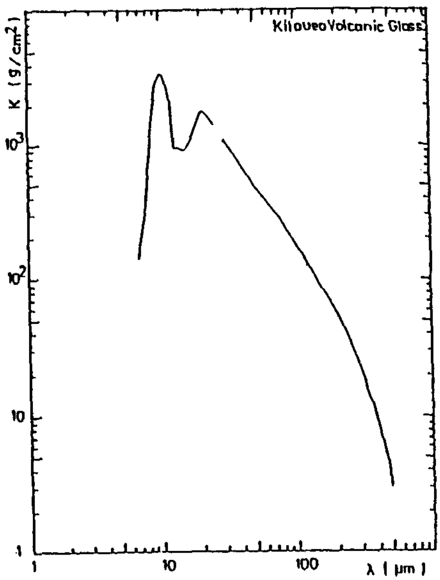

Fig.5. Mass extinction coefficient of kilauea volcanic glass.

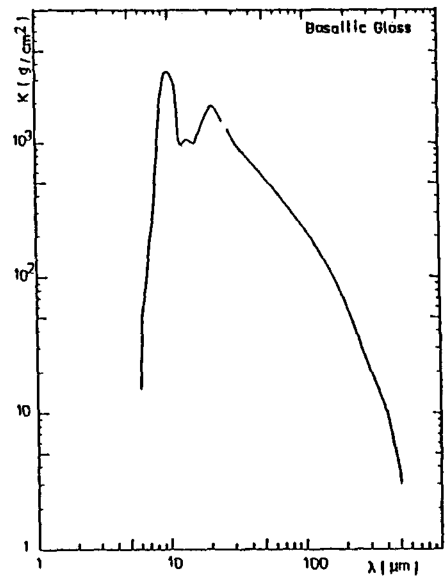

Fig.6. Mass extinction coefficient of basalt glass.

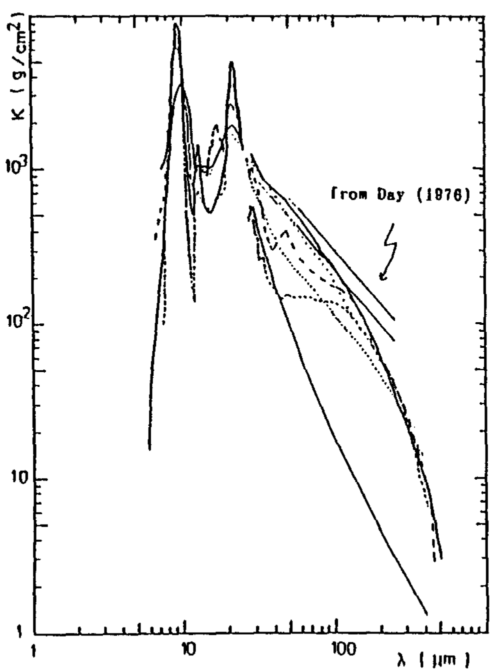

Fig.7. Mass extinction coefficients of various silkates. The thick solid line indicates the extinction spectrum of fused quartz, the broken line is that of obsidian, the dotted line is that of tektite, the dashed line is that of sanukite, the thin dotted line is that of kilauea volcanic glass, and the thin solid line is that of basalt glass.

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