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MERCURY: MID-INFRARED (7.3 - 13.5 μm) SPECTROSCOPIC OBSERVATIONS SHOWING FEATURES CHARACTERISTIC OF PLAGIOCLASE.

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Mid-infrared spectroscopic observations of the surface of Mercury are reported for the wavelength range 7.3 to 13.5 μm. The observed spectral radiance emanated from equatorial and low latitude regions between 110-130° Mercurian longitude. The area is primarily an intercrater plain. The spectra show distinct and recognizable features, the principal Christiansen emission peak being the most prominent. The Christiansen feature strongly suggests the presence of plagioclase (Ca,Na)(Al,Si)$AlSi_2O_8$, (in particular labradorite: $Ab_{(50)}$ - $Ab_{(30)}$). In addition we have studied the effects of thermal gradients to gain insight into the effects of thermal conditions on the spectral radiance of rock samples. This simulates the thermophysical effects as the rotating surface of Mercury is alternately heated and cooled. The spectral features of the samples are retained, however the relative and absolute amplitudes vary as illustrated by laboratory reflectance and emittance spectra from quartzite.

Figure 2 shows a solid, whole rock sample of quartzite that was measured for both reflectance and emittance. Spectral emittance (E1) is high when the rock is initially removed from an oven (530K). After some cooling (E2) the peak of the Planck function moves to longer wavelength and the ratio of the cooler rock to the same blackbody cavity shows decreased emissivity at short wavelengths. Spectra obtained from a cold sample immediately after illumination (R1), and after steady illumination for two minutes (R2) are shown. It can be seen in figure 2 that the effect of rock warming with time was to change the slope of the overall spectrum. The values at the short wavelength end of the spectrum are raised because of the additional flux contributed by warming the rock. Spectral features are well-correlated among all four spectra. The characteristic fundamental and overtone Si-O stretching modes are clearly seen although the emission spectra show less overall spectral contrast than those in reflectance.

OBSERVATION - INSTRUMENTATION

Mercury observations were made at the NASA Infrared Telescope Facility (IRTF) 3.0 m telescope on Mauna Kea, Hawaii. The thermal IR spectra were obtained July 12, 1992 using the High Resolution Grating Spectrometer (HIFOGS) Witteborn *et al.* [1]. HIFOGS has cryogenically cooled aperture and filter wheels, grating, and a linear array of 120 Bi-doped Si detectors. To increase the spectral range slightly, and to increase the resolution (decrease the wavelength sampling increment), all standard stars and Mercury were measured at two grating settings. The first grating setting spanning wavelengths of 7.22 to 13.02 μm and the second 7.61 to 13.30 μm. The individual spectra have an average resolution of 0.048 μm. After the spectra from the two grating settings are interleaved, the spectral resolution is improved to 0.025 μm. Telluric absorptions were corrected for by using alpha Boo. All ratioed spectra were then corrected for the spectral shape of alpha Boo (K2 II) using a spectrum generated from several observations of alpha Boo from Kuiper Airborne Observatory, the IRTF, and the NASA 1.5 m telescope at Mt. Lemmon (Cohen *et al.* [2]; Cohen *et al.* [3]). The spectra were smoothed with a five point smoothing function and normalized to unity at the maximum in emissivity.

References: [1] Witteborn F.C., et al. Astro. Soc. Pacific Conf. Series Astro. IR Spec. Conf. 365-372 (1993). [2] Cohen et al. Astro. J. 104, 5, 2030-2044 (1992). [3] Cohen et al. Astro. J. 104, 5, 2045-2052 (1992).

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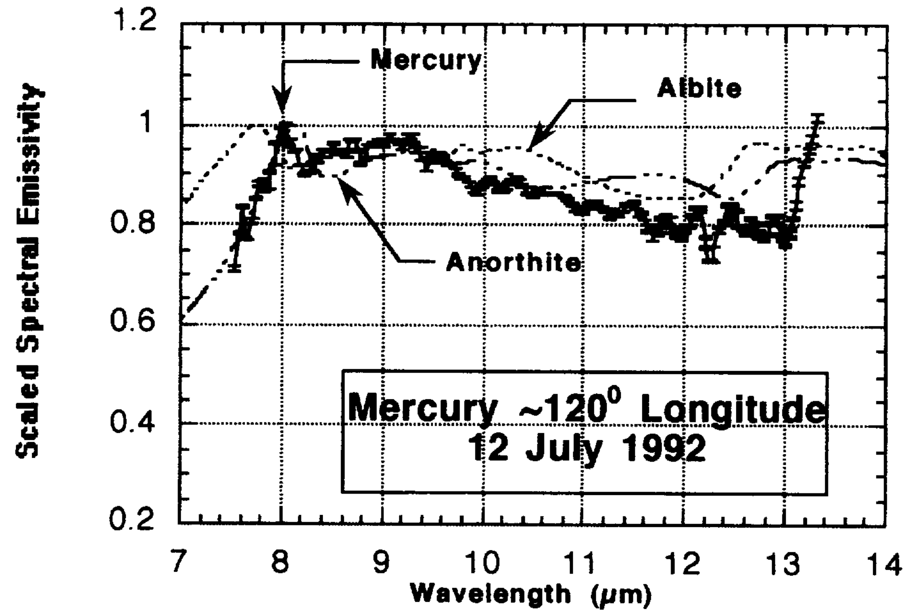

Figure 1. The Mercury spectrum is plotted with spectra of the end members of the plagioclase series: albite ($NaAlSi_3O_8$) and anorthite ($CaAl_2Si_2O_8$). Note the Christiansen features at 7.7 and 8.2 μm respectively. The Mercury Christiansen feature is at 8.0 μm. Assuming a linear mixing model, this corresponds to 40% albite and 60% anorthite, i.e. labradorite. Labradorite is characteristic of igneous rocks of gabbroic composition and of anorthosites.

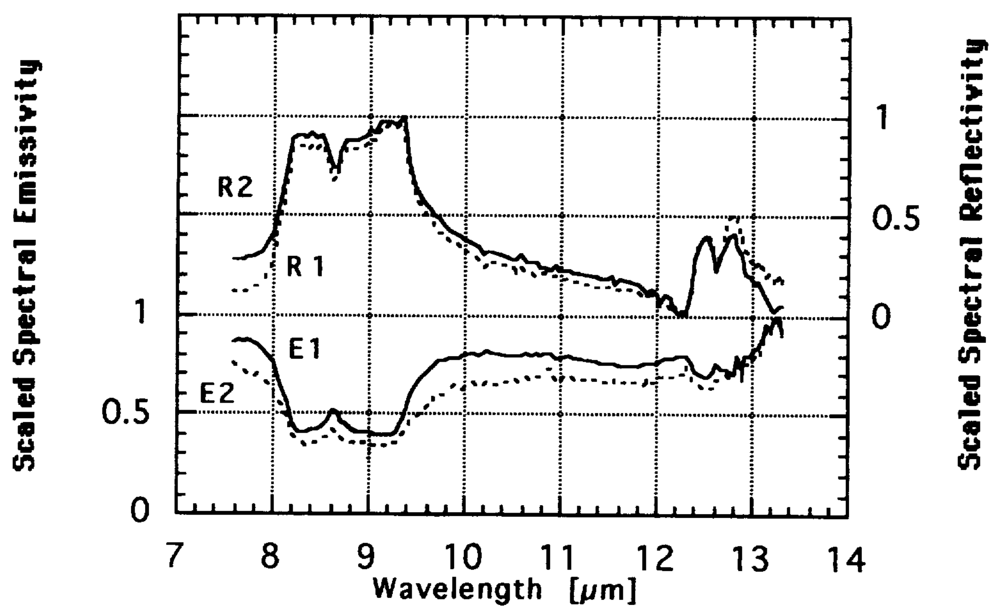

Figure 2. Plotted above are spectra of quartzite obtained with HIFOGS at the same spectral resolution used to observe Mercury. The top two spectra (R1 and R2) are reflectance spectra from an illuminated, cold sample. The bottom two spectra (E1 and E2) are emittance spectra obtained from the same sample after heating to 530 K. Spectra were ratioed to the spectrum of a blackbody cavity at 347 K. Heating and cooling effects are described in the text.