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**STATIONARY EDDIES IN THE MARS GENERAL CIRCULATION AS SIMULATED BY THE NASA-AMES GCM.** J. R. Barnes<sup>1</sup>, J. B. Pollack<sup>2</sup>, and R. M. Haberle<sup>2</sup>, <sup>1</sup>Oregon State University, Corvallis OR 97331, USA, <sup>2</sup>NASA Ames Research Center, Moffett Field CA 94035, USA.

Quasistationary eddies are prominent in a large set of simulations of the Mars general circulation performed with the NASA-Ames GCM. Various spacecraft observations have at least hinted at the existence of such eddies in the Mars atmosphere. The GCM stationary eddies appear to be forced primarily by the large Mars topography, and (to a much lesser degree) by spatial variations in the surface albedo and thermal inertia. The stationary eddy circulations exhibit largest amplitudes at high altitudes (above 30–40 km) in the winter extratropical regions. In these regions they are of planetary scale, characterized largely by zonal wavenumbers 1 and 2. Southern hemisphere winter appears to be dominated by a very strong wave 1 pattern, with both waves 1 and 2 being prominent in the northern hemisphere winter regime. This difference seems to be basically understandable in terms of differences in the topography in the two hemispheres.

The stationary eddies in the northern winter extratropics are found to increase in amplitude with dust loading. This behavior appears to be at least partly associated with changes in the structure of the zonal-mean flow that favor a greater response to wave 1 topographic forcing. There are also strong stationary eddy circulations in the tropics and in the summer hemisphere. The eddies in the summer subtropics and extratropics are substantially stronger in southern summer than in northern summer. The summer hemisphere stationary circulations are relatively shallow and are characterized by smaller zonal scales than those in the winter extratropics.

craft over the past 20 years have revealed that the ferric mineralogy occurs in two distinct forms: (1) nanophase or truly amorphous Fe<sup>3+</sup>-bearing materials [14,15] that spectrally resemble certain terrestrial palagonites [e.g., 16–20]; and (2) well-crystalline ferric oxides like hematite ( $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>), maghemite ( $\gamma$ -Fe<sub>2</sub>O<sub>3</sub>), or magnetite (Fe<sub>3</sub>O<sub>4</sub>) [1,13,15,21–24]. The available data indicate that the poorly crystalline “palagonite-like” phases are spectrally dominant [e.g., 5,6, and references within] and that the highly crystalline ferric oxides cannot constitute an abundance of more than about 4–8 wt% [24].

The research presented here represents the initial phase of a broader project that is intended to provide data in the mid- and far-IR spectral region for both well-characterized iron oxides/oxyhydroxides and poorly crystalline or amorphous materials (e.g., palagonites). Such information can be used in the interpretation of data to be returned by the Mars Observer Thermal Emission Spectrometer (TES). Additionally, this same information will prove useful for assessing the information content of existing Kuiper Airborne Observatory, Mariner 7, and Mariner 9 spectra, which also cover the thermal IR wavelength region.

**Spectral Studies:** In the mid IR (5–25  $\mu$ m), spectral features arise from vibrational motions of atoms and molecules that compose the materials. These fundamental modes are 1–2 orders of magnitude more intense than any associated combination and/or overtones of these modes that occur at wavelengths less than 5  $\mu$ m, and hence remote sensing observations in the IR are extremely sensitive to minor concentrations of these absorbing species.

From a planetary perspective, in the mid to far IR these diagnostic features occur where thermal emission rather than reflected sunlight supplies the observed photons. They occur under two sets of conditions. First, suspended particles in a nonisothermal atmosphere produce features near their vibrational fundamentals since these bands modulate the wavelength behavior of both the extinction coefficient and the single scattering albedo of the atmospheric layers within

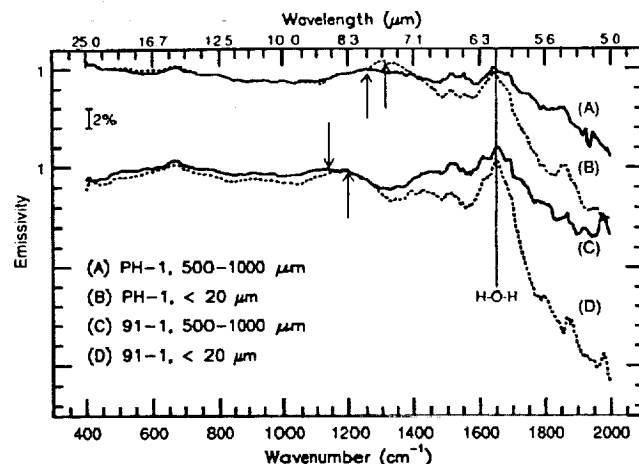
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**THERMAL EMISSION MEASUREMENTS (5–25  $\mu$ m) OF HAWAIIAN PALAGONITIC SOILS WITH IMPLICATIONS FOR MARS.** J. F. Bell III<sup>1</sup> and T. L. Roush<sup>2</sup>, <sup>1</sup>Mail Stop 245-3, NRC/NASA Ames Research Center, Moffett Field CA 94035-1000, USA, <sup>2</sup>San Francisco State University and NASA Ames Research Center, Mail Stop 245-3, Moffett Field CA 94035-1000, USA.

**Background:** There is ample evidence that abundant Fe-bearing minerals are present on Mars. This evidence takes the form of *in situ* analyses [1–4], previous and continuing Earth-based telescopic spectroscopic observations (reviewed in [5,6]), Viking Lander and Orbiter multispectral imaging [7–10], and Phobos 2 multispectral imaging [11,12]. Information regarding the crystalline or amorphous nature of the Fe-bearing (and other) surface materials on Mars can provide insight into the availability of liquid water at the surface and the duration, mode, and extent of weathering.

Data from Viking X-ray fluorescence analyses, magnetic experiments, and aerosol imaging were interpreted as indicating the presence of a variety of Fe-rich materials, including iron oxides [1–4,13]. However, since the Viking Landers did not carry any instruments capable of determining mineralogy, the exact mineralogical form of the Fe-bearing material remains uncertain.

Interpretations of continuing visual, near-, mid-, and far-infrared (IR) spectroscopic observations of Mars from the Earth and space-



**Fig. 1.** Emissivity spectra of Hawaiian palagonitic samples PH-1 (thermally altered palagonitic tephra from Mauna Kea) and 91-1 (palagonitic tephra from South Point, island of Hawaii). Both coarse and fine size fraction spectra are shown. Arrows indicate subtle shifts in emissivity peak position between the two particle size regimes shown. The vertical line shows the frequency of the strong H-O-H bending fundamental caused by molecular water associated with these samples.