

Spectroscopy of Fumaroles with Venus Emissivity Mapper Instrument Breadboard

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Abstract

Venus is the most earth like terrestrial planet in our solar system, yet very little is known about its surface composition. The Venus's atmosphere allows five transparent windows between $\sim 0.86 \mu\text{m}$ and $\sim 1.18 \mu\text{m}$ which could be used to study the surface mineralogy with an imaging spectrometer. An early breadboard of the Venus Emissivity Mapper instrument is used in this study, performing spectroscopy in three bands with wavelengths $850 \mu\text{m}$, $905 \mu\text{m}$ and $1000 \mu\text{m}$. These bands are close to the atmospheric windows in the Venus's atmosphere. For the field test, the caldera of Vulcano in Italy is selected as it has active fumaroles that continuously release hot gases and water vapor. The hot temperatures, fumes and the ample Sulphur deposits around the fumaroles makes it possible to simulate Venus like conditions in the field. In this study, the fumaroles are imaged at the above-mentioned wavelengths and at apertures F1.4, F2 and F4. The recorded images are deconvoluted with the sensor's QE response curves to obtain the original incident radiation. The processed images are then analyzed with Principal component analysis and K-means clustering to classify each of the pixels into groups of similar materials. The results clearly show that with our instrument, it is possible to distinguish between the basaltic volcanic ash background, the fumes released in the air and the Sulphur deposits around the fumaroles. The results obtained in this study are confirmed with actual onsite observation and comparison with color images of the observed site.