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Progress Report on Study of Cybele Group Asteroids

K. D. Hargrove (1), H. Campins (1), M. Kelley (2)
(1) University of Central Florida, USA, (2) University of Maryland, USA
(khargrove@physics.ucf.edu)

Abstract

In 2010 we reported water ice and organics on asteroid 24 Themis, and shortly after on asteroid 65 Cybele [1], [3]. These findings have spurred us to investigate more primitive asteroids in the outer regions of the main belt. We present our findings for two Cybele Group asteroids: 107 Camilla and 121 Hermione. Our 2-4 μm IRTF-SpeX spectrum of 121 Hermione appears significantly different from those of 24 Themis and 65 Cybele. This is in contrast with our 2-4 spectrum of 107 Camilla, which is closer to the spectra of asteroids 24 and 65. We also present 5-38 μm spectra obtained with NASA's Spitzer Space Telescope. The Spitzer spectra also suggest that 121 Hermione is compositionally *different* from 65 and 24, while 107 Camilla is *similar*. This diversity at infrared wavelengths among primitive asteroids can be used to constrain recent dynamical models of the origin of these objects.

1. Introduction

Asteroids in the outer belt, defined here as objects with a semi-major axis greater than 3.0 AU, hold clues to the origin and evolution of the solar system. These bodies are believed to have experienced less heating than most other asteroids and likely have a primitive composition. Since only a few primitive asteroids have been observed in the 2-4 μm region, and most of them at a low S/N ~ 10 level, we have started an infrared spectroscopic investigation of these objects, which has already yielded exciting published results. Using NASA's Infrared Telescope Facility (IRTF) and NASA's Spitzer Space Telescope, we have obtained spectra of a number of these primitive objects. We have focused so far on two groups of asteroids: the Themis family and the Cybeles. The Themis family is home to at least two "main belt comets", which are asteroids that exhibit comet-like activity. Our spectra of the largest member of the Themis family, 24 Themis, showed features in the 2-4 μm region that could only be explained by the presence of water ice and organics covering the entire observed surface [1], [4]. This was the first detection of water ice and organics on an asteroid, and was quickly followed by a similar finding we made on the largest member of the Cybele group, asteroid 65 Cybele [2]

We have chosen to continue our study of Cybele dynamical group asteroids, more specifically, primitive C-types 107 Camilla and 121 Hermione, which have semi major axis of approximately 3.4 AU. The Cybeles are located between two significantly different populations of primitive asteroids, those in the main belt and those in the Jupiter Trojan clouds. Interestingly, asteroid 107 Camilla shares some surface characteristics with asteroid 24 Themis, and some with 65 Cybele and Jupiter Trojans. This suggests a spectral gradient with heliocentric distance may exist among primitive asteroids. By establishing the presence and composition of organics in asteroids throughout this region we intend to characterize any compositional gradient and use it to constrain models of solar system formation.

2. Preliminary Results

Our 2-4um IRTF-SpeX spectrum of 107 Camilla may be similar to that of asteroids 65 Cybele and 24 Themis; though Camilla's spectrum still requires subtraction of the thermal emission and fits to water-ice models. Even without subtraction of its thermal component, the spectrum of 121 Hermione suggests that it is compositionally different from 107 Camilla.

We used a thermal model to fit the IRS 5-48 μm Spitzer spectrum of 107 Camilla. By dividing the asteroid flux by the thermal model, we were able to check for silicate emissions at 10 μm (the Si-O stretch fundamental) [2]. We compared the emissivity spectra of 65 Cybele and 107 Camilla, shown in Figure 1. Both objects show emission plateaus at about 9.1 to 11.5 μm due to fine-grain silicates.

3. Figures

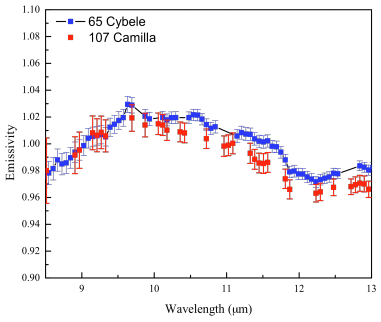

Figure 1: Emissivity Spectra of asteroids 65 Cybele and 107 Camilla. The emission plateaus are indicative of fine silicate grains.

4. Summary and Conclusions

We have confirmed water ice and organics on two primitive asteroids, and suspect that these compounds may be present on a third, 107 Camilla. Though, more data processing and analysis is needed. We also rule out 121 Hermione as having ice, organics and fine-grain silicates due to our interpretation of our IRTF SpeX 2-4um spectra and Spitzer IRS 5-48um spectra.

References

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