All About A-type Asteroid 446 Aeternitas

Lucas, Michael P.[1], MacLennan, Eric M.[1], Emery, Joshua P.[1], and Fauerbach, Michael[2]
(1) Department of Earth and Planetary Sciences, University of Tennessee, 1412 Circle Drive, Knoxville, TN 37996, mlucas9@utk.edu, (2) Egan Observatory, Florida Gulf Coast University, 10501 FGCU Blvd. South, Fort Myers, FL 33965

Abstract

Asteroid dynamical work has suggested that differentiated asteroids, precursors of metallic (core), olivine (mantle), and basaltic (crustal) fragments, may have formed in the terrestrial planet region and are now interlopers to the main-belt. Based on the geochemical diversity of iron meteorites, at least ~108 asteroid parent bodies experienced partial or total melting, hence differentiation and core formation, within the first few Myr of solar system history. However, aside from chips of 4 Vesta (Vestoids and HED meteorites), mantle and crustal fragments from differentiated asteroids are rare. Mantle fragments are represented in the asteroid population by taxonomic A-types, but these *pure-olivine* and *olivine-rich* objects remain cryptic among the spectrally observed asteroids. Here, we present data from several observational campaigns, acquired mostly using ground-based telescopes, for *olivine-rich* A-type asteroid 446 Aeternitas.

The main-belt asteroid Aeternitas (a = 2.79 AU) was discovered in 1899 by Wolf and Schwassmann. Knowledge regarding the physical properties of this object has greatly increased over the past three decades. Inversion techniques using our photometric lightcurves collected over three apparitions yield a refined sidereal rotation period of 15.73743 ± 0.00005 h, and generated a convex-hull shape model of the asteroid. Our results reveal that Aeternitas is a prograde rotator with an angular shape, and is likely a collisional fragment. Accordingly, for mantle material to be exposed the parent asteroid must be fragmented or its interior exposed via collisions. Visible and near-infrared spectra indicate that Aeternitas is an *olivine-rich* A-type with an ol/(ol+px) ratio of 0.92, with a minor (~8%) pyroxene component. Several inferences of mineral chemistry derived from these spectra suggest Mg-rich olivine compositions, analogous to pallasite meteorites. However, recent results suggest that the R-chondrites are a possible meteorite analog. We performed NEATM thermal modeling utilizing WISE (12 and 22 μm) data, employing refined absolute magnitude and slope parameter values. These results provide new estimates for effective diameter (D_{eff}) 56 ± 3 km, geometric albedo (p_v) 0.167 ± 0.030, infrared albedo (p_{ir}) 0.403 ± 0.040, and beaming parameter (η) 1.48 ± 0.10 for Aeternitas.