Asteroid 16 Psyche: Primitive or Differentiated?

MICHAEL K. WEISBERG[1,2] AND KIEREN T. HOWARD[1,2]

[1]Kingsborough Community College and Graduate Center, City University New York Brooklyn, NY 11234
[2]American Museum of Natural History, NY, NY 10024

16 Psyche is the target of a NASA Discovery-class mission scheduled to lauch in 2022. Interpreting the spectra of M-type asteroids, like Pysche, and reconciling them with the metoerite record has been challenging. They are described as similar to irons, enstatite chondrites (EC) [e.g., 1] and [2] suggested a possible link between the annomolus M-type asteroid 21 Lutetia and CH chondrites. Based on its high radar albedo [3], thermal inertia [4] and estimated grain density [5,6], Pysche is interperted to be dominated by FeNi and possibly an exposed core of a differentiated asteroid [e.g., 7]. Here we explore an alternative hypothesis that Psyche is a primitive asteroid possibly linked to CH-CB chondrites.

The bulk density of Pysche (~4.4 g/cm^3) requires considerable porosity (~40%) for intepretation as an iron-rich core [5,8]. Spectra suggest presence of enstatite on its surface [9], as well as a 3μm absorption feature characteristic of hydrated minerals, with similarity to CI chondrites [10]. This led [10] to suggest that Psyche might not be a metallic core or was impacted by a C chondrite-like material. The 3μm feature is present in 35% of M-type asteroids and inconsistent with them as metallic cores [11]. Irons and ECs are not known to contain hydrated minerals. Thus, a link of Pysche, and other M-type asteroids, to irons or ECs seems unlikely. However, presence of magnesian silicates and hydrated minerals is consistent with the metal-rich CH-CB chondrites.

CH-CBs have up to 70 vol.% metal. They contain magnesian silicates and hydrated CI-like clasts [12]. The bulk density of the Bencubbin CB is 5.66 g/cm^3 [13], closer to that for Psyche than irons. Thus, meteorites like CH-CB are more easily reconciled with the properties attributed to Psyche than irons or ECs and Psyche may be a primitive asteroid.

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