# ACTIVE ASTEROID (3200) PHAETHON AS THE PARENT BODY OF THERMALLY-ALTERED CARBONACEOUS CHONDRITES.

E. M. MacLennan[1] and M. Granvik[2], [1]Department of Physics, University of Helsinki, PO Box 64, FI-00014 Helsinki, Finland (eric.maclennan@helsinki.fi), [2]Department of Physics, University of Helsinki, Finland and Asteroid Engineering Laboratory, Space Systems, Luleå University of Technology, Kiruna, Sweden.

**Introduction:** The near-Earth asteroid (3200) Phaethon is thought to be the parent body of the annual Geminid meteor shower. Over the past decade, an active dust tail has repeatedly been observed over ~3 days during its perihelion approach at 0.14 au [1,2] making it one of the few rocky bodies associated with a meteor stream. The reflectance spectrum indicates that Phaethon is primitive in origin, but lacks evidence for hydration that is typical of primitive solar system bodies [3–5]. As a non-cometary body without volatile ices, no activity mechanism has been established and previously suggested mechanisms cannot precisely explain the short lived activity when temperatures exceed 1000 K. Additionally, the connection to an appropriate meteorite analog is ambiguous due to the lack of diagnostic features. Here, we interpret the mid-infrared emissivity spectrum of Phaethon (Figure 1, purple line), which exhibits clear signatures of both olivine and carbonates (e.g., calcite), and no phyllosilicate features that are expected from its primitive nature. This evidence strongly suggests a connection to the primitive Yamoto-group (CY) of carbonaceous chondrites and is inconsistent with other primitive meteorite groups. The CY chondrite group represents aqueously-altered CM or CI-like material that later experienced thermal metamorphism [6]. Carbonates found in these meteorites show evidence of thermal decomposition, which releases $CO_2$ gas [7, 8]. We show that Phaethon's surface temperatures during its observed window of activity exclusively match the experimental thermal decomposition of calcite or a similar carbonate species. All of these lines of evidence are strong indications that $CO_2$ release from carbonate thermal decomposition is responsible for Phaethon's dust activity. These findings validate solar heating as a valid mechanism for the thermal alteration products found among CY chondrites. The many implications of this work are relevant to the formation of the Geminid meteor stream [9], the source(s) of thermally-altered meteorites [10], and the destruction of low-perihelion asteroids [11].

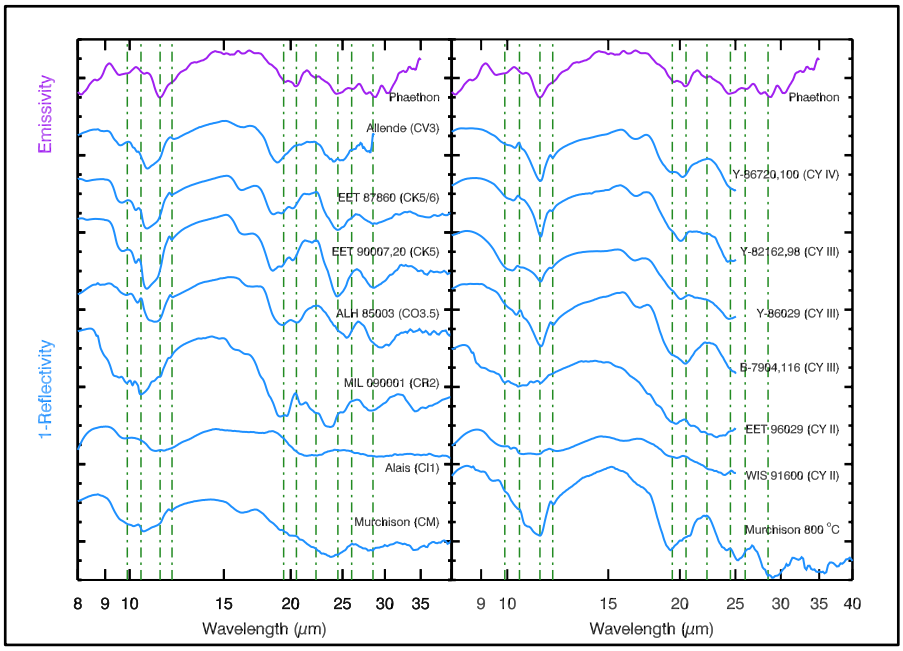


**Figure 1.** Spectral comparison between Phaethon (purple) and meteorite samples (blue). The left panel shows representative meteorites belonging to various carbonaceous chondrite subtypes and the right panel shows comparison to naturally heated (CY group) and artificially heated carbonaceous chondrites. Vertical green lines indicate fundamental olivine vibrational features.

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