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The Almahata Sitta Meteorite and its Relevance to Asteroid (101955) Bennu

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Abstract

We analyzed six strewn fields of low-albedo meteorite falls in order to determine if there are xenoliths of high albedo material present among them, as is the case for Almahata Sitta. We determined the location and size of the six carbonaceous chondrite strewn fields listed in the Meteoritical Bulletin Database: Allende (CV3, fell in Mexico, 1969), Moss (CO3, Norway, 2006), Murchison (CM2, Australia, 1969), Sutter's Mill (CM2, United States, 2012), Orgueil (CI1, France, 1864), and Tagish Lake (C2 ungrouped, Canada, 2000). The meteorite candidates were mapped and narrowed down by geographic location, placement relative to each strewn field, and year of fall to determine their likelihood of being a potential member of the original body. There are eight high albedo finds (ordinary chondrites, H and L) within the Allende strewn field that postdate the recorded fall. The finds have a placement that is supportive of being possible members of the Allende strewn field, although weathering of finds and exposure ages are still to be studied. No other recorded finds have been reported within the other strewn fields.

1. Introduction

The albedo diversity on the surface of asteroid (101955) Bennu is the largest observed in any asteroid. The geometric albedo ranges from 3.5% to >15% and the surface features detected so far range from centimeters to decameters in diameter [8]. To date, similar albedo diversity among meteorites have been reported for Almahata Sitta and Kaidun; however, for Kaidun the different lithologies were within one meteorite with a sample size was too small be used as an analog for the surface of Bennu [5]. Almahata Sitta was a large-scale fall event (in 2008) more relevant for comparison with Bennu. Almahata Sitta contained different lithologies within its strewn field including: ureilites, enstatite chondrites, two types of ordinary chondrites (H and L), and carbonaceous chondrites [2,4]; all these were linked to Almahata Sitta by their exposure histories. How rare are meteoritic falls like Almahata Sitta that contain different classifications within its strewn field? Here, we address this question and explore the relevance to the albedo diversity observed on the surface of Bennu. This comparison is motivated in part by the likelihood that both Bennu and Almahata Sitta originated from the same region of the asteroid belt and may have been affected by similar processes [1,3].

2. Summary and Conclusions

There are eight high albedo finds (ordinary chondrites, H and L) within the Allende strewn field that postdate the recorded fall. The finds have a placement that is supportive of being possible members of the Allende strewn field, although weathering of finds and exposure ages are still to be studied. No other recorded finds have been reported within the other strewn fields. Further investigation of the exposure ages (both the cosmic-ray exposure ages and the terrestrial exposure ages) of the individual finds within the Allende strewn field would be diagnostic of a link with the Allende fall. The fact that a large number of high-albedo meteorites have been found within the Allende strewn field, and none have been found in the other strewn fields, is consistent with the possibility that the incorporation of foreign lithologies into a carbon-rich meteoroid may not be uncommon. If correct, the data would suggest that the Allende parent body was composed of multiple lithologies, similar to that of the Almahata Sitta parent body and possibly Bennu.

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