HOW UNIQUE IS ALMAHATA SITTA AND HOW RELEVANT IS IT TO BENNU?

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Abstract | How uncommon 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].

Introduction

The geometric albedo of asteroid (101955) Bennu ranges from 3.5% to >15% and the surface features detected so far range from centimeters to decameters in diameter[8], as shown in *Figure 2*. 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 that was too small be an analog to 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.

Methods

We started by determining 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 (CM, United States, 2012), Orgueil (CI1, France, 1864), and Tagish Lake (C2 ungrouped, Canada, 2000). The high albedo meteorite candidates were mapped, arranged by geographic location, placed relative to each strewn field and year of find to determine their likelihood of being a potential member of the original body.

References

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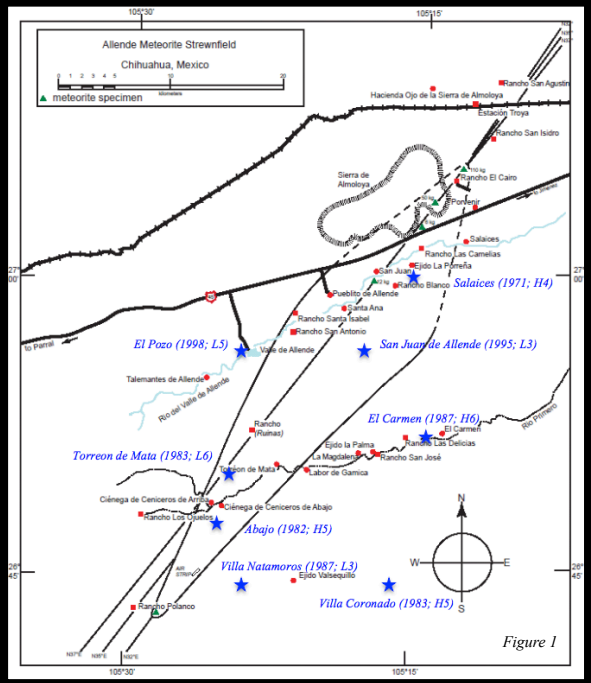
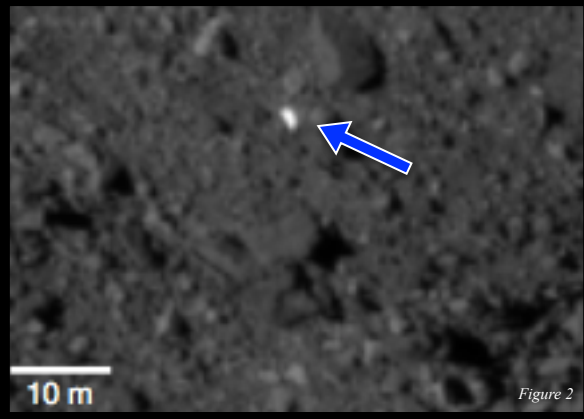
Results

There are eight high albedo finds (ordinary chondrites, H and L) within the Allende strewn field that postdate the recorded fall, as shown by *Figure 1*. Finds have placement that is consistent with being members of the Allende strewn field, although weathering and exposure ages of finds are still to be studied. No other recorded finds have been reported within the other strewn fields.





Summary

- A large number of high-albedo meteorites have been found within the Allende strewn field; none have been found in the other strewn fields. This is consistent with the possibility that foreign lithologies in carbon-rich meteoroids may be more common than previously thought. If correct, the data would suggest that the Allende parent body was composed of multiple lithologies, analogous to the Almahata Sitta parent body and possibly Bennu.
- Investigation of the cosmic-ray and terrestrial exposure ages of the individual finds in the Allende strewn field would be diagnostic of a link with the fall.

Figure 1 | The eight high albedo finds (blue stars) within the Allende strewn field. Adapted from Meteoritical Society Database.

Figure 2 | Brightest object identified thus far on 101955 Bennu. Credit: Lauretta and DellaGiustina et al. 2019