PDC 2025
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Review of instrumentally recorded meteorite falls as geological hand specimens of asteroid families

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To date, 74 meteorite falls have been instrumentally recorded by video cameras and still photographs and their pre-impact orbit determined. Two of which are the fall of Saint-Pierre-le-Viger from asteroid 2023 CX1 in France and the meteorite Ribbeck from asteroid 2024 BX1 in Germany.

A recent review paper takes stock of what we have learned so far about the source regions of our meteorites [1]. While six years ago there were only hints that different meteorite types approached on different orbits, now distinct patterns are emerging. Notably, the 10-cm to 1-m sized meteoroids responsible for most of our meteorites arrive on different orbits than larger 10-m to 10-km NEA of corresponding taxonomic type. They do, however, identify the meteorite type of a number of asteroid families in the Main Belt.

Most notable is a source of H chondrites at low inclination just beyond the 5:2 mean motion resonance. This source is likely located in the Koronis family. Three of those meteorites have the about 7 Ma Cosmic Ray Exposure (CRE) age corresponding to the dynamical age of the Karin family within Koronis, one has the 12 Ma age of Koronis2 and one has an 83 +/- 11 Ma CRE age that may well be the age of the Koronis3 family.

There is also a source of H chondrites in the Inner Main Belt with an about 35 Ma CRE age. I will present arguments for why that is likely the Massalia asteroid family, which has a 40 Ma sub-family. Other sources of H chondrites are high in the Central Main Belt, from where many of our H-like NEA

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originate. Two source regions are identified, one has the same dynamical age as the CRE age of the meteorites.

Most L chondrites arrive to Earth from a single source in the Inner Main Belt. I will present arguments for why that is likely the Hertha family (also known as the Nysa family).

Most LL chondrites arrive to us from the Inner Main Belt also, defining the petrographic and mineralogical properties of the Flora family.

In addition to these main ordinary chondrite groups, some other meteorite types have also provided approach orbits. We now know that CM chondrites originate from a low inclined source in the Central, Pristine or Outer Main Belt. Possible sources are discussed. It has been long recognized that Vesta and its family are the likely source of most of our HED achondrites. Some are now traced to specific impact craters on Vesta. The source regions of other meteorite types are discussed also.

Comments:

(Intended for NEO Characterization session, oral presentation)

References

[1] P. Jenniskens, H. A. R. Devillepoix, Review of asteroid, meteor, and meteorite-type links, Meteoritics and Planetary Science (2024) submitted.