Observing the planetesimal size distribution amongst main belt asteroids.

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Introduction: The mechanism by which dust accretes into planetesimals is an important subject of debate in the planetary science community (1,2). Fundamental parameters, such as their original size frequency distribution of planetesimals are unknown (2).

This problem is typically approached theoretically. Here we use astronomical data to identify the leftover planetesimals amongst all other asteroids, thereby constraining planetesimal formation processes.

An observational approach to the study of planetesimals: Our search is based on separating planetesimal survivors from families of asteroids generated by collisions all along the history of the Solar System.

If we could identify all collisional families and "clean" the Main Belt from their members, we would be left out with the survivors of the original asteroids, the planetesimals. Unfortunately, current asteroid family catalogues are not suitable for this cleaning. They are conservative and only a quarter of known asteroids is associated with ~110 distinct asteroid families (3).

Our new method of collisional family identification: Thus, we have developed a more general method (4,5) to identify asteroids that are collisional fragments and applied it to the population of asteroids of the inner part of the Main Belt (population of asteroids with orbital semimajor axis between 2.1 and 2.5 au). The major advantage of this method is that it searchers a correlation between semimajor axis and inverse diameter in a population of asteroids. This correlation is expected for families of fragment asteroids produced by the fragmentation of a parent body and the subsequent dispersal due to the Yarkovsky effect.

Results: We discovered three very old asteroid families that escaped detection with classical families identification method (5,6). We report about our "cleaning" operation in the inner Main Belt and about the resulting planetesimal cumulative size distribution (5,6). This becomes shallow for sizes smaller than about 100 km and shows a lack of 30 km or smaller planetesimals, supporting previous works indicating that asteroids were born big (7,8,9).

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