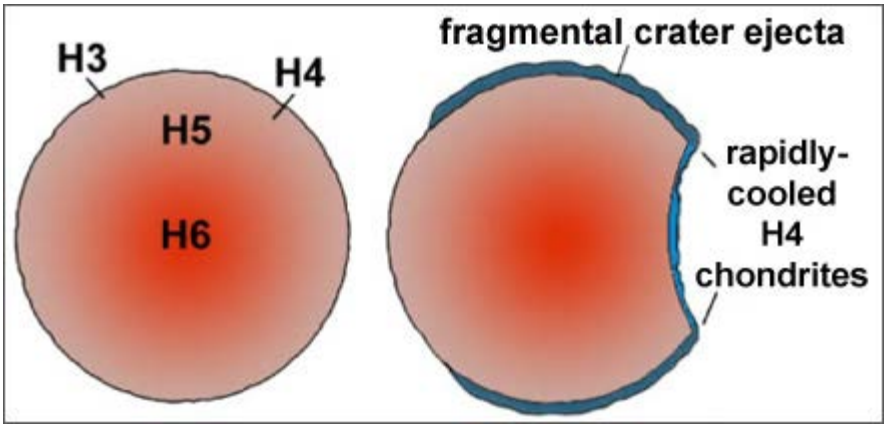
PLANETARY SCIENCE RESEARCH DISCOVERIES
CosmoSparks

Quick Views of Big Advances

Messing with an Onion

Meteorites have recorded the heating and cooling of asteroids. In the case of meteorites that did not melt, the story should be simple: radioactive decay of short-lived isotopes such as aluminum-26 heat an asteroid, which then cools, with the deepest rock cooling slowest and the layers near the surface cooling fastest, with gradations in between. A classic case is H chondrites and their parent asteroid. Cosmochemists classify these meteorites by the extent to which they were modified (metamorphosed) by heating, from type 6 (deepest, hottest, and slowest cooled) to type 3 (shallowest, coolest, and most rapidly cooled).



The expected smooth temperature and cooling rate gradations along the radius of the asteroid are nicknamed the "onion shell model." Precise determinations of ages of H chondrites are consistent with the onion shell model: Type 4 H-chondrites are older than the more slowly-cooled Type 6 chondrites. On the other hand, Ed Scott (University of Hawai'i) and coworkers measured cooling rates from the compositions of metallic iron-nickel grains in H chondrites. Although they also found that in general cooling rates decrease from Type 4 through Type 6, some Type 4 samples cooled so fast that their burial depths would be too shallow for them to have been heated enough to record the effects of metamorphism. Scott suggests that the nice, orderly cooling of the H-chondrite asteroid was disrupted by an impact that exposed deeply buried rock, causing it to cool faster. Thus, impacts play an important role in asteroid cooling, including messing up the tidy H-chondrite onion shell structure.

See: Scott et al. (2010) Metamorphism and impacts on the parent asteroid of H chondrites, 41st Lunar and Planetary Science Conference, abstract #1529 [***NASA ADS entry***] and the PSRD article ***Heating, Cooling, and Cratering: One Asteroid's Complicated Story***.

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