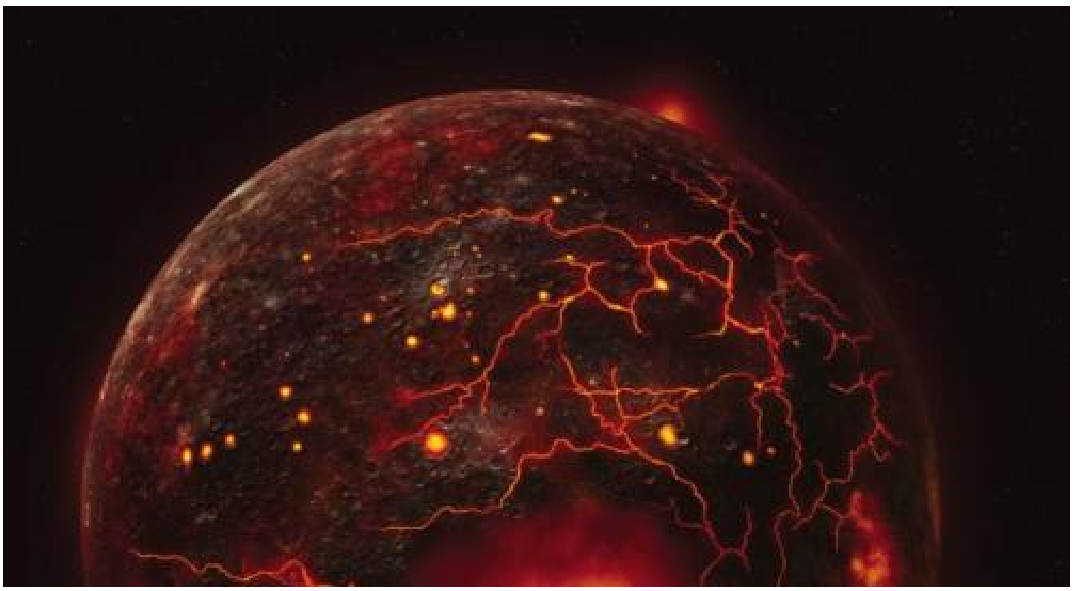
Researchers find evidence of speedy core formation in solar system planetesimals

June 6 2014, by Bob Yirka



Planetary core formation. Credit: Speed metal, *Science* 6 June 2014.

(Phys.org) —A combined team of researchers from Germany, Switzerland and the U.S. has found evidence of faster than thought core formation of planetesimals in our solar system. In their paper published in the journal *Science*, the team describes how they came up with a new approach to using tungsten isotope dating in a way that overcame the problem of cosmic rays affecting accuracy. Tim Elliot offers a Perspective piece in the same issue delving further into the work by the team and explains how the new findings are likely to lead to better dating for planetary development in general.

Scientists believe approximately 4.6 billion years ago, our solar system was little more than a star surrounded by a molecular cloud. That cloud eventually coalesced into a proto-planetary disk which eventually coalesced further into planetesimals. Planets and moons and other bodies in the solar system came about as a result. But, one thing that has puzzled space scientists was the rate at which the cores of the planetesimals formed, or put another way, how soon after the formation of solar system, did the cores start to form? To come up with a good approximation, the researchers looked to existing iron meteorites—they are believed to been the creative force behind core formation.

To determine the age of five existing iron meteorites, the researchers used tungsten radioactive isotope dating, an approach used before. Such prior efforts were hobbled in their accuracy, however, by the impact of cosmic rays over time. To get around that problem, the researchers used platinum isotope compositions. Doing so allowed the researchers to calculate that core formation of early planetesimals likely began as early as 100,000 years to 300,000 years after the formation of the solar system.

These findings help explain why the materials that made up the bodies currently in our solar system weren't blown away by the sun—previous estimates suggested core formation took up to twenty million years, enough time to push such materials beyond our stars' gravitational pull. With such a short formation time, however, the cores of the developing planetesimals would have formed before they were pushed too far out, allowing them to be captured by the tug of the sun's gravity.

More information: Protracted core formation and rapid accretion of protoplanets, *Science* 6 June 2014: Vol. 344 no. 6188 pp. 1150-1154
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ABSTRACT

Understanding core formation in meteorite parent bodies is critical for constraining the fundamental processes of protoplanet accretion and differentiation within the solar protoplanetary disk. We report variations of 5 to 20 parts per million in 182W, resulting from the decay of now-extinct 182Hf, among five magmatic iron meteorite groups. These 182W variations indicate that core formation occurred over an interval of ~1 million years and may have involved an early segregation of Fe-FeS and a later segregation of Fe melts. Despite this protracted interval of core formation, the iron meteorite parent bodies probably accreted concurrently ~0.1 to 0.3 million years after the formation of Ca-Al–rich inclusions. Variations in volatile contents among these bodies, therefore, did not result from accretion at different times from an incompletely condensed solar nebula but must reflect local processes within the nebula.

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