
EAPS Planetary Lunch Colloquium Series (PICS)

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Paleomagnetic evidence for an outer solar system meteorite

It is thought that there were at least two major planetary rearrangements within the first 1 Gyr of our solar system. Such events are believed to have played a crucial role in shaping the present-day architecture of our solar system as well as possibly those of exoplanetary systems. Within our own solar system, these planetary migrations have been proposed to have brought material that formed beyond the orbit of the gas giants into the inner solar system, possibly explaining the compositional trends across the asteroid belt as well as the makeup of the Trojan asteroids. However, very few robust, accurate or quantitative estimates of the heliocentric distances of the formation of meteorite parent bodies exist. These distance estimates would also provide a means of investigating the range over which the first solids may have been recycled throughout the solar system by stellar outflows.



Here, we present paleomagnetic evidence that the Tagish Lake meteorite does not contain a stable magnetic remanence. Given the ancient aqueous alteration age of this meteorite (<4 Myr after calcium-aluminum rich [CAI] formation), this absence suggests that the Tagish Lake parent body must have originated from >10–20 AU where the magnetic field generated by the collapse of the dust and gas within the nebula was <0.15 μ T. This distance corresponds to radii greater than the orbits of the gas giants prior to Grand Tack, suggesting the Tagish Lake parent body represents the outer disk bodies that now constitute the Kuiper belt and could therefore feasibly be a comet. Tagish Lake contains sparse chondrules and even rare CAIs, indicating that stellar outflows were capable of moving material that formed within 1 AU of the Sun, and within 1 Myr of CAI formation, to distances as far as that of present-day Saturn or Uranus. Finally, our results provide the first direct, quantitative observation from the meteorite record that a body formed in the outer solar system now resides in the inner solar system, supporting the existence of major planetary migrations that altered the architecture and structure of our solar system.

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