

The Lockne – Målingen doublet impacts, the result of a binary asteroid from the 470 Ma Main Asteroid Belt Event

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Approximately 470 million years ago one of the largest cosmic catastrophes occurred in our solar system since the accretion of the planets. A 200-km large asteroid was disrupted by a collision in the Main Asteroid Belt (MAB), which spawned fragments into Earth crossing orbits. This had tremendous consequences for the meteorite production and cratering rate during several millions of years following the event. The 7.5-km wide Lockne crater, central Sweden, is known to be a member of this family. The 600 m large Lockne asteroid was a binary and had a companion in space by a smaller 150 m satellite. The recent discovery of the nearby, 0.7-km diameter, synchronous Målingen crater suggests it to form a doublet impact structure together with the larger Lockne crater, and as we will show here, most likely by a binary, ‘rubble pile’ asteroid. Despite observational evidence that about 16% of the Near Earth Asteroids (NEA’s) are binary, only a handful of the approximately 188 known craters on Earth have been suggested as potential doublets. The stratigraphic and geographic relationship with Lockne suggests the Lockne and Målingen craters to be the first described doublet impact structure by a binary asteroid into a marine-target setting. In addition, the precise dating of the Lockne-Målingen impact in relation to the MAB breakup event provides a hands-on reference for studies of the formation of binaries from asteroid breakup events.