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Cratering on 4 Vesta – Comparison of Crater Retention Ages and Ar-Ar Ages of HED Meteorites.

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In July 2011 the Dawn spacecraft entered orbit around the Main Belt asteroid 4 Vesta utilizing three different instruments to map the asteroid [1]. The Main Belt is the source region of most impactors in the inner solar system [2]. We compare the obtained crater size-frequency distribution (CSFD) of Vesta with that of the Moon and other Main Belt asteroids such as 951 Gaspra, 243 Ida, and 21 Lutetia. We also compare our results of crater counting on Vesta with K/Ar-Ar reset ages of HED meteorites, which most likely originated from Vesta [3].
To properly compare the lunar CSFD with that of the asteroids we applied scaling laws [4] to account for various impact velocities, surface gravities as well as material properties between the investigated bodies. We found well defined lunar-like CSFDs of impact craters on all four asteroids. The CSFD of Vesta and Lutetia had to be constructed from several individual measurements following [5]. We were able to derive lunar-like chronologies for each asteroid utilizing intrinsic collision probabilities [6], lunar-like CSFDs and the ground truth-derived lunar chronology. Since the Moon and the Main Belt asteroids share the same main impactor source, it is straightforward to also assume a very similar time-dependent impact rate over the solar system history. Alternative chronologies, which are based on computer models of the LHB [7], result in surface ages >4.5 Ga, which are highly unlikely for Vesta.
Our lunar-like chronology for Vesta is able to match three out of four peaks in age probabilities of HED meteorites [3]. We measured the age of the Rheasilvia basin with 3.70 +/-0.02 Ga, which coincides with a wide-spread resurfacing age on Vesta. An underlying older basin, partially obliterated by the Rheasilvia impact was formed 3.81 +/-0.05 Ga ago. Finally the large basins and craters >150 km in diameter and the densest cratered areas on Vesta indicate a global resurfacing event 4.00 +/-0.02 Ga ago. This represents the oldest age we can infer from Vesta by this technique.

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