Crater Size-Frequency Distributions and Chronologies of Asteroids. N. Schmedemann[1], T. Kneissl[1], G. Michael[1], R.Wagner[2], G. Neukum[1], A. Nathues[3], H. Sierks[3], [1]Institute of Geosciences, Freie Universität Berlin, Berlin, Germany, [2]German Aerospace Center, Institute of Planetary Research , Berlin, Germany, [3]Max-Planck-Institut für Sonnensystemforschung, Katlenburg-Lindau, Germany, (nico.schmedemann@fu-berlin.de)

Introduction: In recent years several space probes visited a number of small bodies. Right now the Dawn mission [1] is gathering imaging data from an orbit around the asteroid 4 Vesta. The asteroid Main Belt is believed to be the source region of impactors in the inner solar system [2]. For decades the lunar cratering record has been investigated and even probed by sample return missions. Thus, it is well suited for comparison with other planetary surfaces. In the case of Vesta it is even possible to test cratering chronologies against the radiometric ages of HED meteorites, since Vesta is probably the only source of HED meteorites in the solar system [7].

Crater Size-Frequency Distribution (CSFD): Scaling laws have been derived by several groups e.g. [3, 4] to predict the relation between projectile size and crater size with respect to numerous impact properties like impact speed, angle, target materials, etc. In this work we utilize the scaling laws by [4]. Because the CSFD of impact craters on the Moon is well known, we can use it together with scaling laws to predict the CSFD of other celestial bodies like asteroids and test it against observations we got from space probes. Fig. 1 shows the lunar CSFD in comparison with measurements derived from a number of small asteroids like Gaspra, Ida, Steins and Lutetia. It is obvious that low gravity targets like asteroids display a significantly flatter distribution of large craters. Despite slightly different material properties of the investigated bodies the scaling is dominated by the impact velocity and surface gravity. This results in highly similar CSFD throughout the mentioned asteroids. Vesta, however is much more massive and consequently has a CSFD lying in between the lunar CSFD and the shown small asteroid CSFD. Our measurements on Dawn imaging data are in very good agreement to our modeled CSFD for Vesta.

Asteroid Chronologies: As the lunar surface has accumulated a cratering record dating back to the early solar system history and sample return missions provided radiometrically datable material, we now have a ground truth calibrated lunar chronology available [5]. Scattering processes caused by collisions among asteroids, dynamical interaction with major bodies as well as non-gravitational forces scatter projectiles from the Main Belt all over the solar system [6]. This processes left behind a detailed cratering record on many planetary surfaces which are less affected by resurfacing processes. The travelling time of meteorites from the Main Belt to e.g. the lunar surface is short [6]. It is about an order of magnitude less than the half life time value derived for the exponential decay in the lunar cratering rate [2].

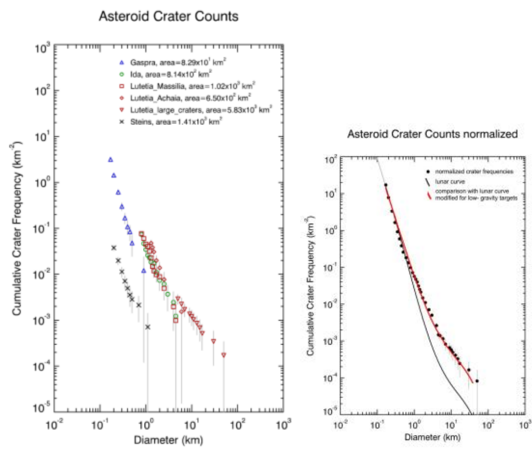

Fig.1: *Left: Crater measurements on asteroids Gaspra, Ida, Lutetia and Steins show a high intrinsic similarity to each other. Right: Normalized measurements from the left hand-side (dark points) display a flatter CSFD than the lunar curve (black curve). Scaling laws account for different impact properties and predict a well fitting model CSFD for small asteroids (red curve).*

Thus, it is very likely that any time dependent development of the impactor population in its source region, the asteroid Main Belt is directly projected into the cratering records of the planetary surfaces. Therefore, we use a lunar-like chronology for asteroids and scale it to the respective impact rates. This scaling is primarily based on an attempt by [6] but incorporates as much observational data as possible. In the case of Vesta we have radiometric Ar-Ar ages of HED meteorites [7] available, which seem to be in excellent agreement with our results from crater counting.

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