Mercurian Impact Ejecta: Meteorites and Mantle. B.J. Gladman[1] and J. Coffey[1], [1]University of British Columbia, Department of Physics and Astronomy, and Institute for Planetary Science, 6224 Agricultural Road, Vancouver, British Columbia, V6T 1Z1, Canada. Email : gladman@astro.ubc.ca .

Introduction: We have examined [1] the fate of impact ejecta liberated from the surface of Mercury due to impacts by comets or asteroids, in order to study (1) meteorite transfer to Earth, and (2) re-accumulation of an expelled mantle in giant-impact scenarios seeking to explain Mercury's large core.

Meteorite Transfer : In the context of meteorite transfer during the last 30 Myr [2,3,4], we note that Mercury's impact ejecta leave the planet's surface much faster (on average) than other planet's in the Solar System because it is the only planet where impact speeds routinely range from 5—20 times the planet's escape speed [5]; this causes impact ejecta to leave its surface moving many times faster than needed to escape its gravitational pull. Thus, a large fraction of mercurian ejecta may reach heliocentric orbit with speeds sufficiently high for Earth-crossing orbits to exist immediately after impact, resulting in larger fractions of the ejecta reaching Earth as meteorites. We calculate the delivery rate to Earth on a time scale of 30 Myr (typical of stony meteorites from the asteroid belt) and show that several percent of the high-speed ejecta reach Earth (a factor of 2—3 less than typical launches from Mars). Similar quantities of material reach Venus. These efficiencies are one to two orders of magnitude larger than previous estimates in the literature, making more plausible the hypothesis that the worldwide collections may already hold mercurian meteorites.

Stripping of a proto-mercurican mantle: These calculations also yield measurements of the re-accretion time scale of material ejected from Mercury in a putative giant impact [6] (assuming gravity is dominant). For mercurian ejecta escaping the gravitational reach of the planet with excess (speeds once out of the gravity well) equal to Mercury's escape speed, about one third of ejecta re-accretes in as little as 2 Myr. Thus collisional stripping of a silicate proto-mercurian mantle can only work effectively if the liberated mantle material remains in small enough particles that radiation forces can drag them into the Sun on time scale of a few million years, or Mercury would simply re-accrete the material. The heliocentric ring of material is sufficiently massive that it may self interact and self shield itself from radiation drag forces, thus enhancing its re-accretion onto the planet. A mantle-stripping hypothesis [7] must carefully address the quantity and physical state of the material ejected.

References:

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