



The parallel grooves of Phobos: new evidence on their origin from HRSC Mars Express

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The origin of the grooves of Phobos has been debated since they were first discovered. Early hypotheses included faults or outgassing vents caused by tidal or drag forces during the capture of Phobos, but more recently, origins associated with the impact of Stickney, at 10 km the largest crater on Phobos, have predominated. The latter have envisaged the grooves as chains of secondary craters or fracturing associated with the Stickney impact. More recently, it has been suggested that they result from chains of secondary craters from large impacts on Mars. This last hypothesis predicts that the leading apex of Phobos should have families of parallel grooves crossing each other at all angles, but deciding between these various hypotheses has been hampered by the fact that not all of Phobos has been imaged by previous missions with sufficient resolution and illumination to detect the grooves. Phobos has now been imaged during more than a dozen passes by HRSC, including one of the unknown part of the northern hemisphere at 7m resolution. There are also two images which include the leading apex at 48m and 50m resolution. Despite unfavourable vertical illumination, it can be seen to be heavily grooved, with orientations corresponding closely to those predicted by the last idea.

A new map of Phobos' grooves shows their orientation to be quite independent of Stickney crater, and the evidence is now overwhelming that the grooves of Phobos were caused by debris ejected from a large impact craters on Mars. The orientation of each family of grooves allows the inertial direction of arrival of the ejecta at Phobos to be determined, but not its velocity. By varying the velocity, we are able to determine

the possible orbits that come from Mars' surface, and a range of launch angles. Since launch angles of ejecta from hypervelocity impacts are now reasonably well understood, the latitude of the impact event on Mars that gave rise to each groove family can be calculated with a reasonable degree of confidence.