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Cassini Imaging of Iapetus and Solution of the Albedo Asymmetry Enigma

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Cassini imaging of Iapetus during one close and several more distant flybys mainly in the first years of the mission revealed an alien and often unique landscape of this third-largest moon in the Saturnian system [1]. The data show numerous impact craters on the bright and dark terrain, equator-facing dark and pole-facing bright crater walls, huge impact basins, rather minor endogenic geologic features, a non-spherical, but ellipsoidal shape, a giant ridge which spans across half of Iapetus' circumference exactly along the equator, a newly detected global 'color dichotomy' presumably formed by dust from retrograde irregular moons, and of course the famous extreme global albedo asymmetry which has been an enigma for more than three centuries. Revealing the cause of this 'albedo dichotomy' enigma of Iapetus, where the trailing side and poles are more than 10x brighter than the leading side, was one of the major tasks for the Cassini mission. It has now been solved successfully.

In the mid-1970es, deposition of exogenic dark material on the leading side, originating from outer retrograde moon Phoebe, was proposed as the cause. But this alone could not explain the global shape, sharpness, and complexity of the transition between Iapetus' bright and dark terrain. Mainly with Cassini spectrometer (CIRS) and imaging (ISS) data, all these characteristics and the asymmetry's large amplitude are now plausibly explained by runaway global thermal migration of water ice, triggered by the deposition of dark material on the leading hemisphere. This mechanism is unique to Iapetus among the Saturnian satellites for many reasons. Most important are Iapetus' slow rotation which produces unusually high daytime temperatures and water ice sublimation rates, and the size (gravity) of Iapetus which is small enough for global migration of water ice but large enough that much of the ice is retained on the surface [2].

References:
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[2] Spencer, J.R., Denk, T. (2010): Formation of Iapetus's Extreme Albedo Dichotomy by Exogenically-Triggered Thermal Migration of Water Ice. Science 327, no. 5964, 432-435.