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Surface-Interior Interactions on Terrestrial Planets and Satellites

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The surfaces of the terrestrial planets and of the major moons of our solar system differ considerably in their morphology and ages. These differences are to a large part due to endogenic activitiy. At the one extreme are the old surfaces of the Moon, Mercury and Callisto (satellite of Jupiter). These are mostly characterized by craters of sizes ranging from mictoimpacts to large impact basins with diameters up to about a thousand kilometers. The floors of major impact basins have typically been flooded with lava, the origin of which is to be sought with the impact process itself. The other extreme is Io (satellite of Jupiter) with no impact craters up to the resolution of the observing cameras. The latter observation suggests a volcanic resurfacing rate of about 10cm/year. This activity requires surface recycling, possibly by the continuous burial and remelting of crust. Other planets and satellites that are thought to have been partially or completely resurfaced by endogenic activity are - besides the Earth - Venus, Mars, and the other major Jovian satellites Europa and Ganymede. Surface recycling by subduction of crust units accompanied by large-scale lateral movement of crust plates is apparently restricted to the Earth. It has been speculated though that Venus was completely resurfaced through a single event as little as 500 Ma ago but the details remain mostly unclear. In the inner solar system endogenic activity scales with the size of the planets, with Earth being more active than Venus and Mars, etc. Venus's surface is dotted with small volcanoes. The lack of dating of these may hide any clustering with age representing time variations in interior activity. Taken at face value, the distribution is random. Mars on the contrary has one major volcanic center - Tharsis - with a small number of large volcanoes that was in existence for almost the entire history of Mars. The Martian surface is also characterized by a dichotomy with

an ancient southern hemisphere and a younger northern hemisphere. Whether or not the resurfacing of the younger hemisphere was entirely volcanic remains debated. In the outer solar system the simple scaling with size is not feasible. Here, small bodies like e.g., the Saturnian satellite Enceladus may be highly active while significantly larger bodies are not. The reason most probably lies with tidal interactions and the dissipation of tidal energy.