

WATER AND THE PUNCTUATED EVOLUTION OF THE TERRESTRIAL PLANETS

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One of the scientific surprises of planetary exploration is that the great synthesizing idea of the Earth sciences seems to apply to a sample of one. Plate tectonics does not occur on Venus, despite its geophysical similarity to Earth. The tectonics of Mars and Venus is most similar to intraplate tectonics on Earth. The vertical tectonics of intraplate Earth, Mars and Venus occurs in hierarchical spatial patterns of linear and quasi-circular deformation. Similarly, cyclic temporal patterns of change operate at various spatial scales. The planet-wide cycles (global resurfacing history of Venus, Earth Wilson Cycles, and Mars cycles) have periods of about 5×10^8 years. These cycles are driven by punctuated episodes of planetary heat release. The heat release cycles of the terrestrial planets all connect to exogenetic processes via major volatile transfers. For Venus, water has been driven out of the lithosphere, but cataclysmic floods of lava produced phenomenal channels. Cataclysmic floods on Mars derived from water-magma interactions during the punctuated epochs of endogenetic heat release. Earth's megaglaciations similarly follow analogous megacycles. Any new, general theory of the terrestrial planets will explain these spatial and temporally integrated exogenetic and endogenetic processes.