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Morphology of river deltas on Earth and Titan

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Presently volatile cycles are known to operate on surfaces of two planetary bodies in the Solar System, Earth and Titan. Fluvial erosion, transport and deposition of rocky material modify parts of the surface. Numerous indications of geologically recent sediment transport have been discovered on Titan by the Cassini-Huygens mission. Theoretical calculations suggest greater mobility of Titanian sediments in comparison to terrestrial, due to lower gravity and lower density of typical crustal material. Using numerical model of flow and sediment transport, we compare the development and morphology of deposits forming in lakes in terrestrial and Titanian conditions. We explore the range of possible river discharges, including natural variability, and several dominant grain sizes. We consider several compositions of sediments on Titan, on Earth we model the transport of quartz grains by water.

We perform simulations for the same initial geometry of river channel and lake basin, for a given discharge and dominant grain diameter in each environment. Morphology and evolution of the deltaic deposits are compared. We observe that the erosion has dominant role for the smallest grains, and the effect is more pronounced on Titan than on Earth. The largest grains usually form steep-sloped fan-like deltas on both planetary bodies.

The processes of formation and development of the sedimentary landforms are generally similar in both environments. Particular types of deposits may however form in different ranges of discharge and grain size, due to differences in environmental parameters. Greater mobility of sediments on Titan result in easier displacement of loose granular material, especially for smallest considered grains. The flat, lobate deltas can form in narrower range of discharges and grain sizes than on Earth. This fact might be partially responsible for scarcity of river deltas on that active moon, where other signs of fluvial processes are widespread.