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Aggradational Channels on Mars

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Sedimentary deposits and geomorphic landforms preserved on the surface of Mars afford scientists a possible insight into the formative conditions of these features and of the planetary climate in the deep past. We use a high-resolution digital elevation model (~1 m/pixel) created from imagery captured using the High Resolution Imaging Science Experiment (HiRISE) camera on board the Mars Reconnaissance Orbiter to examine the characteristics of 17 meanders from a channel in the Aeolis Dorsa region of Mars. We extracted the topographic signatures from 17 meanders that reveal a characteristic vertically stacked sequence of preserved point bars. These bars increase in elevation by up to 10 m and exhibit incline angles of between one and eight degrees. Each of the meanders is observed to grow vertically while contemporaneously undergoing lateral migration, creating sedimentary architecture not characteristic of fluvial meandering rivers. These landforms are commonly described as inverted channels; however, the preserved architecture differs from other so-called inverted channel topography on Mars, which fail to display such prevalent preserved bar topography. On Earth, vertically stacked deposits are observed in aggradational environments such as in tidally-affected backwater river sections, coastal wetlands, submarine settings, and sediment-rich fluvial systems. Given the pronounced vertical aggradation, and observed in-channel topography, we propose that this channel was fed with an exceptional sediment load – potentially comprised of a high concentration of fine-grained sediment – confined within strong cohesive banks that limited lateral migration and promoted vertical bedform growth. The channel may have also experienced base level controls from a downstream water body. These findings suggest that liquid water must have been persistent over a considerable timescale in Mars' history.