

BREACHED CRATERS ON MARS: TERRESTRIAL ANALOG OF DOWNSTREAM EROSION

CANYON LAKE GORGE

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Outflow from the Canyon Lake Reservoir in 2002 in response to heavy rainfall in the watershed provides an analog to downstream channels cut by spillover from flooded craters on Mars.



A 365 m wide spillway was cut and re-enforced to relieve overflowing of the lake above the 277m level. The storage capacity of the lake at conservation level is 471,000,000 m³. Normal flow exits the lake through tunnels below the dam and continues down the existing Guadalupe River channel. Overflow discharged through the spillway rejoins with the Guadalupe 2.5 km west of the dam. A paved road crossing the relief channel was built to washout in the event of flooding.

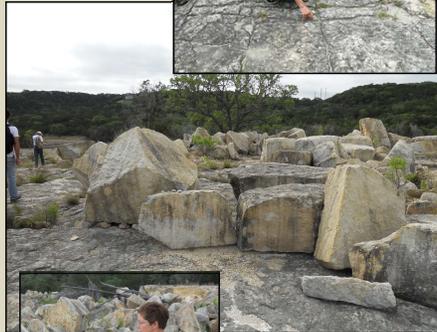


Outflow at Canyon Lake relief spillway during 2002 flood crested 2.3 m above the spillway as 2.5 times the volume of the lake was discharged over a 7 day period. Extensive flooding occurred downstream.



The discharge removed vegetation; a thin regolith; and 650,000m³ Cretaceous limestone to create a bedrock gorge. Most incision occurred within the first days of the outflow.

Bedding planes and jointing in limestone controlled quarrying of blocks of limestone 1-1.5 m on a side. Blocks, which moved short distances, retained flat sides and angular edges.

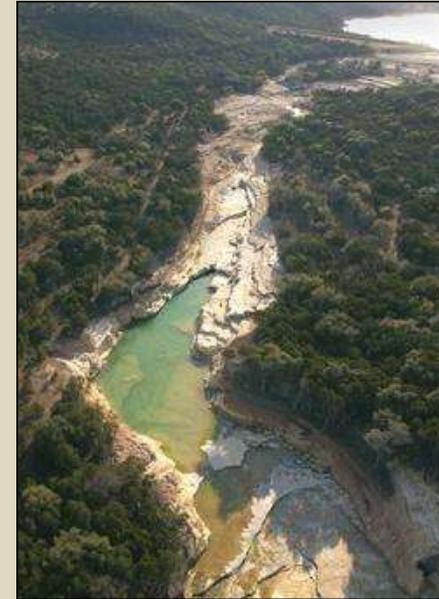


A thin cover soil and blocky regolith was stripped from the limestone bedrock. Angular limestone boulders were moved short downstream by turbulent flow. Residents of the area report hearing blocks tumbling above the roar of the flood flow. The longitudinal profile is typical nongraded with many small falls and large pools.

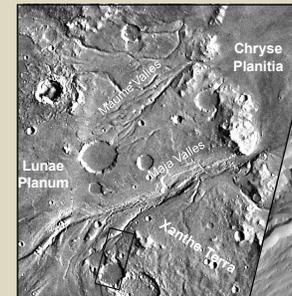
A much reduced flow is seen here a week after the initial overflow. Bedding planes control the stepped topography. Photograph by Paul N. Smith



Erosion by the overflow created a bedrock channel in solid limestone. Limited depositional features are seen as a mega-point bar deposit of 1-1.5 m imbricate blocks in the upper part of the gorge; a mid-channel bar with similar boulders; and the dumping of 230,000 m³ rock and soil at the confluence with the Guadalupe River and the overflow channel.



The channel floor is mostly solid rock which descends in steps controlled by bedding planes in the bedrock. The irregular floor has many large, deep pools. Photograph by David Ferrill, Southwest Research Institute.



Many craters were flooded in the Xanthe Terra region in response to the initial Maja outflow.

The Canyon Lake spill is small compared to the major Martian catastrophic outflows, but it provides an analog for similar discharges from beached craters. This 25 km diam. crater was filled to overflowing by the initial surge of the Maja outflow. Once filled, water spilled over the downslope rim and cut a channel to join the main Maja channel. Remnants of two smaller craters are dissected by the gorge, and steps in the channel walls suggest the presence of layered resistant bedrock. Mariner 9 image of Maja Valles crossing Xanthe Terra and HiRISE image of breached crater.

