

## **Lava tubes and aquifer vulnerability in the upper Actopan River basin, Veracruz, México**

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Rapid infiltration leads to very dry conditions on the surface of some volcanic terrains, with large allogenic streams sometimes sinking underground upon reaching a lava flow. Aquifers in lava flows tend to be heterogeneous and discontinuous, generally unconfined and fissured, and have high transmissivity. Springs associated with basalts may be very large but are typically restricted to lava-flow margins. Concern has been expressed regarding the potential for lava-tube caves to facilitate groundwater contamination similar to that afflicting some karst aquifers. The upper Actopan River basin is a series of narrow valleys excavated in Tertiary volcanic breccias. Several extensive Holocene basaltic tube-fed lava flows have partially filled these valleys. The youngest and longest flow originates at El Volcancillo, a 780 ybP monogenetic volcano. It is over 50 km long, and was fed through a major master tube, the remains of which form several lava-tube caves. Another tube-fed flow initiates at a vent at the bottom of Barranca Huichila and can be followed for 7 km to where it is covered by the Volcancillo flow. The Huichila River is captured by this system of lava tubes and can be followed through several underground sections. In dry weather the stream disappears at a sump in one of these caves, although during heavy rains it overflows the tube, floods the Tengonapa plain, and finally sinks through a series of skylights into the master tube of the Volcancillo flow. Near villages, the caves are used as trash dumps, which are mobilized during floods. Trash includes household garbage, fertilizers and even medical supplies. This is a relatively recent phenomenon, caused by population growth and the building of houses above the lava flows. The water resurges at El Descabezadero, gushing from fractures in the lava above the underlying breccias, giving birth to the Actopan River.