



Volcano-tectonics at Tharsis Tholus, Mars: Observation and Experiments

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Tharsis Tholus, located to the east of the three Tharsis Montes, is a large volcano partly buried beneath volcaniclastic material. The visible edifice has a planar extent of about 155 km (NW-SE) by 125 km (NE-SW), and displays large fault scarps and a central caldera. The fault traces are extending radially from the centre of the volcano and deeply breach the flanks. Towards the NE and SE flanks these form amphitheatres which are opened up to \sim 90 km wide at the volcano's base. The arcuate and lobate shape of the scarps and the alignment of these structures suggest large flank displacements in the NE and SW affecting about half of the visible volcanic edifice. The central caldera is bordered by a well-preserved system of concentric ring faults. The maximum subsidence of the caldera floor is 2700 m; the caldera collapse volume is calculated at approx. 2160 km³.

In order to better understand the deformation processes on Tharsis Tholus we performed analogue sandbox experiments. The volcano was simplified by a cone of cohesive sand material. Silicone was used for simulating a weak basal layer and a weak central core. Gravitational flank spreading as well as a central subsidence of the central weak core produced deformation structures that well matched the observation on Tharsis Tholus.

On the basis of the main volcano-tectonic structures observed and reproduced in experiments, we interpret at least three major phases of deformation at Tharsis Tholus. During the first deformation phase, collapses of the western and eastern flanks produced the four major fault scarps. The second phase is characterised by a partial collapse of the re-grown eastern flank forming the more than 5400 m high scarp at the centre of the volcano. The latest major deformation event formed the central caldera.