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The morphology of an active zone near Enceladus' south pole and implications

Bernd Giese (1), Paul Helfenstein (2), Peter C. Thomas (2), Andrew P. Ingersoll (3), Jason Perry (4), Roland Wagner (1), Gerhard Neukum (5), and Carolyn C. Porco (6)

(1) Institute of Planetary Research, DLR, Berlin, Germany (Bernd.Giese@dlr.de, +49 30 67055402), (2) Center for Radiophysics and Space Research, Cornell University, Ithaca, NY, USA, (3) Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA, USA, (4) Planetary Image Research Laboratory, Sonett Space Sciences Building, Tucson, AZ, USA, (5) Department of Earth Sciences, Freie Universität Berlin, Germany, (6) Space Science Institute, Boulder, CO, USA

On Cassini's 121st orbit, the onboard ISS camera acquired high-resolution (15-30 m/pxl) images in Enceladus' south polar province. The imaging sequence was specifically designed to study one of the source regions of Enceladus' erupting plumes, Baghdad Sulcus. To facilitate the analysis, we derived a digital elevation model in an active section (76°S/323°E) across Baghdad Sulcus. The model reveals that there is a V-shaped trough up to 500 m deep in the center of this section, with flanking slopes of 30° (SW-facing) and > 32° (NE-facing, this slope is in shadow). The slopes do approach angle of repose, but the morphology on the SW slope (blocky terrain with lineation patterns and even benches at angles to the maximum slope) suggests that this is not a slope undergoing angle-of-repose control. The trough, therefore, may owe its shape primarily to faulting, with only some modification by deposition of icy particles by the plume-forming gas. Blocky covering, which includes block sizes of up to 50 m, is not restricted to the trough but also occurs at about the same size and frequency distribution away from it. This suggests that the blocks are not related to the venting process, which concentrates in the trough. Rather, the association of the blocky surfaces with multiple patterns of lineations (presumably fractures and faults) suggests they are outcrops of fault-related ice blocks or lithified detritus undergoing some form of erosion. A potential erosion process may include seismic shaking.
The V-shaped trough is partly accompanied by an elevated flanking ridge, which is indicative for rift zones and hints at an extensional origin of Baghdad Sulcus. Alternatively, fault-block rotation at large strains could have led to the elevated ridge.