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Large impacts and tectonism: the relative ages of the basin Odysseus and Ithaca Chasma on Saturn's icy moon Tethys

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Large impact events forming craters of basin size (> 200 – 300 km in diameter) on planets, asteroids or planetary satellites can cause intense tectonic deformation on their surfaces, indicated by concentric and/or radial troughs or ridges [e.g., 1]. Recently, sets of parallel grooves on asteroid (4) Vesta have been discussed to be the result of impact-related deformation in connection with basin-forming events on Vesta's south polar area [2]. On Saturn's mid-sized icy satellites Tethys, 1072 km in diameter, major landforms are the 445 km large impact basin Odysseus and the huge graben system of Ithaca Chasma which were first imaged during the Voyager encounters in 1980 and 1981 [3][4]. Ithaca Chasma is a ∼100 km wide terraced trough. It has been discussed that Ithaca Chasma could be the result of structural deformation caused by the impact event that created Odysseus [4][5]. Preliminary mapping and crater counts using Cassini ISS imaging data on Odysseus and Ithaca Chasma, however, infer that this has not been the case [6]. Cassini VIMS spectral data show that Ithaca Chasma has less ice compared to Odysseus which supports this finding that it is older than the basin [7]. Major problems to exactly define the stratigraphic position of Ithaca Chasma with respect to the basin Odysseus are (1) that only those craters are allowed to be used for crater counts which clearly superimpose the tectonic structures (e.g., the terraced scarps) across the chasm, and (2) further geologic processes that affected the chasm interior caused obliteration of craters which results in lower crater frequencies. Our preliminary crater counts [6] were carried out on lower-resolution Cassini imaging data. During Cassini's orbital tour since July 2004, the ISS cameras have provided almost complete global image coverage of Tethys at resolutions of 100 – 300 m/pxl. In this work we present results from our ongoing studies on Tethys' geology, based on these new imaging data, primarily focused on the topic of the relative age of Odysseus versus Ithaca Chasma. These stratigraphic findings are also put into context to Tethys' global geology which is characterised preferentially by old densely cratered plains showing little geologic diversity other than impact crater forms with various degrees of degradation [3][4][5][6]. References: [1] Spudis P. D. (1993), Cambridge Planet. Sci. Series Vol. 8, 263p, Cambridge, U.K. [2] Jaumann R. et al. (2012), Science 336, 687 – 690. [3] Smith B. A. et al. (1981), Science 212, 163-191. [4] Smith B. A. et al. (1982), Science 215, 504-537. [5] Moore J. M. and Ahern J. L. (1983), JGR 88 (suppl.), A577-A584. [6] Giese B. et al. (2007), GRL 34, doi:10.1029/2007GL031467. [7] Stephan K. et al. (2012), LPSC XLIII, abstr. No. 2119.