MARS: RECENT AND EPISODIC VOLCANIC, HYDROTHERMAL, AND GLACIAL ACTIVITY REVEALED BY THE MARS EXPRESS HIGH RESOLUTION STEREO CAMERA (HRSC) EXPERIMENT. G. Neukum[1], R. Jaumann[2], H. Hoffmann[2], E. Hauber[2], J. W. Head[3], A. T. Basilevsky[1,4], B. A. Ivanov[1,5], **S. C. Werner**[1], S. van Gasselt[1], J. B.Murray[6], T. McCord[7], and the HRSC Co-Investigator Team, [1] Institut fuer Geologische Wissenschaften, Freie Universitaet Berlin, Malteserstr. 74-100, Bldg. D, 12249 Berlin, Germany.[2] DLR-Berlin, Germany (swerner@zedat.fu-berlin.de).[3] Brown University, Providence, RI 02912, USA.[4] Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, 119991 Moscow, Russia.[5] IDG-RAS Moscow, Russia.[6] Open University, Milton Keynes MK7 6AA, U.K.[7] University of Hawaii, Honolulu, Hawaii 96822, USA.

Introduction: On board the ESA Mars Express Orbiter, the High Resolution Stereo Camera, a multiple line scanner instrument, is acquiring high-resolution colour and stereo images of the surface of Mars[1]. Resolution down to 10 meters per pixel coupled with large areal extent (swaths typically 65-100 km wide and thousands of km long) means that small details can be placed in a much broader context than was previously possible. Among the major objectives of the experiment is an assessment of the level of recent geological activity on Mars, particularly the type of volcanic and climate-related deposits that might indicate areas of hydrothermal activity and recent water exchange conducive to exobiological activity.

Data: We have made use of the new HRSC images and their particular qualities in mapping out terrain-types for the interpretation of morphological features and topographic relationships from the 3-D data and high-resolution imagery including the Super Resolution Channel (SRC) data (resolution down to 2.5 metres per pixel) [1]. The high-resolution colour data was very useful for distinguishing different materials. The combined use of the HRSC data and nested MOC [2] or SRC imagery has proven to be extraordinarily helpful in the interpretation of morphologies and processes which shaped the landforms. The main emphasis in this paper was put on understanding the time-stratigraphic relationships and the sequence of events in order to understand the geologic evolution of the Martian areas investigated. Time sequences were obtained by determining the number of superimposed impact craters and deriving absolute ages.

Results: The HRSC Experiment on the ESA Mars Express Mission has obtained new evidence for recent and episodic volcanic resurfacing activity on Mars, revealing an unusually geologically robust and recently active planet. Calderas on five major volcanoes in the Tharsis and Elysium regions show repeated activation and resurfacing during the last 20% of Martian history, with caldera floors as young as 100 Ma, and flank eruptions as young as 2 Ma. These results confirm that the edifices are constructed over billions of years [3] and are characterised by episodically repeated phases of activity[4] continuing almost to the present and suggesting the volcanoes are potentially still active today. It appears that the more recent volcanic activity on both the Tharsis and Elysium volcanoes clustered around 100-200 Ma ago, practically coinciding with radiometric ages of several Martian meteorites[5]. Glacial deposits at the base of the Olympus Mons escarpment[6,7,8] show evidence for repeated phases of activity over the last 5% of Martian history, with the latest phase occurring as recently as ~4 Ma ago. Bright deposits on the flanks of Olympus Mons, on the top of the scarp and on high-standing plateaus at the edge of the western scarp are interpreted to be remnants of ice and dust accumulations dating from these times and even earlier periods as old as 3.8 Ga ago. Morphological evidence is found that snow/ice deposition on the Olympus construct at elevations more than 7000 m high led to episode(s) of glacial activity at this height. The data suggest that water ice protected by an insulating layer of dust may now be present at high altitudes at the edge of the Olympus Mons shield. The presence of the young glacial deposits in the tropics of Mars at the base of the Olympus Mons escarpment supports the hypothesis that the obliquity of Mars[9]may have recently been in excess of 30^{o}, during which times snow and ice accumulations are predicted in these regions[10,11]. These new results confirm that Mars is fundamentally important exploration target, combining a preserved ancient record with accessible deposits representing recent volcanism and the geological record of recent glaciation.

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