STUDY OF BRECCIA TYPES IN THE CENTRAL PEAK OF AN UNNAMED COMPLEX CRATER ON MARS. [1]W. Iqbal, [1]G. Wulf, [1]T. Kenkmann, [1]Institute of Earth and Environmental Sciences – Geology, Albert-Ludwigs-University of Freiburg, Germany, jia646@hotmail.com

Introduction: Fragmentation of rocks beneath the crater floor strongly determines the rheology of target rocks during crater formation. The degree of target damaging is strongest in the center and attenuates towards the rim of a crater. Quantification of the degree of target disintegration, e.g. by determination of the mean block size, provides important input parameters for numerical modelling of crater formation. The availability of high resolution remote sensing data in combination with their comprehensive coverage for some craters now enables to carry out detailed structural mapping of Martian impact craters that in turn provides the basis for understand the spatial arrangement of breccia zones and their interconnection in the crater´s sub-surface.

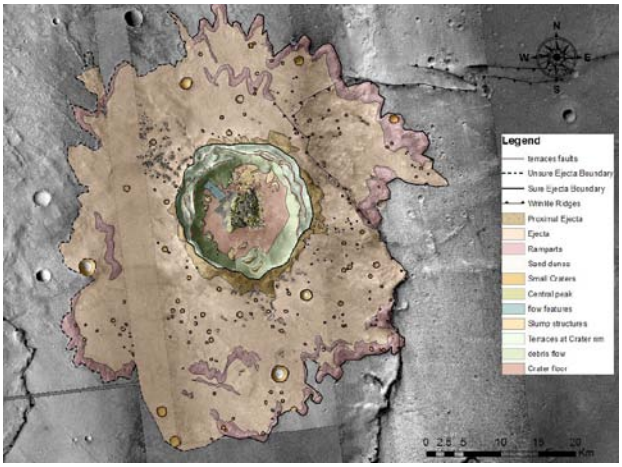

Fig. 1 The mapped Martian crater is located at 26°17'16. 12"S / 54°46'20.41"W (CTX mosaic).

Methods: All available image data of the crater, including High Resolution Stereo Camera (HRSC), Context Camera (CTX) and High Resolution Imaging Science Experiment (HiRISE) were processed by using USGS's Integrated System for Imagers and Spectrometers (ISIS) to get the base data for further mapping in ArcGIS. Important structural features such as faults, bedding planes, blocks, flow features, and the occurrences of different types of breccias could be mapped at meter-sized resolution considering sunlight and morphology.

The crater: We mapped an unnamed complex crater 17.4 km in diameter (26°17'16.12"S/ 54°46'20.41"W) that is situated about 650 km S of Valles Marineris east of Nectaris Fossae. This area is characterized by relatively flat plains permeated by widely spaced, sinuous wrinkle ridges. The ''ridged plains material'' is interpreted as extensive flows of low-viscosity lava of early Hesperian age erupted from numerous sources at high rates [1]. The crater has a flat floor, a highly deformed central uplift and a terraced crater rim. The multi-layered, partly degraded ejecta blanket shows abundant ramparts and flow lobes that are affected by the presence of wrinkle ridges (Fig. 1). The crater rim shows both extended terracing (mainly in the W, N, and E) and slumping. Straight scarps partly give the impression of a polygonal crater whose shape is influenced by preexisting crustal joints. The relatively flat crater floor is largely covered by slumps, alluvial debris and dune fields. The 4 x 4 km central uplift has a somewhat quadangular shape and consists of complex network of faults, folds, blocks, breccia pools and dikes (Figs. 2 and 3). Morphologically the central uplift forms a collar with a central hill. Faults in the north are N dipping and EW striking on average. In the southern part of the central uplift NS striking faults are dominant. Structural analyses of other impact craters on Earth and Mars showed that such structural arrangements can be formed by oblique impacts [2, 3]. Volcanic layering of the target rock helps to unravel the deformation of the fault-bounded blocks: many of them appear to be internally disintegrated into monomict breccias with minor off-sets while others are bent and folded. The layering is mostly steep. Note that monomict breccias within target blocks are not displayed in Fig. 3.

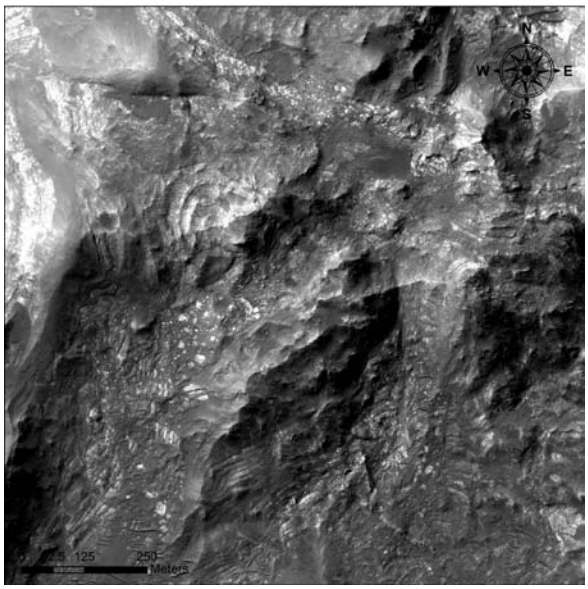

Fig. 2 Type 1 breccias are structurally related to the block framework of the central uplift (HiRISE image section).

Breccias: We have mapped two types of breccias in the area of the central uplift and adjacent surrounding: breccias whose occurrence is related to the structural deformation within the central uplift (Type I) and breccia pools that possibly represent impact melt breccias (Type II). Type I breccias are polymict, unsorted, angular to sub-angular, and embedded in a matrix of fine debris. They occur in narrow, elongated and dike-like zones of variable width ranging between a few meters and several hundred meters (Figs. 2, 3). These occurrences are oriented either parallel to fault plans or perpendicular to them. Breccia occurrences parallel to faults are interpreted as fault breccias. Fragmentation is resulting from shear failure and subsequent comminution during the relative motion of adjacent target blocks that reach sizes of several hundreds of meters. Breccias oriented at an obtuse angle to the faults may also formed during block movements as secondary splay faults. Alternatively they are the product of breccia injections into tensile gaps that sporadically open during block movements and uplift of the crater floor.

In contrast type II breccias form irregular pools of dispersed geometries. They often occur in depressions between high-standing ridges of target blocks or they form patches in the surrounding of the central uplift and superimpose target blocks. Lobate morphologies and local schlieren textures suggest a high mobility of their matrix that may be indicative for a melted state. The breccias are unsorted, polymict with a spectrum of fragment sizes from sub-meter to deca-meter size. Type II breccias are allochtonous breccias that covered the crater floor and subsequently crowded together in the crater moat and in local depressions of the rough topography of the central uplift. A minor fraction of these breccias may represent air-borne breccia of the central ejecta plume. In a future study we will use this crater to determine block sizes and the fragment size distribution within the breccias.

References: [1] Scott, D. H. and Tanaka, K. L. (1986). USGS Misc. Inv. Ser. Map I-1082-A. [2] Kenkmann, T. and Poelchau, M. H. (2009). Geology 37, 459–462. [3] Wulf, G. et al. (2012). Icarus 220, 194–204.

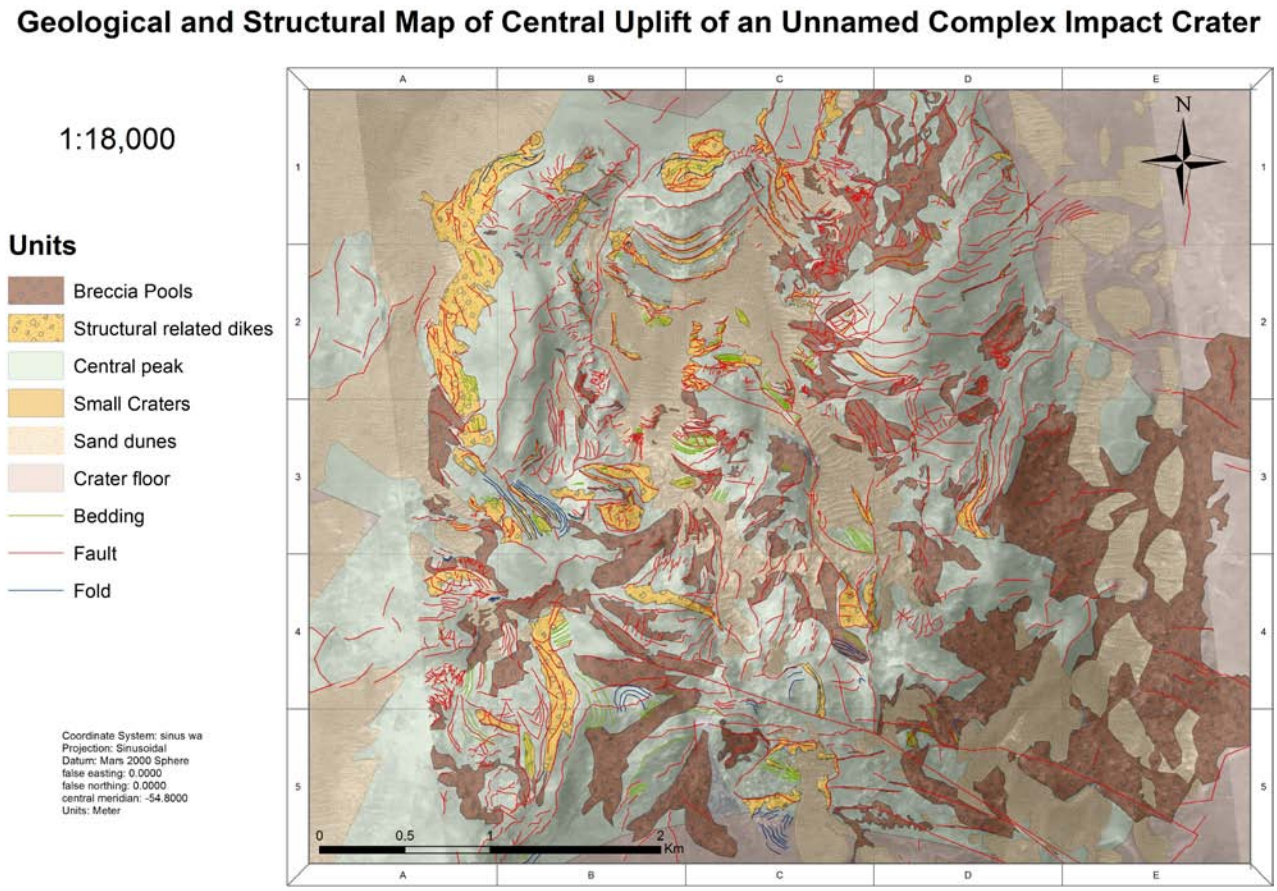

Fig. 3 Geological map of the central uplift that has a foursquare appearance. Based on their geometry breccia pools and dike breccias are distinguished in the map