CRATER SIZE-FREQUENCY MEASUREMENTS ON LINEAR FEATURES - BUFFERED CRATER COUNTING IN ARCGIS. T. Kneissl and G. Michael, Freie Universitaet Berlin (Malteserstr. 74-100, 12249 Berlin, Germany, thomas.kneissl@fu-berlin.de).

Introduction: The age-dating of linear surface features using standard crater counting techniques (e.g., [1], [2], [3]) has to deal with several difficulties. In most cases linear features, like tectonic faults, graben, or valley systems, provide only limited area sizes for the conventional crater counting approach. In combination with poor image resolution and/or young surface ages this results in low-number statistics of craters, if craters exist at all. Furthermore, most linear features are associated with steep slopes, which often cause mass wasting processes modifying the original CSFDs and, thus, avoiding reliable age determinations. In order to address these issues a method called buffered crater counting was designed and improved by several authors in the past (e.g., [4], [5], [6], [7], [8]). In this work we would like to introduce a new functionality of the CraterTools software [9], which allows a straightforward application of the usually cumbersome procedure of the buffered crater count analysis.

Buffered Crater Counting: In contrast to the common crater counting techniques, where only craters inside a measurement area are used for an age determination, the buffered crater counting approach includes craters with their centers outside the mapped area which clearly superimpose the linear feature. Since the analysis of CSFDs requires the number of craters normalized to an area, which is almost negligible in case of linear features, one needs to determine the effective counting area (buffer surrounding the lineament) of every individual crater post-dating the linear feature. These buffer areas are usually much bigger than the area of the linear feature itself. Assuming craters are only included if the crater rim directly cuts the linear feature (simple approach), the resulting

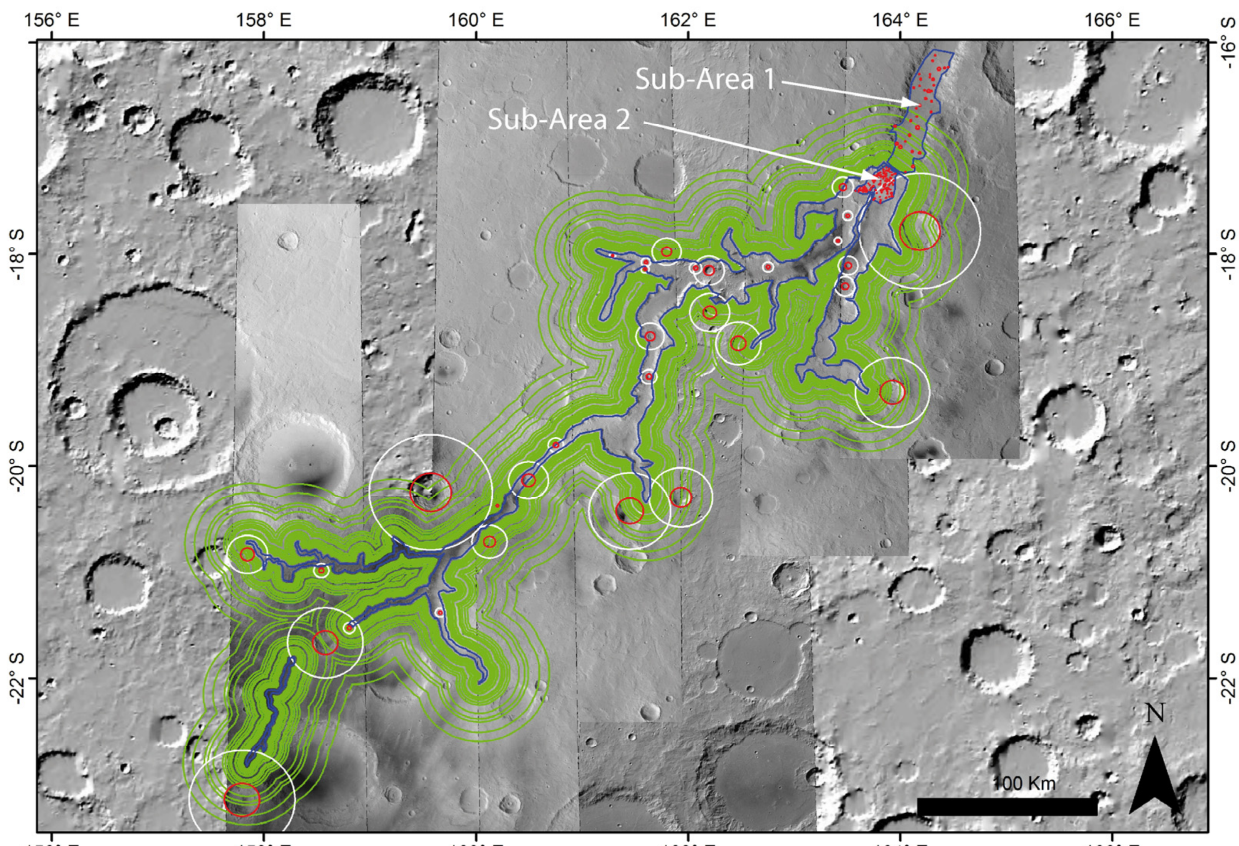

Figure 1: Test site Al-Quahira Valles and the measurement areas (blue) and impact craters (red) used for the measurements. Individual buffers (1.5 x diameter of the crater) around the mapped valley are shown in green, the assumed extent of the ejecta deposits of the craters are shown in white.

buffer would have the size of 1/2 crater diameter (D) on each side of the linear feature, respectively. In a more liberal approach (e.g., [7]) craters are also included where only the crater ejecta blanket superimposes the linear feature (ejecta approach). Assuming the ejecta blanket to extend up to a distance of 1xD radial from the crater rim [7] proposed to apply a buffer 1.5 times the diameter of the counted crater on each side of the lineament. The relative crater frequency has then to be calculated for each crater and its according buffer, separately.

Integration in CraterTools: The buffered crater counting approach has been seamlessly integrated to the CraterTools extension for ArcGIS [9]. Using the new software, the user has to map the linear feature (which technically has to be mapped as a polygon) and all intersecting/ post-dating craters. The software automatically calculates the required buffer sizes for each crater and exports the resulting SCC-file. This file can directly be used in the software CraterStats [10] for subsequent statistical analysis in the usual manner. This is accomplished by normalizing the crater frequency to the area of the mapped linear feature. The normalization is calculated using the ratio of the area of the produced buffer zone to area of the mapped linear-feature polygon. Furthermore, the user has the possibility to define the crater diameter - buffer size ratio which is used for the creation of the buffer, depending on whether he included only craters where the crater rim directly intersects the linear feature (simple approach) or also the ejecta of craters has been used to determine the super-positional relationships (ejecta approach). The extent of continuous ejecta may be estimated according to local observations.

Application/ Validation: In order to check whether the buffered crater counting approach and the developed software derive valuable results compared to the standard counting technique, we determined the age of the Al-Quahira Valles, a valley network at the highland/lowland boundary at ~158°-165°E and ~17°-23°S on Mars, using both approaches: the buffered crater counting and the standard counting technique. For the former, we used the whole area of the valley network; for the latter we used only two sub-areas on the valley floor as shown in figure 1. Derived CSFDs as well as the according fits to the production function are shown in figure 2. The derived ages are consistent with each other within the given error range. Furthermore, these ages are in agreement with the valley ages determined by [7], using the same buffered crater counting approach manually.

Summary and Conclusion: The buffered crater counting approach has been successfully integrated and tested as a new functionality in the CraterTools extension for ArcGIS. Furthermore, it has been shown, that this approach provides comparable results to the standard crater counting technique and, thus, that this method offers an alternative possibility to determine surface ages in case of poor image resolution or very limited measurement areas.

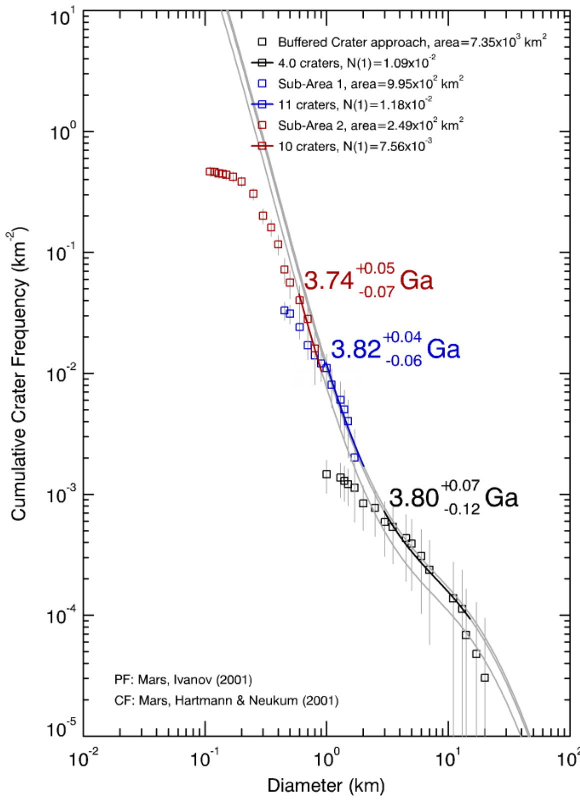

Figure 2: CSFDs derived from the buffered crater counting approach (black) in comparison with smaller-scale measurements in sub-areas 1 and 2 (blue and red) on the valley floor using the standard measurement technique.

References: [1] Öpik E. J. (1960) *Mon. Not. R. Astron. Soc.*, 120, 404-411. [2] Baldwin R. B. (1964) *Astron. J.*, 69, 377-392. [3] Neukum G. and Wise D. U. (1976) *Science*, 194, 1381-1387. [4] Tanaka K. L. (1982) *NASA Tech. Memo*., TM-85127. [5] Wichman R. W. and Schulz P. H. (1989) *J. Geophys. Res.,* 94, 17333-17357. [6] Hoke M. R. T. and Hynek B.M. (2007) *LPSC XXXVIII*, #1209. [7] Fasset C. I. and Head J. W. (2008) *Icarus*, 195, 61-89. [8] Bouley S. et al. (2010) *Icarus*, 207, 686-698, [9] Kneissl T. et al. (2011) *Planet. Space Sci.*, 59, 1243-1254. [10] Michael G. and Neukum G. (2010) *Earth Planet. Sci. Lett.*, 294, 223-229.

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