SURFACE DATING: SOFTWARE TOOL FOR ANALYSING CRATER SIZE-FREQUENCY DISTRIBUTIONS INCLUDING THOSE SHOWING PARTIAL RESURFACING EVENTS G. Michael, G. Neukum, Freie Universitaet Berlin, Germany. (gregory.michael-at-fu-berlin.de)

The method of determining absolute ages for cratered surface units has been described and developed in many papers (e.g. [1,2,3]). The concept is to fit the observed crater size-frequency population of a given surface unit to a known crater production function which derives from the impacting population, and to use the relative crater density via a calibrating chronology function to obtain an absolute age.

Erosional or mantling resurfacing processes change the crater population by removing members at the low-diameter edge of the distribution. If we have a surface which formed at time t_0 , and such a resurfacing process occurs for a period up to a time t_1 removing all craters with a diameter below d_1, at a later time of observation, we expect to observe a crater population which reflects the age t_0 for craters of diameter $d > d_1$ and the age t_1 for craters with $d < d_1$.

In a cumulative crater frequency (N_{cum}) plot (which plots the number of craters exceeding diameter d per unit area) this appears as a step in the distribution between two segments which have different asymptotic isochrons. The lower asymptote can be used to make a first order estimate of the time of end of the resurfacing event t_1, but the cumulative plot in this region includes larger craters which were formed between t_0 and t_1 and results in an apparently older event.

One approach to this problem is to estimate the excess crater population above the step diameter for the difference in ages between the older and younger asymptotes, and subtract this value from the cumulative population before fitting an isochron [4]. The other, described here, is to estimate the expected larger population from the younger segment of the distribution by iterative fitting of the production function.

If we can assume that a portion of the size-frequency distribution represents craters accumulated from a single time-point, then we have a set of values of $N_{cum}(d)$ which are all in error by some fixed amount k. The last value of that range $N_{cum}(d_{max})$ represents the density of craters too large to be influenced by the resurfacing, which is unknown. The effect of k, when positive, is to decrease the gradient of the distribution relative to the known production function; when negative, to increase it. By fitting the production function to the given range of N_{cum} and using the resultant curve to obtain a new value for $N_{cum}(d_{max})$ and hence k, one can obtain the value of k which gives the best fit to the production curve within a few iterations. The resultant points adjusted by k now fall as they would if the surface had been entirely renewed at time t_1, and so can be used to derive an age in the usual manner.

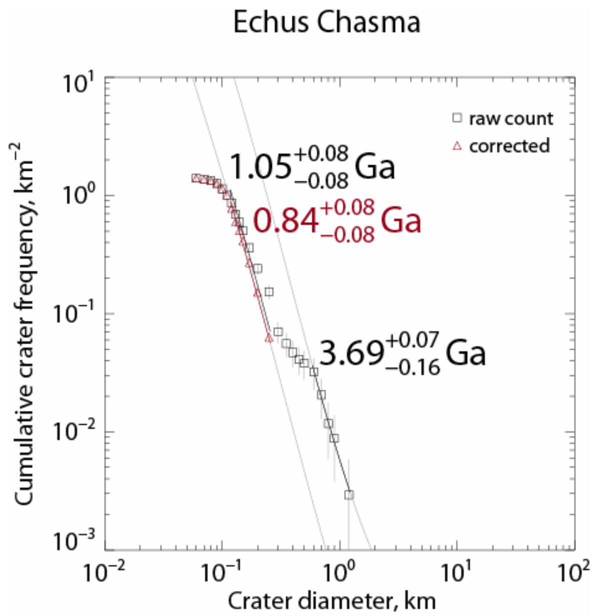

Fig. 1. Sample resurfacing age correction for a count from Echus Chasma. The black squares are the original crater count. The light grey lines are the isochrons for 3.69 and 0.84 Ga. The red triangles are corrected points according to the method here, assuming the interval 0.12-0.25 km includes craters accumulated from a single time-point: a partial resurfacing event. A fit to this same range without the correction would yield an age estimate of 1.05 Ga – an overestimate of about 25%.

A software tool has been developed for the analysis of crater size-frequency distributions in this way. It is available from http://hrscview.fu-berlin.de/software.html

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