Geophysical Research Abstracts, Vol. 9, 07593, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07593

Refinement of cratering model age for the case of partial resurfacing

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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 cali-brating 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 t0 , and such a resurfacing process occurs for a period up to a time t1 removing all craters with a diameter below d1, at a later time of observation, we expect to observe a crater population which reflects the age t0 for craters of diameter $d > d1$ and the age t1 for craters with $d < d1$. In a cumulative crater frequency (Ncum) 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 as-ymptote can be used to make a first order estimate of the time of end of the resurfacing event t1, but the cumulative plot in this region includes larger craters which were formed between t0 and t1 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 a single age, then we have a set of values of Ncum(d) which are all in error by some fixed amount k. The last value of that range Ncum(dmax) 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 Ncum and using the resultant curve to obtain a new value for Ncum(dmax) and hence k, one can obtain the value of k which gives the best fit to the production curve within a few iterations.

I acknowledge Stephanie Werner for detailed discussions of the problem.

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