AGE OF GRATTERI CRATER: PRELIMINARY TEST OF THE CRATER-COUNT ISOCHRON CHRONOMETRIC SYSTEM. William K. Hartmann[1] and Cathy Quantin-Nataf[2], Planetary Science Institute (1700 E Ft Lowell Rd Ste 106, Tucson AZ 85719-2395 USA, hartmann@psi.edu), [2]Laboratoire des Sciences de la Terre, Université Claude Bernard (2, rue Raphaël Dubois, 69622 Villeurbanne, Lyon, FRANCE, cathy.quantin-nataf@univ-lyon1.fr).

Introduction: McEwen et al. [1] suggested a self-consistency test for Martian crater count chronology systems. Here we perform this test on the young crater Gratteri and find a satisfactory result.

The test involves craters thought to be among the youngest of their size classes, based on sharp, fresh-appearing morphology, ray systems, and other features. Examples include Tooting (D = 29 km) [1, 2, 3] Zunil (D = 10 km) [1], and the craters Gratteri (D = 6.9 km), Tomini (D = 7.4 km), Zumba (D = 3.3 km) and Dilly (D = 2.0 km) [4].

McEwen et al. [1] suggested that the numbers of small (D ~ 10-50 m) craters superimposed on very young host craters should give an age consistent with the likely ages of the host craters, which should be on the order of the interval between impacts of the host crater's size class. They applied this test to Zunil and Tooting, and reported gross inconsistency. They proposed that the small-D end of our isochrons is inconsistent with the large-D end by factors of > 2000, and that the probability of the Hartmann and Neukum crater count systems giving even roughly correct ages is only around 0.1% to 1.4% [1, 5, 6].

A serious problem with their result was that they assumed that the Hartmann isochrons referred only to primary impacts, whereas in reality we attempt to count the total mix of primaries and relatively randomly distributed "field secondaries" (excluding obvious rays and clusters). Also, they counted small craters on the floor, interior walls, and ejecta blankets of the host craters. We believe, however, that interior walls and even ejecta blankets of young primaries may be unstable, with loss of small craters caused by downslope motions, wind erosion, etc. Hence we make the test on the flatter floor surfaces of such craters. The basic concept of the McEwen et al. test is still valid, however.

We repeated the test for the young crater Gratteri [4]. The McEwen et al. figures and our isochron diagrams both suggest a mean interval of about 700,000 years between crater formation in the size range 5.6 to 8 km (the bin size in our diagram). The youngest Gratteri-sized crater on Mars is thus expected to have an age of this order of magnitude. Because Tomini crater (D = 7.4) is also a candidate for the youngest crater in this bin, it is plausible that Gratteri is not the youngest, but might be a few My old. On Hi-RISE images at three different resolutions, we counted many small craters on the floor of Gratteri, with fair statistics in the size range of 4 to 32 meters. These numbers suggest a model age of ~ 2-10 My (see Fig. 1). A similar result of about 5 My comes from direct observations of the formation of decameter-scale craters [7, 8]. This is consistent with Gratteri being as one of the youngest craters of its size class.

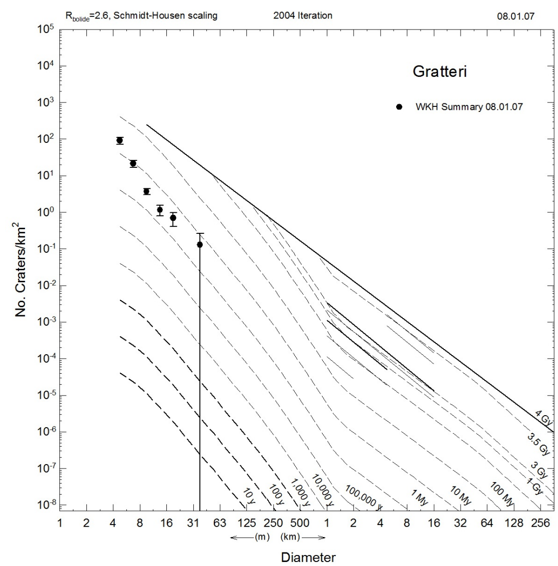

Figure 1. Preliminary crater count isochron diagram for craters on the floor of Gratteri suggest an age of ~2-10 My, consistent with it being the 2nd or 3rd largest crater in its size range. Dashed isochron shapes at D < 10 m show curvature based on models of atmospheric loss of small meteoroids [9], but this curvature is uncertain, and is not extrapolated below D ~ 6 m.

In a similar case, McEwen et al.1 concluded that a Tooting-size crater should form every ~5 My but that the small craters give an age of only about .068 My years, a discrepancy of a factor ~70. However, Mouginis-Mark and Garbeil [3] recently report 13 superposed craters (D = 54 to 234 m) on the ejecta blanket, and estimate a crater retention age of about 0.4 to 2 My, not out of the realm of plausibility.

To summarize, current data from Gratteri and Tooting suggest no impossible discrepancy between the expected age and the observed age. As indicated by McEwen et al. [1], Zunil appears more problematic, though it simply may be unusually young. (We are beginning a study of Zunil.) Given the uncertainties and the statistics-of-one nature of the problem, we suggest that the problems are much less than the "> 2000" disparity factor proposed by McEwen et al. [1].

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