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Ages of Rampart Craters in Two Equatorial Regions on Mars: Implications for the Present Distribution of Ground Ice

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Many large craters on Mars exhibit fluidized ejecta blankets (Rampart craters) which are not observed on other terrestrial planets like the Moon. The morphology is suggested to be caused by a volatile rich target material like ground ice. In a given area a certain minimum diameter exists for craters which show fluidized ejecta blankets, called the onset diameter. Geographic mapping shows a latitude dependence of the onset diameters. In equatorial regions the onset diameters are typically 4 to 7 km versus 1 to 2 km in high latitudes (50° lat.) which might indicate a ice rich layer at depths of about 300 to 400 m near the equator and ∼100 m at 50° latitudes. The rampart craters may have formed over a significant time interval and therefore reflect the ground ice depth at a given time. We determined the absolute ages of rampart craters in two near equatorial regions on Mars by measuring the ejecta blankets superposed crater frequencies in Mars Express High Resolution Stereo Camera (HRSC) imagery. The study regions are located in the Xanthe Terra Region between Maja Vallis to the west and Shalbatana Vallis to the east (0°-15°N and 310°-314°E) and southern Chryse Planitia west of the Pathfinder landing site (11.8°-25.6°N and 324.5° - 326.7°E).

Ages of rampart craters in the Xanthe Terra region are in the range of ∼4 to ∼3 Gyr. Most absolute model ages of individual ejecta blankets are around 3.8 Gyr. The derived ages imply that their formation is connected with the Noachian aged fluvial activity (∼3.8 Gyr) in this region. The formation rate of rampart craters declines in the Hesperian, whereas onset diameters increase. At the Hesperian-Amazonian boundary

the formation comes to an end. This might indicate a lowering of the ground ice table with time which could be, if present at all, several kilometers deep in present days. Either all ground ice was lost with time due to diffusion to the atmosphere or there is still a deep ground ice layer which can only be reached by relatively large (and in recent times rare) impacts. In southern Chryse Planitia the rampart craters, which ejectas are eroded by fluvial events, show absolute model ages around 3.8 Gyr and between $\sim$0.5 to $\sim$1.5 Gyr for channel superposed ramparts. These ages are in good agreement with the fluvial activity of Tiu Vallis. The formation of young ramparts with onset diameters of $\sim$6 km indicates that ground ice could still be present in this region at depths of a few hundreds of meters. The ground ice might have been recharged by the last fluvial episode of Tiu Vallis and sheltered from diffusion by thick fluvial sediments.

The distribution of present equatorial ground ice varies regionally. The correlation of rampart ages with fluvial activity and the lack of new fresh rampart craters in the Xanthe Terra region indicates that the ground ice table is possibly at a depth of several kilometers or non-existent in present times. In southern Chryse Planitia relatively young rampart craters with onset diameters of about 6 km formed after the last fluvial activity in this region. This indicates a ground ice table (possibly a few hundred metres deep) in recent geological times which might be still present today.