CONSTRAINING THE AGES OF SHORTENING LANDFORMS IN MERCURY'S H-11 DISCOVERY QUADRANGLE. J. D. Clark[1], H. Bernhardt[1], F. Preusker[2], C. Klimczak[3], M. E. Banks[4], D. A. Williams[1], D. Nelson[1], T. R. Watters[5], [1]School of Earth and Space Exploration, Arizona State University, Tempe, USA, [2]German Aerospace Center, Institut für Planetenforschung, Berlin, Germany, [3]Structural Geology and Geomechanics Group, Department of Geology, University of Georgia, Athens, GA, USA, [4]NASA Goddard Space Flight Center, Greenbelt, MD, USA, [5]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, Washington, DC, USA. (jclark@ser.asu.edu).

Introduction: The temporal trends of the geographic, morphometric, and structural parameters of shortening structures on Mercury are key to better understanding the planet's history of contraction, tidal despinning, and lithologic/rheologic variation in its current crust [1-4]. Employing the best resolution image mosaics (166 m/px), as well as a novel, global stereo-DTM with three times the resolution of currently available global DTMs [5,6], we are producing a new global map and parameter catalog of shortening structures on Mercury.

To assess the temporal trends of scarp parameters and to better understand global/regional stress, we will determine both relative and absolute ages for the shortening structures. Our database will enable us to discern any spatial as well as temporal trends within any of our gathered values. Although this work is being conducted on a global scale, we present here the initial results for the H-11 Discovery quadrangle (see also our companion abstract #1608 on the correlation between shortening structures and ancient basins in that quadrangle).

Data and Methods: The gathering of relative and absolute ages is carried out on high- and low-incidence angle, ~166m/pixel mosaics of images by MESSENGER's Mercury Dual Imaging System [5]. A relative age bracket will be assigned to all our mapped shortening structures that clearly intersect at least one impact crater (or ejecta) with a diameter >1 km. These structures lend themselves to a stratigraphic classification via the degradation state of the superposing/superposed crater(s)/ejecta [7 22] and assigning a chronographic system as defined by [8] (pre-Tolstojan, Tolstojan, Calorian, Mansurian, Kuiperian). This technique has been previously applied to ~400 large scarps (> 100 km in length) [4] and ~6000 scarps in the northern smooth plains [2].

As degradation states of craters and erosional processes have been suggested to regionally vary on Mercury [9], we will further narrow down the stratigraphy-based age brackets for the shortening structures with absolute model ages (AMAs) [10]. These AMAs will be derived via crater size-frequency distribution (CSFD) measurements [10] on the floors and/or ejecta blankets of sufficiently large craters. Recently used by [11] on five mercurian thrust systems,

we will employ the method on a subset of scarps where CSFDs on the floor of a crater cross-cut by the fault would derive a maximum age limit, while CSFDs on the floor of a superposing, unfaulted crater or on the ejecta superposing the fault scarp would give us a minimum age limit. We will use the production model by [12] to determine AMAs, but will also offer AMAs derived with the Neukum production model [13] for comparison. For the Le Feuvre and Wieczorek functions [12], both non-porous and porous scaling laws for target materials will be considered [14]. This will incorporate the effects of a porous megaregolith and non-porous hard rock targets. Reporting AMAs using each production and chronology function allows the best representative age to be reported.

Although another method to date linear landforms, buffered crater counting (BCC), has been used on Mercury for very large thrust systems [11, 15-17], the technique does require a sufficient crater population that is superposed on the linear feature [18]. For scarps that are not part of Mercury's largest thrust systems, there might not be enough or no craters to determine a robust AMA and therefore, the BCC method will not be used in this global study. Utilizing a stratigraphic model [4], with traditional CSFD measurements in large craters crosscut by the faults [11, 15] will permit comparative ages to be determined, where possible.

Observations: The first CSFD measurements were conducted on the floor of an unnamed crater (28.2°S, 77.8°W) between Rude and Haydn craters to determine a maximum absolute age as a fault cross-cuts the crater (Fig.1a). The AMAs are shown using the functions of [13] (Fig. 1b) and the non-porous (Fig. 1c) and porous (Fig. 1d) function of [12]. While the non-porous hard rock target function [12] derived an extremely young age, we infer that the faults on the crater floor have a maximum approximate age of 3.7 – 3.8 Ga as shown using the [13] and porous megaregolith function of [12]. Younger AMAs derived using the non-porous function versus the porous function were also observed and discussed in detail by [11] and [14].

Future Work: Using the latest MDIS mosaic release, we will expand on [19] database, which assigned ~6000 scarps to one of four stratigraphic age brackets based on a preliminary, lower resolution MDIS mosaic. Additionally, we will further constrain some of

these age brackets by extracting absolute model ages from crater size-frequency distribution measurements on the floors and/or ejecta of scarps-intersecting craters. We will perform this refined method on approximately 100 geographically evenly distributed, suitable scarps. This will allow us to plot all other scarp parameters as a function of time, thereby characterizing temporal variability in faulting, which will allow a better understanding of mercurian stress states through time at a higher geographic and temporal precision than previously achieved [4, 19].

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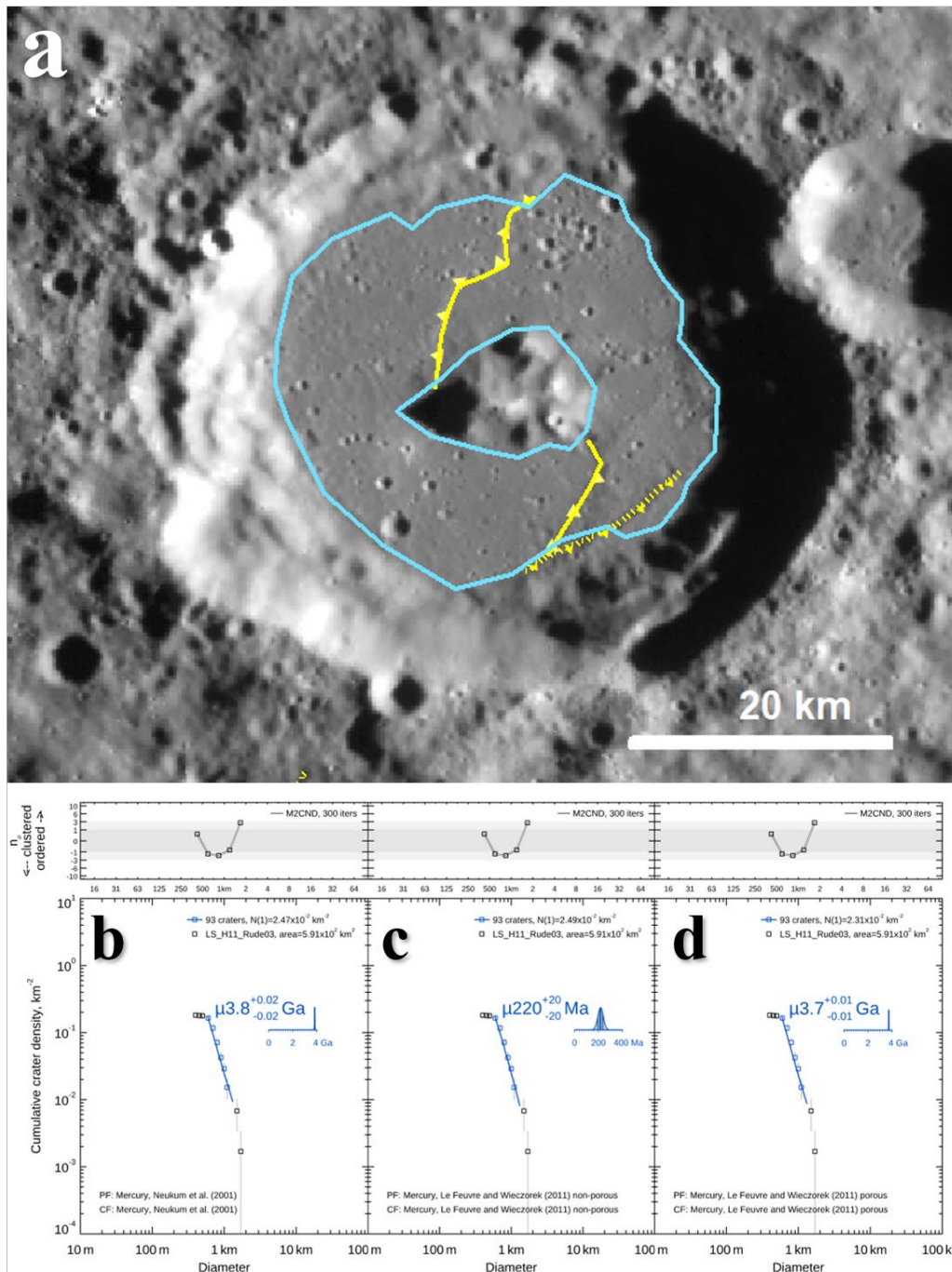

Figure 1: (a) An unnamed crater (coordinates) between Rude and Haydn crater is used to determine a maximum absolute age as the fault (yellow lines) cross-cuts the crater floor. The count area for CSFD measurements is shown with a light blue outline. Ages using the [23] (b), non-porous [24] (c), and porous [24] (d) function. Although the non-porous [24] function derived a very young AMA, we estimate that the faults on the crater floor have a maximum age of 3.7-3.9 Ga.