MERCURY CATENAE: LINEAR FEATURES AND LIGHTING BIAS E. R. Fegan[1], D. A. Rothery[1], S. J. Conway[1,2] and M. Anand[1,3], [1]Department of Physical Sciences, The Open University, Milton Keynes, MK7 6AA, UK (emma.fegan@open.ac.uk). [23]LPG Nantes, - UMR--CNRS 6112, France [3]Department of Earth Science, The Natural History Museum, Cromwell Road, London, SW7 5BD, UK.

Introduction: Catenae are chains of more-or-less coalesced craters found on the surfaces of various planets and moons in the solar system. On the Martian moon Phobos it has been hypothesised that they are secondary impact chains, the primary craters for which are located on the surface of Mars [1]. On Jovian moons Callisto and Ganymede, comets fragmented by Jupiter's gravitational field are thought to have formed catenae by serial impact [2].

In previous work [3] we examined the global population distribution of these features on Mercury, and found that they are common, range from 5-300 km in length and 10 - 30 km in width, and they mainly on older plains and material associated with impacts. They frequently exist in clusters – normally around craters and basins. In these cases we interpretted these catenae to be secondary impact chains.

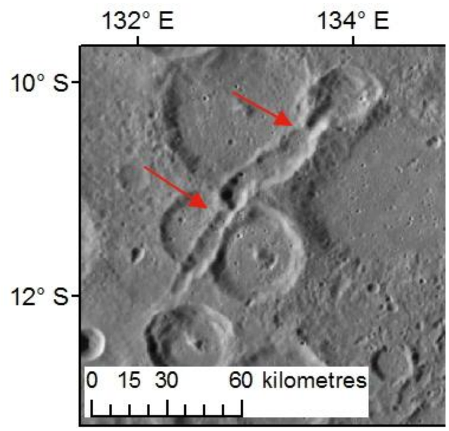

Figure 1: An un-named catena on Mercury, indicated by red arrows. MDIS mosaic, equirectangular projection. A landslide in the crater at the southern end of the catena may have been triggered by its emplacement [3]

Orientations: In order to investigate catenae further we calculated the compass bearing (strike) of each of the catenae to see if there was a global trend in orientation and tentatively stated that they appear to show a preference for NNE-SSW and NNW-SSE [3]. Although the effect of lighting orientation is known to cause problems in the detection of features on Mercury's surface (for example [4,5]), due to the large size of these features we did not anticipate lighting bias to affect the results to a large degree.

However, we also anticipated a limited effect of lighting bias in recent work on other linear features of similar size on Mercury. Lobate scarps found at the edge of volcanically filled basins ("tectonised basins") initially appeared to have preferential east or west facing directions (tectonised basins are discussed in more detail in [6]). Figure 2 depicts orientation and facing direction of the global population of basin-edge lobate scarps. The data plotted are the frequency of occurrence of lobate scarps per 1 degree segment of basin circumference (where 0/360 degrees – due north – is indicated by the black arrow). For example, Figure 2 indicates a preference for north-south orientations of lobate scarps in our global survey, and a preference for west-facing over east-facing scarps.

Lighting Bias: However, we found that when we resurveyed the scarps on shaded relief models (cre- (created from digital elevation models produced by DLR, available: http://europlanet.dlr.de/node/index.php?id=534; note that this is therefore not a global survey) with artificial lighting directions (as described by

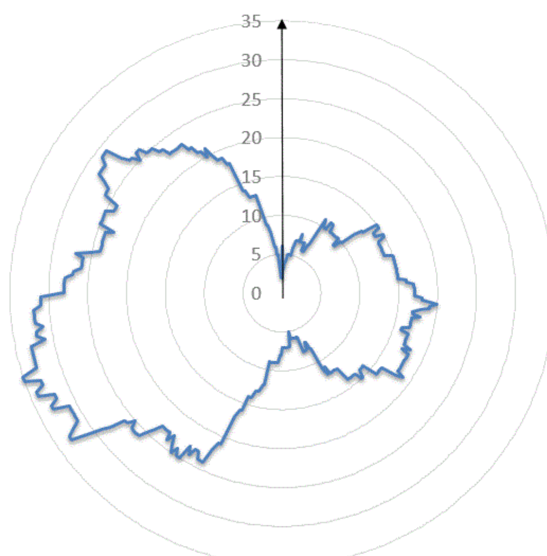

Figure 2: A radial plot displaying the facing directions of the global population of basin-edge scarps (142 scarps in total). The black arrow indicates north, the radial axis indicates frequency of lobate scarp occurrence (per degree of bearing). This plot indicates a north-south alignment of scarps, which are more commonly west-facing than east-facing.

Watters et al (2015) [4] in their supplementary information) we found the orientation radial plots produced varied from the results in Fig. 2, and from each other. For example, to produce the orientation results shown in Fig. 3, the shaded relief model was artificially lit from the east, in Fig. 4 it was lit from the north.

Discussion/Conclusion: The basin-edge scarps are 100s of km long, and have the additional advantage of being only located at the edges of basin volcanic fill. Surveying for catenae requires scanning the entire surface, so it would be easier to overlook a catena if the lighting conditions were unfavourable. The fact that artificially changing the lighting angle changes the results of the basin-edge scarp orientations to such a degree confirms that catenae (and other linear features) will be affected by lighting conditions.

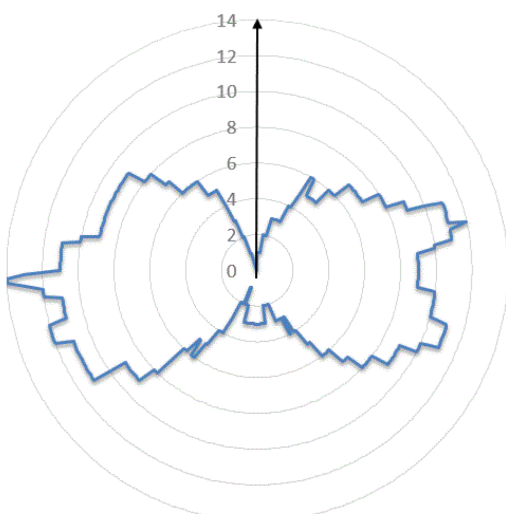

Figure 3: Radial plot of facing directions produced when hillshade model was artificially lit from the east (40 scarps recorded in total). The scarps show strong preference for east or west facing directions. Note that the total frequency is lower than the global plot (Figure 6) as the DLR DEM used only covers a portion of the surface.

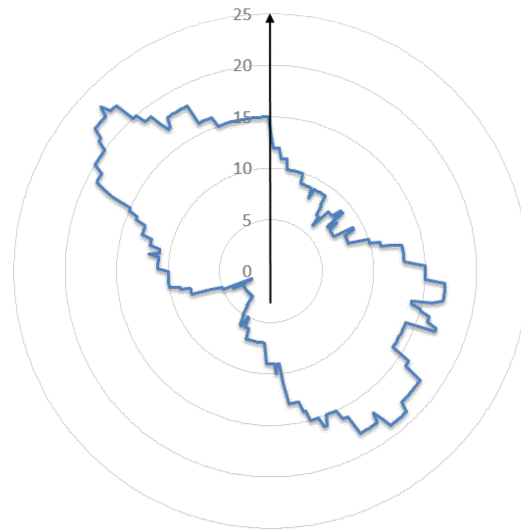

Figure 4: Radial plot of facing directions produced when hillshade model (as used for Figure 7) was artificially lit from the north (56 scarps recorded in total). In this case the survey reveals preferential facing direction northwest-southeast.

References:

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