

MORPHOLOGY AND FORMATION PROCESSES OF PUTATIVE ALLUVIAL FANS IN A YOUTHFUL CRATER: MOJAVE CRATER. K. Goddard¹, S. Gupta¹, P. Carbonneau², A. Densmore², J-R. Kim³, N. Warner¹, J-P. Muller³. ¹Dept. Earth Science & Engineering, Imperial College London, South Kensington Campus, SW7 2AZ, UK, kate.goddard09@imperial.ac.uk. ²Durham University, Dept. Geography, Science Laboratories, DH1 3LE, UK. ³Mullard Space Science Laboratory, University College London, Holmbury St. Mary, Surrey, RH5 6NT, UK.

Introduction: The link between the formation of crater-infilling alluvial fans and localized climate change resulting from the impact cratering process is a subject of much debate. During the Noachian ‘late heavy bombardment’ period it is thought that hot ejecta production and steam release led to global scale warming and precipitation regimes [1]. Noachian to early Hesperian craters containing catchment-alluvial fan systems are not unusual [2], but younger examples are rare [3]. However, there has been a recent discovery of the ~Hesperian/Amazonian aged [4] Mojave crater (7.6°N, 227°W, within an outflow channel between Tiu and Simud Valles) containing at least two generations of alluvial fans, formed in multiple stages [4]. If precipitation played a part in fan formation then this implies at least one recent climate fluctuation, possibly linked to crater formation, during a presumed cold and dry period. Fan-building timescales and formation processes within this crater are so far a subject of speculation [4]. Whilst the broad morphology of fans has been described [4], no attempt to discriminate between fan surfaces or describe their morpho-stratigraphic relations has been made.

Mojave catchment-fans: Complex arrangements of catchment-fan systems are evident in Mojave crater. Small catchment-fan systems (fans <800 m in length) emanate from topographic highs within inner rim terraces, and are characterized by distinct surfaces of varying textures and elevations. Bedrock channels begin on ridge crests of drainage divides, suggesting precipitation as a possible water source [4]. We observe catchments that have ‘cannibalized’ older fan surfaces, indicating temporal variation in fan building. A ‘regional’ sediment routing system, comprised of fans (<2 km in length), superposes these small fans in places (Fig. 1A), and was probably active during, and for a time after, these. Formed from material originating from areas of ponded impact melt [5] within the flat terraces, they appear to comprise a sediment routing system reaching from the rim towards the crater floor. Regional fan formation seems linked to the impact melt material, and our research will aim to develop ideas on the underlying mechanisms.

Results/proposed methods: Preliminary mapping of cross-cutting channels and relative surface heights using HiRISE images (25 cm/pixel resolution) and anaglyphs shows that differentiable surfaces are

present within fans (Fig. 1B). Elevations and textures (color, presence of boulders, channelization) are used to map discrete surfaces, and determine relative age. A terrestrial river remote sensing technique has been used to determine grain size distribution [6]. Results indicate a decrease in grain size on younger surfaces, and smooth decreases in grain size with increased distance from fan apexes. Currently, we are building a ~1 m resolution DTM from a HiRISE stereo pair, and also a ~20 m resolution DTM made from a CTX stereo pair. Catchment-fan slopes will be extracted using the DTM. The long profile of these systems can tell us much about the denudation process operating. De-trending of data from the individual fan surfaces to analyze roughness and relief will also provide a key to identifying sediment transport modes. Furthermore, by crater counting the ejecta blanket and outflow channel we aim to further constrain the age of Mojave’s formation.

Conclusions: Our analysis will add to our knowledge of impact induced climate change and fan building processes which have shaped youthful craters.

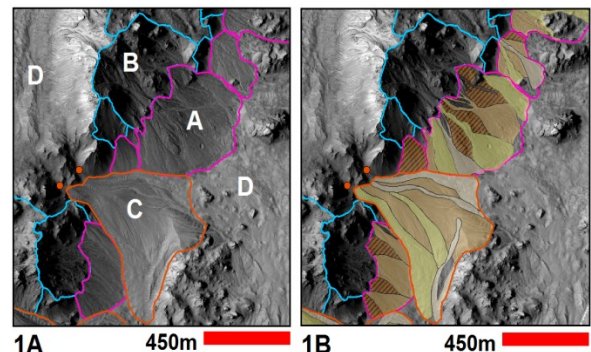


Figure 1A: A is a small fan with catchment (B). C is a regional fan, with the source area being the terrace behind the massif. D is ponded impact melt.

Figure 1B: Surfaces are dated relative to neighbouring surfaces. Darker shades (red-orange) are older than lighter shades (yellow-beige).

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