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Active and fossil aeolian bedforms in Arabia Terra (Mars): climate and sedimentological implications

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Aeolian bed forms such as dark dunes and ripples are abundant and widespread on Mars and can be used to constrain present-day wind conditions at the surface. Fossils aeolian bed forms are usually fractured, cemented and useful to constrain paleo wind conditions. Here we describe active dark dunes and fossil megaripples from an area in Arabia Terra and we discuss theirs climate implications. This area shows dark-toned domes and barchans dunes 1.5 – 10.5 m in height. Dunes slip faces, dipping SW, suggest NE dominant winds. Dunes were targeted in 2006 and 2016 (ΔT = 9.37 Earth years) by the HiRISE camera onboard of the NASA Mars Reconnaissance Orbiter (MRO). By tracking the position of the dunes in the 2006 and 2016 images, we measured an average SW displacement of 1.1 m (0.12 m yr^{-1}). This translates to an average flux of 0.82 $m^3\ m^{-1}\ yr^{-1}$ (median 0.78 $m^3\ m^{-1}\ yr^{-1}$), which is almost three times the median dune flux in the MSL Curiosity landing site but ¼ of the flux measured in McLaughlin and Nili Fossae, areas where active megaripple migration were measured for the first time. Flux distribution (dune by dune) in the study area provides insights on the topographic effect, with the dunes located in depressed areas showing the lower fluxes. The dunes monitored over the 9.37 Earth years' time-span migrated on the top of light toned layered deposit, which show a stair-stepped pattern of bright and dark layers showing different resistance to erosion. The different albedo and erosional pattern may represent different cementation/lithology, chemical composition and/or different grain sizes (bimodal). Eroded mounds 50 – 400 m-large, are the remnants of the widespread-layered unit in the studied area and are surrounded by a set of NW-SE trending linear ridges 10 – 20 m spaced. The morphology and regular spacing of the ridges suggest they are aeolian in origin. The ridges show a clear sinuous morphology that is typical of terrestrial megaripples. Megaripples are a particular type of ripples forming in bimodal sand which have coarse grains (> 1 mm) accumulating over the crest. In this scenario, the light-toned unit erosion could result in the production of bimodal sediment then re-organized in megaripples by the blowing winds and finally fossilized as suggested by the presence of fractures cutting through the megaripple crestlines. The capability of

the winds to move coarse grains give hints on the transport capacity of the flows blowing in the past. The trend of the sinuous megaripples, matching the orientation of the dunes, suggests that the wind regime was consistent through time. The results reported here show how different aeolian features both active and fossils can be used to better constrain Martian climate and sedimentology.