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Aram Dorsum, Candidate ExoMars Rover Landing Site: a Noachian Inverted Fluvial Channel System in Arabia Terra Mars

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Much of Mars' Noachian-aged southern highlands is dissected by systems of fluvial channels and valleys > 3.7 Ga in age. Arabia Terra, lying between the southern highlands and the northern lowlands, is similarly ancient, yet apparently has few valley networks. This regional lack of valley networks only matches Noachian precipitation predictions from climate models if the Noachian climate was dry and cold [1]. In this scenario, highlands dissection was caused by transient flows of meltwater from large, regionally restricted ice-bodies.

However, new results [2,3] show that Arabia Terra is not as poorly dissected as previously thought, and in fact there are extensive networks of inverted channel systems. Here, we describe an example of such a system – Aram Dorsum – which has been studied extensively as an ExoMars Rover candidate landing site. Aram Dorsum is an ∼100 km long, 1-2 km wide, branching, flat-topped ridge system, in western Arabia Terra. We have mapped the system using CTX images, DEMs and other data. We interpret the ridge system to be fluvial in origin, preserved in positive relief due to infill and differential erosion; this working hypothesis is used as a conceptual framework for the study.

Aram Dorsum is a branching, multi-level, contributory network, set in surrounding floodplains-like material. This demonstrates that it was a relatively long-lived, aggradational fluvial system, rather than an erosional outflow or bedrock-carved fluvial channel. Interestingly, the system shows little evidence for unconfined lateral channel migration, so there must have been significant bank stability. Aram Dorsum was therefore probably once a sizable river and, as just one example of many similar systems, is an exemplar for the middle part of a regional sediment transport system that could have extended from the southern highlands to the northern lowlands. Like Aram Dorsum, many of these other recently-recognized fluvial systems have an origin more consistent with precipitation-driven surface runoff than transient meltwater flows. Their presence suggests that fluvial dissection in the Noachian was probably a more globally consistent process than previously thought.

In 2018, the European Space agency will launch the Exo-Mars Rover to search for evidence of past life on Mars. Although Oxia Planum was chosen as prime 2018 site, Aram Dorsum is still in consideration for the 2020 backup launch date. A principal science objective for the Rover is to search for signs of past and present life on Mars, by drilling into the sub-surface. The Aram Dorsum region, being a relatively flat and hazard-free region containing buried and then exhumed, mid-Noachian fluvial/floodplains sediments provides an excellent opportunity for biosignature concentration and preservation and so for ExoMars to meet its science goals.

[1] Wordsworth et al. (2015), JGR, 120(6) [2] Davis, J.M., et al. (2016), LPSC 47, #1982 [3] Chuang, F.C. et al. (2016) LPSC 47, #1490.