THE ANCIENT FLUVIAL CATCHMENT OF OXIA PLANUM: THE EXOMARS 2020 ROVER LANDING SITE.

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Introduction: Oxia Planum will be the landing site for the European Space Agency's 2020 ExoMars program rover. With the primary goal of searching for signs of past and present life on Mars, the ExoMars rover will investigate the geochemical environment in the shallow subsurface over a nominal mission of 218 martian days (sols) [1]. To meet this ambitious mission goal, and for the results of the geochemical experiments to be meaningful, it is crucial to understand the context of the landing site as a whole, and to consider the geological processes that might affect the potential for the formation, concentration and preservation of biomarkers within strata exposed in the landing ellipse.

In this study, we focus on understanding the ancient fluvial systems that fed into the Oxia Planum landing site region from the south, and from Coogoon Valles to the southeast. We compare a hydrological model of the modern topography with geomorphological indicators of ancient fluvial activity visible in remote sensing data to understand: (1) The size of the Oxia Basin catchment, (2) geomorphological evidence for a variety of hydrological settings and processes and (3) how the catchment may have changed though martian history.

These observation are important because biomarkers may have formed in the catchment and transported into the landing site. It is therefore important to know where biomarkers could have formed and how and when they may have been transported.

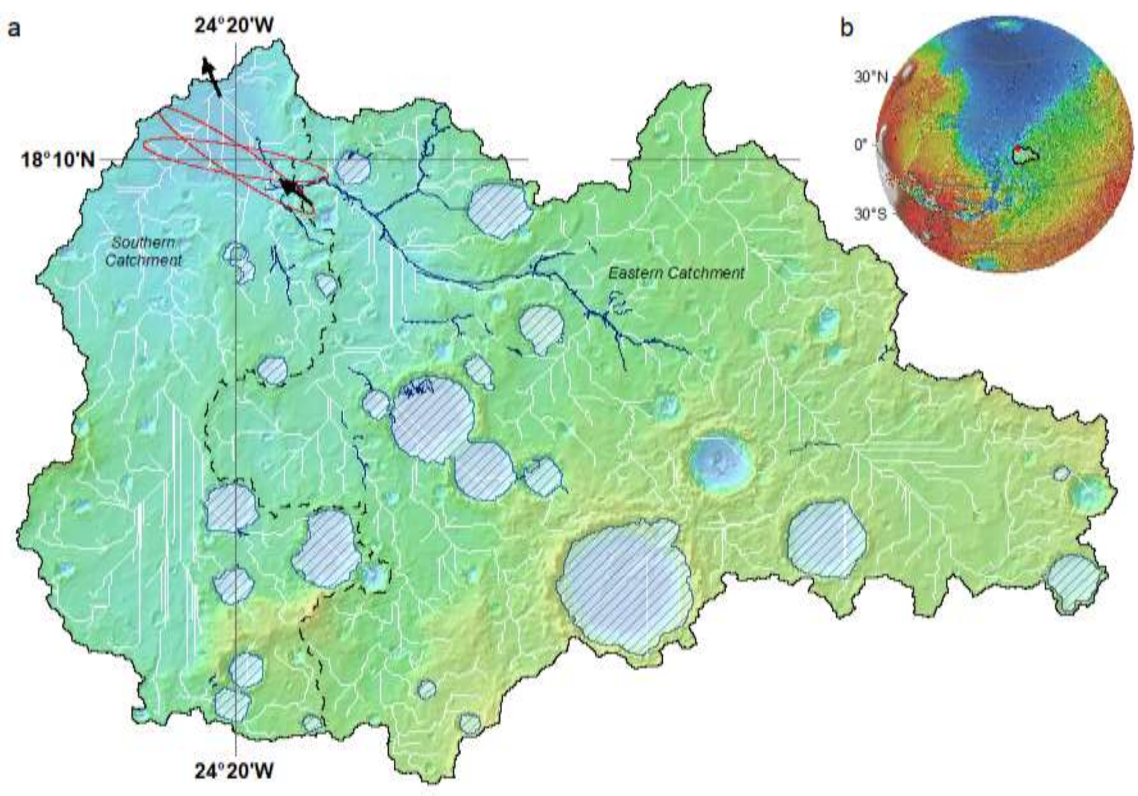

***Figure 1:** The model catchment of the Oxia Planum basin. Shown are east and west catchments (divided by the black line) which supply the ExoMars 2020 landing site (red). Model flow accumulation paths (white) with the observed fluvial network (dark blue) from this study and Hynek et al (2010). We interpret smooth-floored impact craters with inflow, outflow or interior channel structures (hatched) to be candidate palaeolakes.*

Method: The model palaeo-watershed area and drainage network map were calculated using the ArcMap 10.5 Spatial Analyst 'ArcHydro' toolset [2] and MOLA topography data.

Ongoing geomorphological observations of fluvial features are being made using THEMIS, HRSC and CTX data, digitized on to a HRSC basemap at a scale of 1:50,000. These data were then visually compared to identify where the model flow accumulation agrees with, or deviates from, the geomorphological observations.

Observations: The model watershed and flow accumulation (Figure 1) shows that the Oxia Planum landing ellipse lies on the southern margin of a basin with two contributing catchments. The larger Eastern Catchment, covering ~1.5×10^5 km^2 converges to the Oxia basin at the eastern end of the landing ellipse. This model entry point occurred from the Valley Network style channel in contemporary topography and coincides with reported sediment fan remnants [3]. Multiple channels are observed, including the flat floored Coogoon Valles [4], but the precise relationships between channels are obscured by the superposing ejecta of an unnamed impact crater. The smaller Southern Catchment, adds an additional ~0.6×10^5 km^2 of catchment contribution to the Oxia Basin, although it should be noted that downslope the basin is open to Chryse Planitia to the northeast.

The model catchments include several basin-forming craters (Figure 1), with floors at elevations below which water should have ponded. None have previously been identified as candidate paleolakes because they do not have feeder channels. However, many have channel-like incisions in their interior walls, that are onlapped by smooth, layered crater floor deposits that include hydrated minerals [5] (Figure 2b). This raises the possibility that they are groundwater-fed paleolakes, with the lack of feeder channels being explained by the craters' location on a topographic rise at the edge of the Oxia basin catchment.

Overall the model watershed is broadly representative of the observed channel network and includes the large valley Coogoon Valles [4]. However, there is an important deviation to the north of Coogoon, where a channel crosses the model watershed divide (Figure 2a). Here the topography has been affected by the formation of a wrinkle ridge, showing that regional tectonic activity postdates the observed fluvial network, and that the true catchment area for the Oxia basin was more extensive than the model suggests.

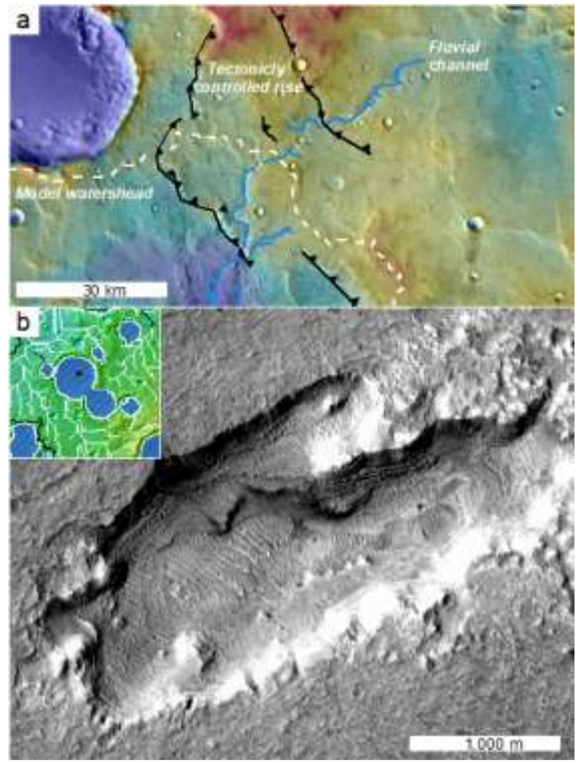

Figure 2: *(a) Fluvial channel uplifted by a wrinkle ridge crossing the model watershed and (b) a pit in the smooth floor of a possible crater lake showing layered sediments in CTX image B19_016961_1970_XN_17N022W.*

Conclusions: Our ongoing work shows that: (1) The Oxia basin has been fed by an extensive fluvial system with a minimum catchment area of ~2.1×10^5 km^2. (compared to ~4.6×10^5 km^2 for Hypanis Valles [6] and ~0.3×10^5 km^2 for Jezero [7] (2) Several deep craters contain possible evidence for interior palaeolakes. Being located on a topographic rise, they do not have feeder channels, so could have been sustained by ground water. (3) Tectonic activity postdates the formation of the fluvial network; consequently the catchment may be significant larger than the model value.

References: [1] Vago et al., Astrobiology, (2017) [2] Esri, /10.5/tools/spatial-analyst-toolbox/how-watershed-works.htm, (2016). [3] Quantin et al., (2019) *in prep.* [4] Molina et al., Icarus, (2017). [5] Carter et al., Icarus, (2015) [6] Fawdon, P., Gupta, S., Davis, J. M., Warner, N. H., Adler, J. B., Balme, M. R., Sefton-Nash, E. (2018). EPSL, 500, 225-241. [7] T.A. Goudge, J.F. Mustard, J.W. Head, C.I. Fassett, S.M. Wiseman J. Geophys. Res., Planets, 120 (2015)