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Studying the NE Eridania sedimentary sequence through the Mars 2020 rover

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Abstract

The landing sites we are proposing for the next Mars 2020 rover span between 28°29'30"S-28°53'0"S Latitude and 178°56'30"W°178°28'0"W Longitude, i.e. on the NE floor of a 1.1×10^6 km^2 closed drainage basin [1]. This area, see Fig. 1, belongs to the bigger (3×10^6 km^2) Eridania basin that gave birth to the Ma'adim Vallis through catastrophic overflow, and presenting a water table between 950 and 1250 m [1,2,3]. The crater counting chronology for this area gives an age between Early to Middle Noachian [4].

By means of OMEGA [5] and CRISM [6] data, a large clay-bearing sedimentary unit has been identified over almost the entire margin of the Eridania basin [7]. On our specific site, i.e. the NE margin of the Eridania basin, sequences of aqueous minerals are observed. Such sedimentary minerals are accessible through erosional windows into the first several tens of meters of the sedimentary sequence. The top-down mineral sequence identified on the landing sites area presents an unaltered capping unit that is overlying an Al-rich clay stratum (see Fig. 2) akin to Al-smectite and/or kaolins with a <1 m thickness. A third sedimentary Fe-rich clay layer (akin to the nontronite smectite) is found, presenting a thickness of <10 m and overlying a mineral at the base of the exposed strata, which could be either a zeolite (favoured scenario) or a hydrated sulfate. On Earth, the thicknesses and compositions of the clay-rich strata have been used to constrain the paleoclimate [8,9], hence, the in situ exploration of the proposed sedimentary sequences at Eridania would provide fundamental observables of the early era (> 3.8 Ga) during which liquid water was durably stable at the surface.

The most valuable candidates for ancient Martian

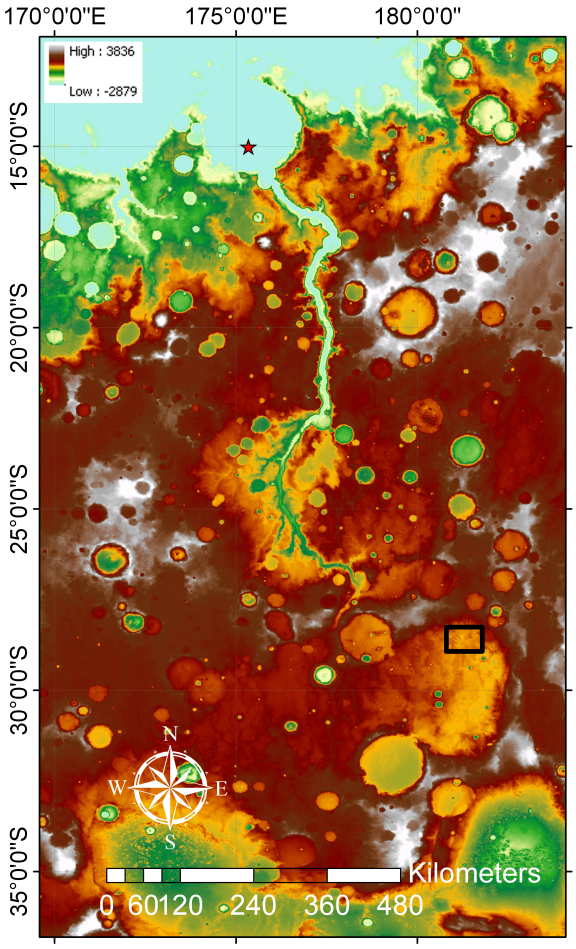

Figure 1: MOLA elevation map showing the Ma'adim Vallis. The red star is the Spirit Gusev crater landing site, while in the black square there are the proposed Mars 2020 Eridania floor landing areas.

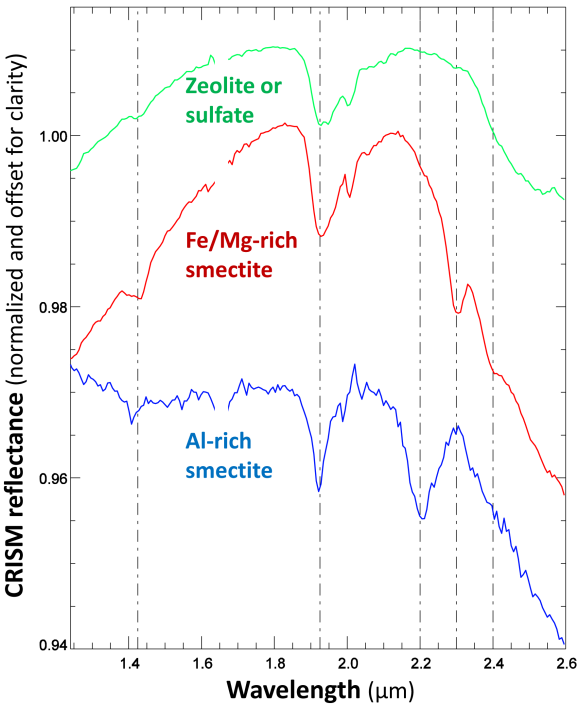

Figure 2: CRISM spectral reflectance of the mineral sequence identified on the Eridania landing sites.

microbial life sustainability and preservation are long-lasting environments, characterized by the presence of ponding water [10,11,12]: hence, the proposed site presents a high exobiological potential that is just waiting to be unveiled. Besides that, when putting into context the future results on Eridania Basin, i.e. the Ma'adim Vallis source, together with those obtained from the Spirit rover inside Gusev Crater (see Fig. 1), i.e. the Ma'adim Vallis mouth, a wide understanding of this intriguing canyon and of the Mars megaflooding age is foreseen.

Besides the above scientific analysis showing than the NE side of the Eridania region fulfills entirely the Mars 2020 scientific requirements [13], the location of the proposed landing sites widely meets all the engineering constraints [14], satisfying the elevation, slopes, rock abundances, thermal inertia, albedo and the dust coverage requests.

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