Geophysical Research Abstracts
Vol. 16, EGU2014-4651, 2014
EGU General Assembly 2014

Widespread Surface Weathering on Early Mars

Damien Loizeau (1), John Carter (2), Nicolas Mangold (3), François Poulet (2), Angelo Rossi (4), Pascal Allemand (1), Cathy Quantin (1), and Jean-Pierre Bibring (2)

(1) Université Claude Bernard Lyon 1, LGLTPE, Villeurbanne, France (icdamien@gmail.com), (2) IAS, Orsay, France, (3) LPGN-CNRS, Nantes, France, (4) Jacobs University, Bremen, Germany

The recent discovery of widespread hydrous clays on Mars indicates that diverse and widespread aqueous environments existed on Mars, from the surface to kilometric depths [1,2]. The study of the past habitability and past climates of the planet requires assessing the importance of sustained surface water vs. subsurface water in its aqueous history.

Using remote sensing data, we propose that surface weathering existed on Mars, suggesting that Mars experienced durable episodes of sustained liquid water on its surface. Weathering profiles are identified as vertical sequences of Al-rich clays and Fe/Mg-rich clays in the top tens of meters of the surface, similar to cases of pedogenesis on Earth (e.g. [3,4]). Such localized clay sequences have been reported by other works in 3 regions of Mars [5-8] and a similar origin was also proposed. Their frequency is however likely underestimated due to limitations of orbital investigations and re-surfacing processes.

A large survey of the CRISM dataset leaded to a down-selection of $\sim$100 deposits with clear vertical sequences, widely distributed over the southern highlands and grouped in regional clusters [9]. These putative weathering sequences are found either on inter-crater plateaus, on the floor of craters and large basins, or on crater ejectas. We investigated the thickness of the altered sequences, the age of the altered units and the different geological contexts to further understand the weathering process(es).

Using few HiRISE DEMs where possible, and CTX DEMs, we find that the thickness of the exposed Al clays is on average of the order of several meters to few tens of meters. The clay sequences reported here are consistent with terrestrial weathering sequences which form under wet climates over geological timescales ($>10^5$-10^7 years).

The combined age assessment of the altered unit and the unaltered capping (where present) provides constraints on the age of the weathering itself. All investigated cases point to an active weathering limited to the late Noachian to early Hesperian.

The widespread distribution of weathering sequences in different geologic contexts, and the consistency in their estimated ages are best explained if Mars experienced a period/periods between the middle Noachian and the early Hesperian during which climatic conditions allowed sustained liquid water flow on its surface, while the high degree of degradation of older terrains does not allow affirming nor infirming earlier surface weathering on Mars. Only the in-situ exploration of Phyllosian/Noachian terrains may provide an answer to this fundamental question.

Some of the authors have received funding from the ERC (FP7/2007-2013)/ERC Grant agreement n° 280168.

[1] Ehlmann B., et al. Nature, 479, 53-60 (2011). [2] Carter J., et al. JGR, 118, 831-858 (2013) [3] Velde B., et al. Ed. Springer, Berlin, (1995). [4] Wilson M. Clay Minerals, 39, 233-266 (2004). [5] Gaudin A., et al. Icarus, 216(1), 257-268 (2011). [6] Loizeau D., et al. Icarus, 205, 396-418 (2010). [7] Noe Dobrea E., et al. JGR, 115, E00D19 (2010). [8] Le Deit L., et al. JGR, 117, E00J05 (2012). [9] Carter J., et al. LPSC 2012, p.1755