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A New View of Mars Aqueous Alteration: First Results from The Mars Orbital Catalogue of Chemical Alteration Signatures (MOCCAS)

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1. Introduction

A decade of orbital and in-situ investigations of the hydrous clay mineralogy of Mars have revealed blanketing aqueous alteration involving a variety of formation and diagenetic mechanisms, and an evolution with time. A paradigm established 10 years ago has withstood intense scrutiny [1]. Mars experienced a clay-forming era early in its history (circa 4 Ga, probably since earlier times), which transitioned to evaporitic salty deposits, as the geologic and hydrologic activity of Mars waned. Open, fiercely-debated questions remain: e.g. did the bulk of alteration involve meteoric waters in open system environments, or was it restricted to the sub-surface under a mostly frozen-over surface, save for episodic climatic excursions [e.g. 2-4]. Also of critical importance for future exploration, the organic matter retention and preservation potential of Martian clay-bearing environments have yet to be fully assessed.

2. Global mapping: rationale

A methodological approach to the large and varied datasets of Mars aqueous alteration available should allow lifting some degeneracy as to the actual geochemical environments on ancient Mars. Here we report on the completion of the MOCCAS (*Mars Orbital Catalog of Chemical Alteration Signatures*) project. A decade of mapping hydrated minerals on Mars at the sub km resolution, using principally the OMEGA/Mars Express and CRISM/MRO imaging spectrometers, now provides a global view of aqueous alteration at Mars. The approach here is hybrid between the early mapping works [1,5], and subsequent cataloging projects [3,6,7]. This new vectorial database combines detailed spectral analysis providing the aqueous mineralogy, with high resolution spatial mapping for morphologic context and global scale distribution. The detailed methodology and goals of MOCCAS are further described in [8].

3. Early results

We present early results from this dataset which provide a new view of Mars alteration: 1. A statistically significant sample (100,000s deposits) globally at Mars which reveal the blanketing nature of Mars's Noachian alteration. Likely an order of magnitude more than established thus far. 2. New regions of extensive aqueous alteration with areas in par with those well studied thus far (e.g. Mawrth Vallis Plateaus, Nili Fossae, Sinus Meridiani). 3. Regional scale trends in Mars's alteration showing coupling between geologic/topographic context and composition.
Collectively, these early results show that Mars's alteration is still largely un-investigated, and there exist several regions of particular interest which would warrant further study and in-situ exploration. Several such example regions are shown here (figure) and will be presented.

4. Perspectives

A systematic, regional-scale investigation of Mars using the MOCCAS dataset is underway which aim is to provide insight on the diversity of alteration settings at Mars. The database itself is being refined to integrate, for each deposit, the geologic age from [9], while the largest deposits will have estimates of their thicknesses (when possible) and modal abundances [10]. These will help interpret the regional diversity, and be used to study *quantitatively* the global scale formation processes of clay minerals at Mars.

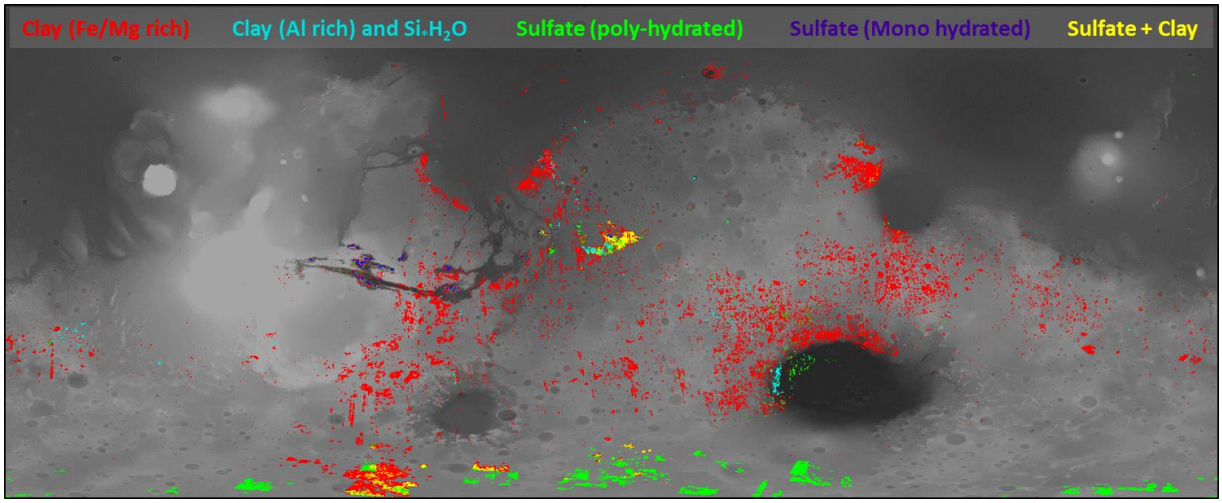

Figure 1. The global scale database. Several 100,000s exposures mapped and their mineralogy determined.

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References

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