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THE CHEMICAL VARIABILITY AT THE SURFACE OF MARS: IMPLICATIONS FOR ROCK WEATHERING

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Recent Mars represents a cold and dry world, surrounded by a thin atmosphere, supporting only physical weathering due to aeolian abrasion, freeze thaw cycles and salt weathering. The atmospheric loss to space was most likely triggered by the early cease of the sheltering planetary magnetic field and interactions of the atmosphere with the strong radiation field of the young Sun. However, large amounts of ferric oxides and sulfates, as well as hydrated minerals were found and are considered as remnants of a warm and humid climate in the past. A denser atmosphere has supported the existence of liquid water and was accompanied by strong volcanic activity. The chemical alteration may have been dominated by palagonitization and acid fog weathering upon attack of volcanic gases and acid liquids/fogs. The processes may have led to chemical fractionation of rock crusts and soils in relation to fresh rock chemistries. The chemical composition of sediments and rocks, as well as their distribution at the Martian surface, represent a long term archive of processes, which have formed the planetary surface. A survey of chemical compositions by means of Compositional Data Analysis represents a valuable tool to extract direct evidence for weathering processes and allows to quantify weathering and sedimentation rates. Clr-biplot techniques are applied for visualization of chemical relationships across the surface ("chemical maps"). The variability among individual suites of data is further analyzed by means of clr-PCA, in order to extract chemical alteration vectors between fresh rocks and their crusts and for an assessment of different source reservoirs accessible to soil formation. Both techniques are applied to elucidate the influence of remote weathering by combined analysis of several soil forming branches. Vector analysis in the Simplex provides the opportunity to study atmosphere surface interactions, including the role and composition of volcanic gases.