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Anorthosite as revealed by CRISM/MRO: Identification, distribution and formation process

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The surface of Mars is primarily made up of basaltic rocks comprised of pyroxene, olivine and intermediate felsic plagioclase minerals. A few localized eruptive sequences may indicate some compositional evolution from basaltic to dacitic rocks, but these remain in essence volcanic rocks. Using the CRISM (Compact Imaging Reconnaissance Spectrometer for Mars) near-infrared imaging spectrometer orbiting Mars [3], we report the detection of a new rock type on Mars, anorthosite. Anorthosite is a highly felsic (>90% plagioclase, <10% mafic minerals) non-volcanic igneous rock which peculiar composition requires very specific formation processes. On Earth, anorthosite is a rare rock found mostly in plutonic rocks in continental areas sharing locations with granitoid rocks. Anorthosite is also a major component of the lunar crust and ubiquitous in the lunar highlands where it is interpreted to be the result of the crystallisation of the primordial magma ocean of the Moon > 4.3 Gyrs ago. To date, 8 anorthosite exposures have been unambiguously identified over the southern highlands of Mars. These are found in the rims of large (D > 50 km) craters or as outcrops in massif units. Their specific locations suggest a formation at depth in all cases and place their formation early in the planet's history (> 4 Gyrs) and. The production of significant quantities of highly differentiated, siliceous melt that would form anorthositic rocks requires specific mechanisms such as fractional crystallization, assimilation, or partial melting of an already evolved source incompatible with the ultramafic source composition inferred for Mars. Possible formation scenarios are discussed with plutonic related formation process as the most likely one.