OMEGA Analysis of Mafic and Hydrated Minerals Associated with the Syrtis Major Region of Mars

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OMEGA 3-color global data 32 ppd R:2.00 μm G:1.53 μm B:1.10 μm

- Straddles the highlandlowland boundary: Ancient Crust
- Hesperian-aged volcanic plateau on the rim of Isidis basin: Volcanic Evolution
- Evidence for interactions of volcanism with volatile-rich deposits: Alteration

Cooperation between OMEGA and CRISM (Compact Reconnaissance Imaging Spectrometer for Mars on MRO)



Distribution of ironbearing mafic minerals shows 3 important properties:

Ancient highlands enriched in low-Ca pyroxene

Hesperian volcanism characterized by 2pyroxene composition, enriched in high-Ca pyroxene

Olivine is highly localized, to crater floor deposits, some volcanic flows, and localized ancient highlands deposits



Modeling Pyroxene Content

- Analyzed with the Modified Gaussian Model (MGM)
- Two pyroxenes are REQUIRED to fit observations
- Noachian: enriched in low-Ca pyroxene (60-80%)
- Hesperian: enriched in high-Ca pyroxene (60-80%)

(Kanner et al., LPSC 36,, 2005)



Olivine



localized ancient highlands deposits

20 km



On Syrtis Major, olivine is found in ejecta deposits and some volcanic flows



20 km



Olivine in this ancient highlands deposit is broadly distributed. Same geographic area as shown by TES to be olivine rich



64°E 30°N





Laboratory Reflectance

1.9 μm band depth Water in smectite clays



Two Distinct Types of Hydrated Silicates





Wavelength

Fe-rich smectite clays (e.g. nontronite, chamosite) display absorptions in the 2.0-2.6 µm wavelength consistent with the OMEGA observations

Glauconite is less likely since it is a mica formed during diagenesis in oceanic sediments

Relative Reflectance

Nontronite, chamosite are typical alteration products of mafic silicates

Hectorite is also possible, but is a Li-clay

Laboratory Reflectance



20 km

Two distinct surface morphologies of hydrated silicate regions:

- 1) Broad areas of ancient crust
- 2) Layered rocks



Hydrated Mineral Band Strength with THEMIS Daytime IR Mosaic





Association with layered terrain



3 km

MOC Image R1003382



Outline of Orbit 232



Reflectance



20 km

Syrtis Major Region

- Ancient crust is enriched in low-Ca pyroxene, with some regions olivine-rich
- Volcanic flows are dominated by 2-pyroxene basalt composition, early (?) olivine-rich phase
- Interaction of volcanism and volatile-rich deposits points to possible hydrothermal alteration as source of hydrated silicates
- This needs to be investigated as an astrobiological target (heat, water, low pH) to expand range of possibilities beyond Meridiani Planum
- Fantastic job by OMEGA instrument and Mars Express spacecraft teams!