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

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- Straddles the highland-lowland 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

OMEGA 3-color global data 32 ppd
R:2.00 \(\mu\)m  G:1.53 \(\mu\)m  B:1.10 \(\mu\)m

Cooperation between OMEGA and CRISM
(Compact Reconnaissance Imaging Spectrometer for Mars on MRO)
Distribution of iron-bearing mafic minerals shows 3 important properties:

- Ancient highlands enriched in low-Ca pyroxene
- Hesperian volcanism characterized by 2-pyroxene composition, enriched in high-Ca pyroxene
- Olivine is highly localized, to crater floor deposits, some volcanic flows, and localized ancient highlands deposits

![Graph showing wavelength vs. concentration for different minerals.]

![Map showing distribution of minerals across the Martian surface.]
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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 is highly localized, to crater floor deposits, some volcanic flows, and localized ancient highlands deposits.
On Syrtis Major, olivine is found in ejecta deposits and some volcanic flows.
Olivine in this ancient highlands deposit is broadly distributed. Same geographic area as shown by TES to be olivine rich.
Laboratory Reflectance

Ratio (Terrain A)/(Dusty Terrain)

Clay-Sulfate Mixture
Nontronite
Dusty Terrain
Hydrated Region

1.9 µm band depth
Water in smectite clays
Two Distinct Types of Hydrated Silicates

- Wavelength: 1.4 µm, 1.9 µm, 2.30 µm, 2.35 µm

Relative Reflectance vs. 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.

Nontronite, chamosite are typical alteration products of mafic silicates.

Hectorite is also possible, but is a Li-clay.
Two distinct surface morphologies of hydrated silicate regions:

1) Broad areas of ancient crust
2) Layered rocks
Association with layered terrain
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!