Martian surface aqueous alteration from the study of the combined evolution of the 1.9 and 3 microns band with OMEGA

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Quick Access Summary

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Mains results

- Co-evolution of the 1.9 and 3 \textmu{}m band at a global scale for bright areas
- Some discrepancies are observed at a local scale for dark regions

(Click on the images for high-res)
Previous studies of the Martian surface water content derived from the 3 µm band have shown an overall increase of water hydration in the polar regions.

The question of the origin of this latitudinal trend remains. Today, two main hypotheses are considered:

- Adsorbed water
- Chemical alteration

The possible presence of diffuse atmospheric water ice particles or sub-pixels patches of exposed subsurface ice from the permafrost can also be involved in the observed evolution of the 3 µm band. Indeed, recent studies have shown the presence of such outcrops down to 55°N, and as the permafrost depth decreases in the higher latitudes, they may be more frequent in the polar regions.
Co-evolution at a global scale

Latitudinal evolution of the reflectance at 2.26 µm (a), the 3 µm integrated band depth (b) and the 1.9 µm band depth (c), averaged on longitude.

Only pixels with albedo ≥ 0.3 are considered here to prevent strong albedo variations effects.

➢ Continuous increase of both the 3 µm and 1.9 µm bands between 30°N and 70°N
➢ Not correlated with albedo variations
➢ This trend is compatible with both an increase of adsorbed water, but also with an increase of the amount of hydrated surface material. As the 1.9 µm band is also known to be associated with sulfates that may also be widespread at polar latitudes

Composite maps from OMEGA/MEx observations between $L_s = 100^\circ$ to $L_s = 150^\circ$ (MY 27).

(Click on the images for high-res)
Regional discrepancies – The region of Acidalia Planitia

➢ **Low albedo** (0.05 – 0.1) terrains

➢ **3 µm feature lower** than other bright regions at the same latitude, but **higher 1.9 µm feature** (cf global maps on page 3)

➢ Comparison yellow spectra vs blue spectra:
  ➢ More 3 µm band
  ➢ Less 1.9 µm band

➢ **Anticorrelation** between the 1.9 and 3 µm bands observed at **local scale**

Possible other signatures under investigation.
Conclusions

➢ *Different behavior observed* for the co-evolution of the 2 absorption bands:
   ➢ *Correlated evolution* of the 1.9 and 3 µm features at a *global scale* for bright terrains.
   ➢ *Anticorrelations* observed at a more *regional scale*, for low-albedo region.

➢ Suggest a *multiplicity of factors* for the high-hydration levels observed in the north polar regions.

➢ Further work will investigate the presence and evolution of other spectral signatures.
Acknowledgements

The OMEGA/Mex data are freely available on the ESA PSA at https://archives.esac.esa.int/psa/#!Table%20View/OMEGA=instrument.

References