OBSERVATIONS OF CALCIUM SULFATE DEPOSITS AT HIGH LATITUDES BY OMEGA/MEX AT KM/PIXEL RESOLUTIONS. Y. Langevin, François Poulet, Jean-Pierre Bibring, Brigitte Gondet, Institut d'Astrophysique Spatiale (CNRS / Université Paris Sud), Batiment 121, 91405 Orsay Campus, France, yves.langevin@ias.u-psud.fr

Introduction: The OMEGA imaging spectrometer on board Mars Express has comprehensively covered the Northern high latitude regions of Mars in October and November 2004. At that time, the altitude of the spacecraft over the pole was ~ 4000 km and decreasing as the pericenter moved northward. The pixel resolution of OMEGA (1.25 mrad IFOV) ranged between 3 and 5 km for these global maps. With its spectral range (0.4 to 5 µm), S/N and resolution, OMEGA has been able to determine the geographic distribution and specific characteristics of surface ices and minerals. In particular, a major mineralogical unit has been associated with the western part of the Olympia Planitia dark dune deposits (125° to 245° longitude, latitude close to 80° [1]) with a large content in calcium sulfates, most likely gypsum [2]. In late December, the altitude of the spacecraft over high latitudes had decreased, and it was possible to perform observations of specific regions with pixel sizes of ~ 1km. We focus here on the dark dune deposits, the results on surface water ice being presented in a companion abstract [3].

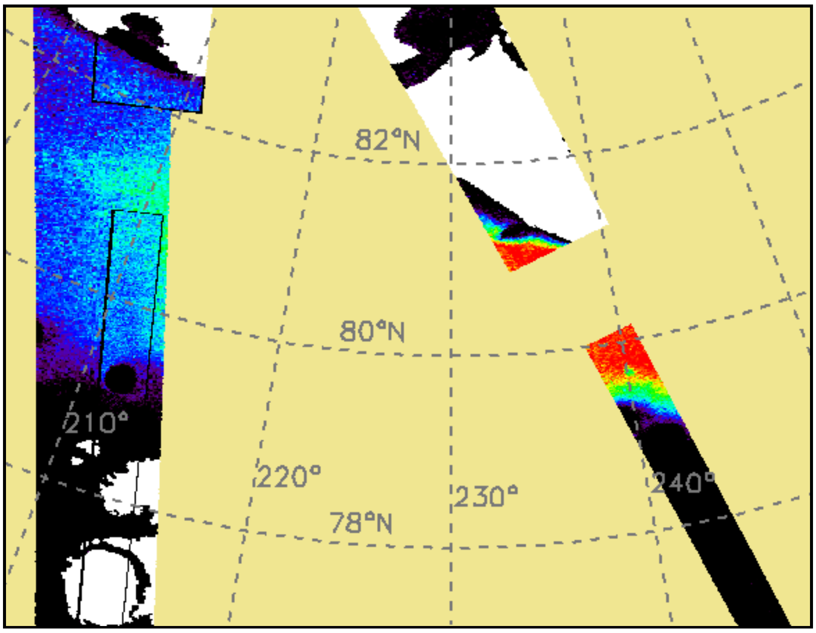

Fig. 1. Maps of the hydration band strength at 1.94 µm obtained by OMEGA/Mex in the second half of December 2004. The rainbow scale covers the range from 4% (black) to 25% (red). Ice rich regions (1.5 µm feature > 20%) are featured in white. The pixel size varies from 1.2 km for the leftmost track (18/12/2004, Ls = 130.8°) to 1 km for the track on the right (29/12/2004, Ls = 136.2°) and the track superimposed as two rectangles on the left (30/12/04, Ls=136.8°). The consistency between the two overlapping tracks rule out major cloud activity in the period. The phase angle (similar to incidence with near-nadir pointing) ranged from 59 to 63° between latitudes 79° and 82°N.

Results: The most specific feature of hydrated minerals in the 1 to 2.6 µm range (best S/N and spectral resolution of OMEGA in the near IR) is at 1.94 µm. Its band strength can be estimated by selecting one wavelength in the band (1.927 µm) and two wavelengths in the continuum (1.86 µm, 2.12 µm) out of the major atmospheric CO_2 absorption features. Even for dark regions at high latitudes, the S/N of OMEGA exceeds 100 at these three wavelengths. Observations in the second half of December, 2004 (18/12, 29/12, 30/12) are presented in Fig. 1. For the last two swaths, there is a change of observation mode (with a gap of 0.5° in latitude) from a swath of 64 pixels to a swath of 32 pixels so as to adjust the cross-track and along-track sampling as the spacecraft altitude lowers. These observations are very consistent with the global maps obtained by OMEGA in October and November 2004 [2]. In particular, they confirm the trend towards increasing band strengths from West to East in the dark dune deposits of Olympia Planitia.

These observations show that the content in calcium sulfates is very homogeneous at a km scale over tens of km, both for regions with high content (Fig. 2) and lower content (Fig.1, left) in calcium sulfate. They also show that there is a gap of several km between this area and the permanent water ice cap (Fig. 3), which could be marginally detected with lower resolution observations [2]. This is consistent with the association of the calcium sulfate rich unit with the dark dune deposits geological unit [2].

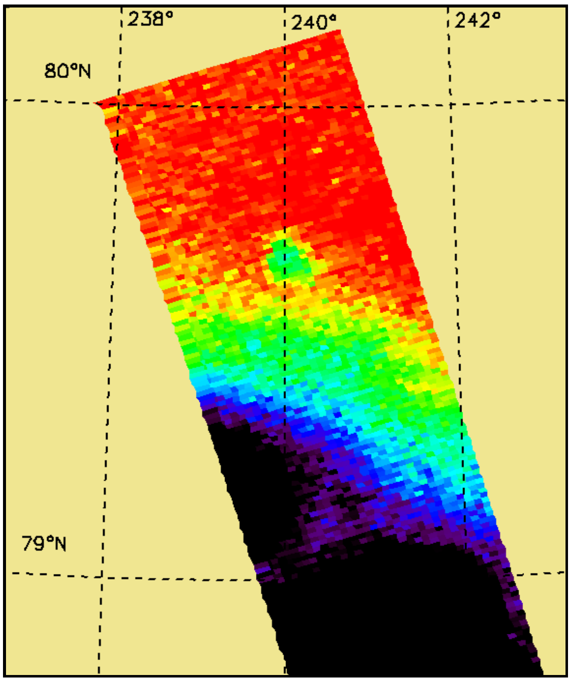

Fig. 2: zoom on the highest resolution observation at ~ 240°E (pixel size ~ 1 km). The band strength is very homogeneous (~ 24%) in a region 20 x 30 km in size (upper right corner), with a variance of ~ 1%.

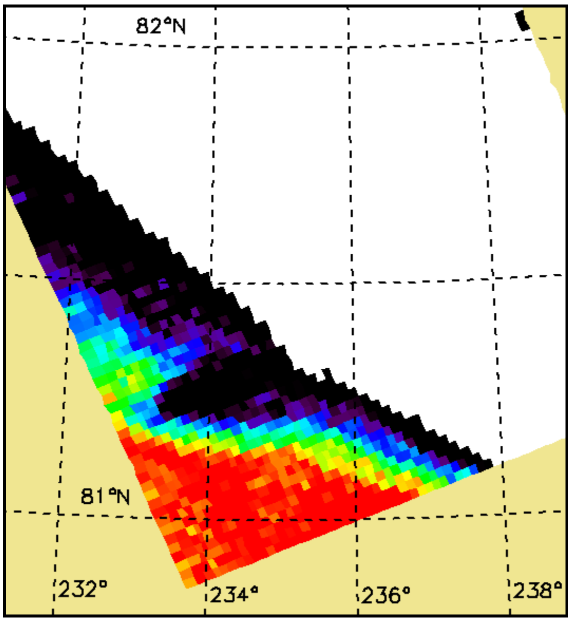

Fig. 3: zoom on the interface region between the permanent water ice cap (white) and the calcium sulfate rich region (blue to red). A band at least two pixels wide (2 km) presents no significant signature of either hydration (dark blue: > 4%) or water ice.

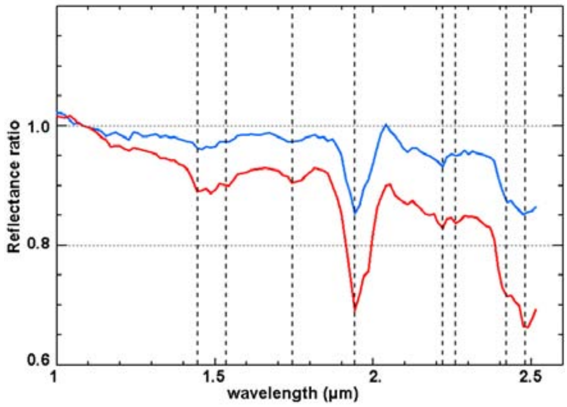

Fig. 4. normalized reflectance ratio between a region with a high content (red curve) or lower content (blue curve) in calcium sulfate and a region at 105° E, 78.3° N, out of the dark dune deposits, with a similar albedo (15% at 1.1 µm) and altitude (-4.4 km).

A confirmation of the identification of calcium sulfates is presented in Fig. 4. Reflectance ratios nearly eliminate atmospheric bands (for a similar altitude) and artifacts resulting from uncertainties on the photometric function. When compared with a dark high latitude region which does not present a narrow hydration band at 1.94 µm, mean spectra from the upper right corner of Fig. 2 (red curve) and from regions with lower hydration level (left of Fig. 1, blue curve) present all the diagnostic spectral signatures of calcium sulfates, with gypsum providing the best fit.

The locally homogeneous mineralogical characteristics and the smooth evolution of the mixture of calcium sulfate with dark material from West to East within the dark dune deposits support a formation as evaporites or alternate alteration processes operating at scales of several 10 km.

Additional observations by OMEGA are scheduled from mid-January to mid-February 2005 with pixel sizes down to 400 m. After that, sun elevations will become too low. A more comprehensive sub-km mapping of this region, which constitutes an important example of large scale hydrous alteration on Mars, is scheduled for late 2006, when the pericenter of Mars Express returns to high northern latitudes in mid-summer.

References: [1] K. Tanaka, D. Scott. *U.S.G.S.* Misc. Invest. Ser. Map I-1802-C (1987). [2] Y. Langevin et al. (2005) submitted. [3] Y. Langevin et al. (2005) this volume.