ACTIVE JETS AND SLAB ICE IN THE SEASONAL SOUTH POLAR CAP OF MARS. F. Schmidt[1,2], R. Dupire[1,2], S. Douté[3], G. Portyankina[4], [1]Univ Paris-Sud, Laboratoire IDES, UMR8148, Orsay, F-91405, France (frederic.schmidt@u-psud.fr); [2]CNRS, Orsay, F-91405, France [3]Laboratoire de Planétologie de Grenoble, CNRS/UJF, Grenoble, France [4]Space Research Planetary Science Division, Physikalisches Institut, University of Bern, Switzerland

Introduction: The cryptic region is a subset of the seasonal south polar cap (SSPC) defined by a low albedo, the presence of CO2 ice and the activity of the spiders [1,2]. The exotic but generally accepted scheme of the CO2 jets formed by sublimation beneath a translucent slab ice [3] has been challenged by OMEGA observation that showed that there is no slab ice in the cryptic region [4]. Recently a new OMEGA spectral index has been built in order to follow the potential presence of slab ice [5]. We will present here the results from the geomorphological classification on 5,000 MOC and HiRISE images to assess the presence of active jets. In particular, we show that jets are active outside the Cryptic region. We will discuss the validity of the standard geyser model by estimating the correlation between slab ice and jet activity.

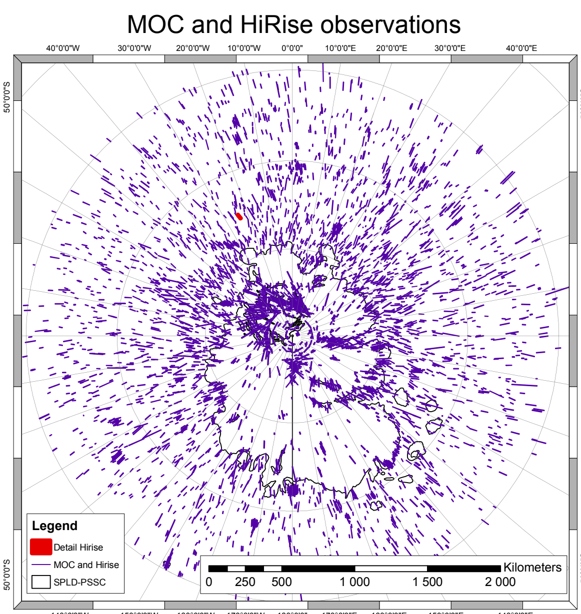

Fig. 1: Footprints of the 5,000 MOC and HiRISE images classified in south stereographic projection. The thick black line represents the Permanent South Polar Cap (PSPC) and the South Polar Layered Deposits (SPLD). MOC observations in the SPLD are removed because already studied [2]. The red footprint represents the images of figure 4.

Methods: We selected all MOC and HiRISE observations in the latitude higher than 60S and estimate the jet activity. The complete dataset is plotted in figure 1. We classify each image into five classes, with increasing probability of jet activity (corresponding probability of activity 0%, 25%, 50%, 75%, 100%.): "no jets activity", "unclear jets activity" ,"unknown activity of jets due to circular deposit", "probable jets activity and small non-circular deposit", "jets activity with directional fans deposit". This probabilistic scheme allows us to quantify the uncertainties of geomorphological interpretation due to noise, presence of clouds, or simply ambiguous structures. The probability of active jets as a function of time is plotted in figure 2.

The equivalent slab ice depth has been estimated using the SIR fast inversion method [5]. It will not be interpreted as a real slab ice depth but more as an indicator of a large free mean path of photons in the CO2. We will interpret a large value of this indicator as a high probability of the slab ice. Thus, we will refer to it as the "slab index". The comparison between our geomorphologic dataset and the slab index is a way to test the geyser model [3].

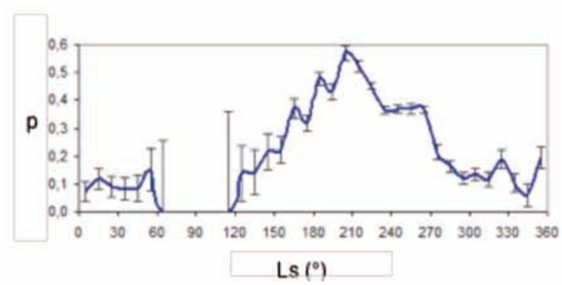

Fig 2: Probability of jets activity as a function of time (Ls).

Results: Figure 2 indicates that the highest probability of jet activity is around Ls=210°, clearly after the winter solstice.

Figure 3 shows the slab index as a function of time for the particular position 75.5S, 339.5E as a function of time, as observed by OMEGA [5]. The slab index decreases from Ls=180 to Ls=200, then increases until Ls=250 and then decreases again. The corresponding HiRISE images show the presence of jet activity increasing with time (fig. 3). This set of image clearly show a late episode of the jets activity in this region (Ls=230) in comparison to other places in particular in the cryptic region active around Ls=180 [6]. The first decrease of the slab index is difficult to interpret but the first increase of the slab index in fig. 2 may be due to metamorphism or early stage of geysers. The second decrease of the slab index (after Ls=250) is shown to be temporally anti-correlated with the jet activity. This anti-correlation is interpreted by the blanketing effect of the dust over the translucent slab ice.

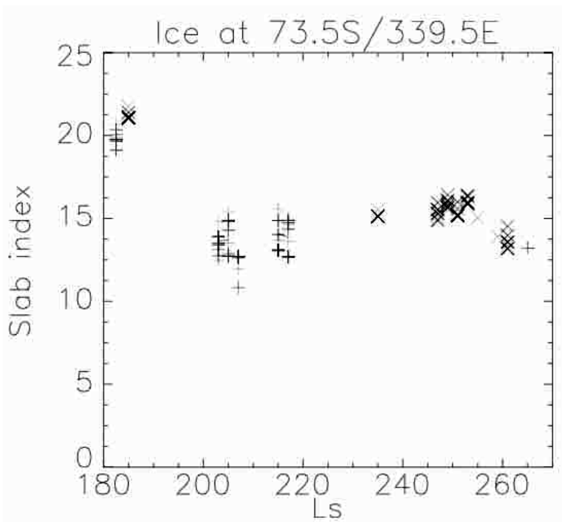

Fig 3: OMEGA slab index as a function of time (Ls) for the region presented in figure 3. "+" signs represent Martian year 27 and "x" signs represent the Martian year 28. The 9 colors represent the central point and 8 points around at a scale of 7 km

Conclusion: We show that jets are active in a peak intensity 30°Ls after the winter solstice. This timescale is be interpreted as the timescale τ for dust to burrow within the slab, for sublimation to occur at the base of the slab and for ice to crack. This measure will be important to constraint models [7,8].

We show that jets are active outside the Cryptic region and active even without observed spider trench. For two HiRISE images, we observe an anticorrelation between the jet activity and the slab index at the last stage of the jet activity. This anti-correlation may be due to dust blanketing, in agreement with the decrease of the CO2 band depth behavior in the Cryptic region [4]. The presence of high value of slab ice index at Ls=180 may indicate that the ice cleaning process and metamorphism have been strong enough to produce a slab ice.

The global correlation between the jet activity and the slab index will be investigated to assess the validity of these statements at global scale. If this interpretation is correct at global scale, then the timescale τ is mainly due the cracking.

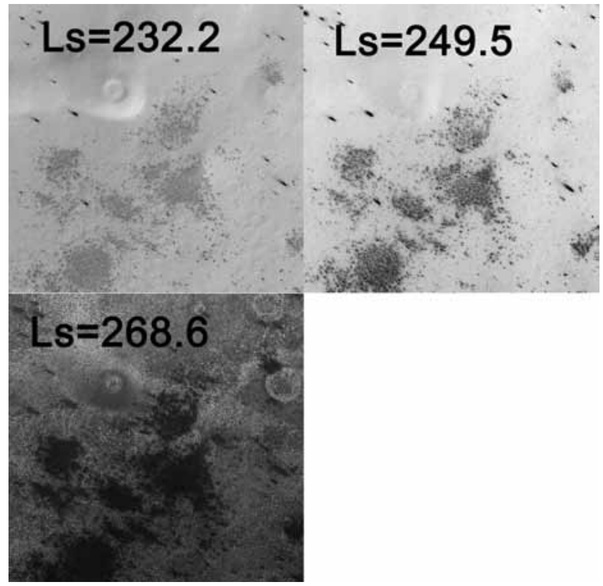

Fig 4: Detail of HiRISE images ESP 012254 1065 (Ls=232.2), ESP 012887 1065 (Ls=249.5) and ESP 013177 1065 (Ls=268.6) showing evidence for late jet activity. OMEGA slab ice index is 15.1 (Ls=232), 16.1 (Ls=250) and 13.55 (Ls=269)

References: [1] Kieffer, H.H et al., (2000) *JGR, 105*, 9653-9700 [2] Piqueux, S. et al., (2003) *JGR, 108*, 3–1 [3] Kieffer, H. H. et al., (2006), *Nature, 442*, 793–796 [4] Langevin, Y. et al., *Nature, .442*, 790–792 [5] Schmidt, F. et al., (2009) *EPSC, 4*, No 289 [6] Thomas, N. et al. (2010), *Icarus, 205*, 296-310 [7] Kieffer H. H. (2007), *JGR, 112*, 8005 [8] Portyankina, G. et al. (2010), *Icarus, 205*, 311-320