NEW ELEMENTS ON STRATIGRAPHY OF SOUTH POLAR LAYERED DEPOSITS ON PROMETHEI LINGULA REGION AND A POSSIBLE STRUCTURAL APPROACH. L. Guallini[1], A.P. Rossi[2], L. Marinangeli[1], D. Biccari[3], E. Pettinelli[4], R. Seu[5], [1]IRSPS, Univ. d'Annunzio, PE, Italy, guallini@irsps.unich.it; [2]ISSI, BE, Switzerland; [3,5]Dip. INFOCOM, Univ. La Sapienza, Roma, Italy; [4]Dip. di Fisica, Univ. Roma Tre, Italy.

Introduction: South Polar Layered Deposits (SPLD) have been analyzed by several authors [1,2,3, 4] in order to describe mayor layers sequences using visible images [1,2,3,4] and sounding radar datasets (Mars Express MARSIS and MRO ShaRAD [1,2]), defining different units.

[1] mapped three main SPLD units through several distinctive erosion-resistant marker beds or packets of layers. In particular [1] defined a PLL sequence, made up of a series of thin layers and mainly found on Promethei Lingula (PL) region and an uppermost and younger sequence (BFL), previously described by [3] and characterized by multiple erosion-resistant layers forming pitted topographic benches separated by multiple thin layers [1]. This unit was not found on PL site [1].

SPLD depositional history was complex both spatially and temporally. SPLD was involved in several erosional events, marked by regional unconformities within layer sequences. These discontinuities are locally exposed at different elevations [1,4]. Some of them seem to be consistent with subsurface reflections observed on ShaRAD and MARSIS radargrams [2,5].

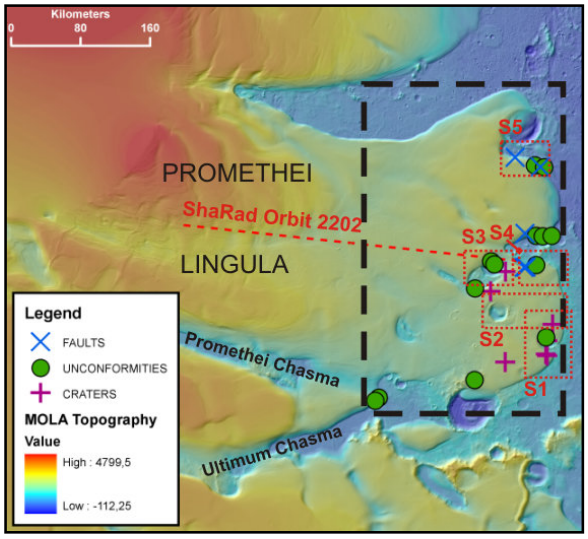

Fig.1. MOLA topography of PL. Dashed box indicate region studied so far. See text for explanations.

Observations: In the present study we focus on the marginal erosional scarps between 107°-120° E Long (Fig.1). For visual observations we used HRSC plus several high-resolution MOC NA, CTX and HiRISE images. We also analyzed relevant ShaRAD orbits crossing the area. The elevations of surfaces are calculated from MOLA 512 pix/deg grid topography.

SPLD stratigraphy: The dominant main sequence observed (PLUn1) is characterized by continuous subparallel thin layers (up to tens of m thickness) showing alternated low and high albedo (due to a variable dust/ice ratio [6]) and different resistance to erosion. We refer to it as PLL like sequence [1]. The second one layers sequence (PLUn2) appears to be less frequent. In this last one, PLUn1 like layers packages seems to be spaced out by bench-like erosion-resistant strata, not observed in this region before. We found this unit in one location (Fig.1 - S1). In other two outcrops its presence is uncertain (Fig.1 – S2). We refer to it as BFL like sequence [3].

Moreover we observed several angular unconformities/lateral pinch-out sequences (13 as far, some dubious) that have been detected at HRSC (12.5 m/pix) - CTX (5.0 m/pix) and MOC NA (2.0÷5.0 m/pix) - HiRISE (0.25 m/pix) scale (circles on Fig.1). These erosional surfaces are located between 1300 m÷2500 m in MOLA height. One of the most spectacular outcrop is located at -80.05S Lat 112.60E Long (Fig.1 – S3), where a sequence of about 700-800 m thickness crops out on a wide trough's scarp. Within the sequence we observed two distinct angular unconformities (Fig.2a): one is clearly visible on the top of the sequence, located from about 1640 to 2075 m in quote (AUn2); the other one, less clear, is located in the middle of the layers package, from about 1475 to 1760 m in quote (AUn1). These unconformities seem to have a low dip direction towards the Lingula margin. Their elevations are comparable with those observed for similar erosional surfaces in several South Polar areas [1], [4]. On the same location, preliminary ShaRAD observations seem to confirm the presence of further unconformities between the layer sequences (Fig. 2b).

SPLD tectonic structures: Deformational phenomena are exposed on some trough's scarps and on the margin of PL (diagonal crosses on Fig.1). In particular we found evidences of remarkable brittle and brittle-ductile structures on two zones. The first one is located at 79.44S Lat 112.25E Long on a trough's scarp (Fig.1 – S4) and it's characterized by at least two subparallel low angle brittle planes interpreted as thrust faults with a possible left-lateral strike slip compo-

nent. These faults displace a package of layers located between 2200÷2300 m, with an estimated vertical offset of about 400 m (Fig.3a). Fault planes appear to be filled with dark cataclastic-like material. The second main deformation zone is located at -80.22S Lat 100.41E Long on the polar cap's margin (Fig.1 – S5) and it is characterized by spectacular ductile-fragile structures. The main sub-parallel fault planes display an high dip. They displace a package of layers between 1350÷1925 m. The maximum horizontal offset is about 2 Km (Fig.3b, red dotted one shows major displacement). Several kinematic indicators as drag folds, kink folds and shear "Z" shaped folds indicate a predominantly right-lateral movement (strike slip faults) plus a possible reverse component (Fig.3b).

Discussion: Two possible different units had been identified so far on the base of morphological observations. Furthermore new angular unconformities demonstrate the presence more than one depositional hiatus in PL region. Our purpose is to understand if defined local units are referable to layers sequences of major order. These could be regionally correlated using erosional surfaces observed on the studied area. We are trying to define higher order sequences bounded by unconformities.

At this moment we hypothesize two main depositional cycles at least, marked by one single main regional angular unconformity, located on the average of about 1700÷1800 m in quote. ShaRAD's data show even more angular unconformities possibly linked to previous erosional/depositional events.

Secondly, previous studies [1,4,7,8,9,10] already identified brittle and ductile deformations (normal and reverse faults, thrusts, folds) within SPLD sequences [8,9,10], but particulary only on Ultimi Lobe region [1,4,7]. Our preliminary analyses shows transpressive fault structures also in PL region, useful to understand the kinematics of ice cap. Their movements seems to be compatible with an ice cap migration towards its margins (ice flow?). Perhaps in some cases it seems to be influenced by interaction with bedrock topography (basal sliding?).

We are also trying to compare structural and stratigraphical data starting from the analysis of the deformative structures within the layers. These structures, if widely observed, could be used as a tool for following the SPLD stratigraphy using strain response of chosen marker layers (which in turn it could be correlated with their composition).

Based on modeling results in the literature [11], in order to define a possible range of age of the unit, we are locating and analyzing several mid-sized convex shaped craters (diameter range 500÷3700 m, crosses on Fig.1) affected by complete viscous relaxation. Based on this, inferred surface ages appear to have a minimum of several tens Myr.

References: [1] S.M. Milkovich and J.J. Plaut (2008) *JGR, 113*, E06007, 10.1029/2007JE002987. [2] S.M. Milkovich et al. (2008) *LPS XXXI* , Abstract #1466. [3] S. Byrne et A.B. Ivanov (2004) *JGR, 109*, E11001, 10.1029/2004JE002267. [4] E.J. Kolb and L. Tanaka (2006) *Mars, 2*, 10.1555/mars.2006.0001. [5] M. Milkovich et al. (2007) *Seventh International Conf. on Mars*, Abstract #319. [6] S. Clifford et al. (2000), *Icarus, 144*, 210-242. [7] B.M. Murray (2001) *Icarus, 154*, 80-97, 10.1006/icar.2001.6657. [8] K.E. Herkenhoff et al. (2003) *Third Mars Polar Science Conf.*, Abstract #803. [9] K.E. Herkenhoff et al. (2008) *LPS XXXIX*, Abstract #2361. [10] J.S. Kargel (2001), *Eos Trans. AGU, 82*(47), F724. [11] A.V. Pathare et al. (2004) *Icarus, 174*, 396-418, 10.1016/j.icarus.2004.10.031.

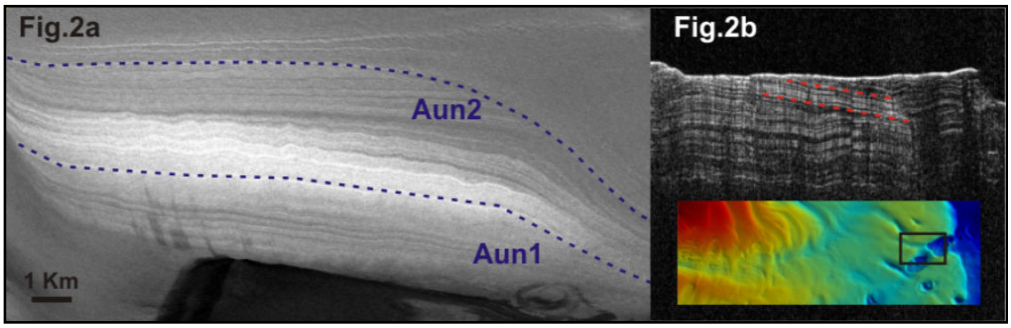

Fig.2. Stratigraphy a)HRSC DEM h2440 showing angular unconformities in S3. b)ShaRAD Orbit 2202 showing subsurfaced angular unconformities in the same location. See text for details.

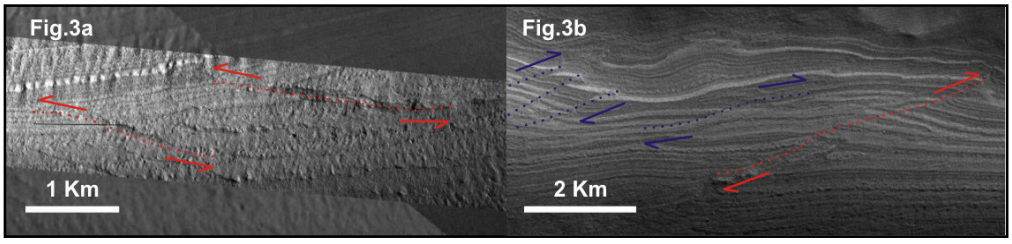

Fig.3. Deformational ductile-fragile structures. a)S4.MOC_NA_r1103900. b)S5.CTX_P09_004708_0998. See text for details.