

Planetary Stratigraphy (Mars)

Liquefaction features: a comparison between the Emilia epicentral area (Italy) and the Cerberus Fossae region (Mars)

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A wide variety of syndepositional deformations and morphological features are related to liquefaction, and seismic shocks are one of the main causes of these deformations. On Earth, liquefaction effects have been observed in either ancient sedimentary rocks and in surficial forms within areas affected by strong earthquakes. In terrestrial sedimentary records analogous syndepositional features have also been attributed to liquefaction caused by meteoritic impact KOMATSU *et al.* (2007) cum biblio. Moreover, the latter process has been retained as the main deformation mechanism of surficial water-saturated un lithified sediments close to impact craters on Mars. A series of coseismic ground effects produced by liquefaction have been observed in the area affected by the 2012 Emilia earthquakes sequence. Some of these seismic-induced features show close analogies with surficial morphological structures imaged on the Cerberus Fossae region on Mars. The aim of this study is to describe the results of terrestrial field and Martian remote observations and to discuss the geological and hydrogeological implications on the recent history of Mars.

Keywords: Liquefaction features, Sand boils, Fissures, Po Plain, Cerberus Fossae.

“Unconformity-Bounded” stratigraphic units in the South Polar Layered Deposits (Promethei Lingula, Mars)

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We carried out a stratigraphic analysis of South Polar Layered Deposits (SPLD) in Promethei Lingula (PL, Mars) based on the identification of regional unconformities at visible and radar wavelengths. According to the terrestrial classification, this approach constraint the stratigraphy of the region and it remedies to the ambiguous interpretation of it through marker layers, bypassing the problematic related to the morphologic and radiometric appearance of the layers. Thus, it does not exclude diverse classifications, but it complements them whereas other discriminant elements are doubtful or difficult/impossible to be defined. With this approach, we defined in PL two stratigraphic units (or Synthems; PL1 and PL2), morphologically different and divided by one regional unconformity (AuR1). This stratigraphy implies that PL geological history has been conditioned by periodic climate changes in turn related to orbital variations of Mars.

Keywords: SPLD, Promethei Lingula, Stratigraphy, Unconformity, Climate.

Stratigraphic analysis of the depositional sequence within Danielson Crater (Mars)

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Danielson crater is a complex impact structure with a diameter of about 60 km, located between North Sinus Meridiani and West Arabia Terra, on Mars. The crater is characterized by deposits showing an alternation of bright material, apparently hard and massive, and dark material, less resistant than the former. Recent data from the *Mars Reconnaissance Orbiter* mission allow for a detailed analysis of the depositional sequence, the realization of a stratigraphic column (in progress), and the identification of several interesting surface features. The basis of our stratigraphic study was the analysis of an USGS HiRISE DTM covering our investigation area as well as the usage of a software tool which allows the computation of layer attitudes (dip and strike angles) from remote sensing data. Our observations, combined with larger-scale investigations carried out by other authors, allow us to constrain possible formation mechanisms of these layered deposits and relate them to climate changes in the history of Mars.

Keywords: Mars, stratigraphy, climate change, HiRISE, MRO, Danielson.

Equatorial layered deposits in Arabia Terra, Mars: stratigraphy and process variability

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The Equatorial Layered Deposits of Arabia Terra are investigated in order to understand their genesis and the controls on their evolution. We interpret the deposits found within the craters as formed by spring deposition because of the large scale geometry, the presence of morphologies consistent with fluid expulsion, the composition and sedimentary structures. Outside of the craters, we found evidence of duneforms and cross stratification suggestive of aeolian activity possibly associated to playa deposition. Groundwater fluctuations are suggested as the control on the deposition.

Keywords: Arabia Terra, Mars, Equatorial Layered Deposits, spring deposits, aeolian reworking, sulfates.

An attempt to apply sequence stratigraphic concepts to Mars: the Eberswalde crater

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The sedimentary deposits within Eberswalde crater are generally interpreted as formed in a fluvio-lacustrine depositional environment. The Eberswalde fan delta consist of five lobes (four deltaic) which relative stratigraphy can be easily unraveled through simple cross-cutting relations, allowing to roughly infer the water level from the transition between delta plain and delta front. Switching between different lobes is inferred to be controlled by allogenic control. We distinguish three water level fluctuations, possibly associated to system tracts, to which a higher order regressive trend is superimposed. The three lower order cycles might partly reflect control by transient and/or localized processes but the cyclic behavior suggests the presence of a climatic control.

Keywords: Eberswalde crater, fan delta, lacustrine environment, sequence stratigraphy, Mars.

Fluvio-Lacustrine sedimentation and tectonic influence, Lunae Planum (Mars)

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This area of Lunae Planum (centered around 4° S and 298°E) was studied by many authors, who described the presence of exhumed channels (sinuous lineation), Light Layered Deposits (LLD) and detected hydrated sulfates associated to LLD. We performed sedimentological, geomorphological and stratigraphical analyses of the LLD and we produced geological maps of the area. The geological maps can serve as a guide for scientific or landing site analyses and it represents a tool to correlate laterally and vertically different units. Our aim is to give a contribution to the debate on processes associated with the presence of water, to the factors controlling these processes and to liquid water's residence time on the Mars surface. The significant element that emerges from this work is the complex evolutionary history of the study area and a unique example on Mars, in the authors' knowledge, of a clear evidence of tectonic influence on sedimentation.

Keywords: Mars, Lunae Planum, Stratigraphy, LLD, Exhumed Channel, Water.

Global distribution of stratified deposits on Mars

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This study uses the highest available resolution imagery of the Martian surface obtained by the Mars Reconnaissance Orbiter (MRO) High Resolution Imaging Science Experiment (HiRISE) to create a global inventory of stratified deposits on Mars. Deposits are categorized as sedimentary or volcanic based on a set of

distinguishing orbital outcrop parameters including albedo, weathering style, layer thickness, and proximity to known volcanic source regions. Deposits are also classified according to geomorphic setting. This study shows that stratified deposits are ubiquitous on Mars, suggesting that a record of surface processes potentially spanning four billion years is preserved. This global inventory will aid in understanding the occurrence and diversity of sedimentary depositional processes through time and across the surface of Mars.

Keywords: Mars stratigraphy, High Resolution Imaging Science Experiment.