DATING SEDIMENTARY PROCESSES AND DEPOSITS ON MARS WITH LUMACH INSTRUMENT.
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The scientific goal of LUMACH (LUminescence MArs CHronology) instrument for *in situ* analysis is to obtain for the first time the absolute dating of sedimentary deposits on Mars. The dating of the Martian aeolian sediments is a primary goal for the future exploration of the planet [1]. Indeed the age of the deposits on the surface of Mars is a key information to understand the recent surficial evolution of the planet. The recent missions to Mars have clearly shown that sedimentary processes have been active during the geological history of the planet. The current method to date the planetary surface, based on the craters counting, is a relative one. This dating tool, even if with a large error, has been extremely useful for dating surface and geological unit of planets and for comparison the age of Solar System bodies.

Last mission data show us that a large range of surficial processes are or have been active in the recent Mars past. These processes are linked to planet wide aeolian activity and probably to limited water flows. Dating of these deposits will be a major leap in the understanding of the recent Mars and may provide some clues on the present and past relationships between the surface and the atmosphere of the planet. Unfortunately very often the duration of such processes is out of the crater counting resolution range as it is evidenced by the almost complete absence of craters on the sedimentary deposits produced.

Luminescence dating is a relatively new approach to chronological problems and has been used extensively in the Quaternary earth science field and is applicable to a wide range of geological materials. LUMACH is an instrument based on luminescence principle [2, 3]. On Mars this experiment will provide us the timescale and dynamic of the aeolian sediments that cover almost the entire surface of the planet. Generally an age of about 1 Myr could be measured using luminescence technique in laboratories on Earth.

The instrument principle is to measure the quantity of luminescence emitted by stimulated minerals such as quartz and feldspars, which are the most common silicate components of rocks. Over geological time, ionizing radiation from the decay of naturally occurring isotopes and from cosmic rays releases charge carriers within silicate minerals grains. The charge carriers can subsequently become localized at crystal defect sites, leading to the accumulation of a trapped charge population. When the sediment is exposed to solar radiation, the trapped charge, optically stimulated, escapes from the trap sites resetting the "luminescence clock". If the mineral grains are then shielded from further solar radiation by burial, the trapped charge population begins to accumulate again. When the sample is collected at later time, the trapped charge population is representative of the time elapsed from the last exposure to the solar radiation of the minerals present in the sediment and, therefore, the time since the last burial process.

LUMACH is able to perform the dating of sediments measuring the luminescence emitted by the sample in response to an artificial stimulation.

Infact to measure the trapped charge population the sample may be artificially stimulated (Optical Stimulated Luminescence – OSL) to let the photons escape from the minerals. If the flux of the ionizing radiation is constant, then the burial time of the grains can simply be determined by dividing the total dose absorbed by the dose rate:

$$\text{Burial time} = \frac{\text{Burial absorbed time}}{\text{Dose rate}}$$

The dose rate is estimated by comparing the natural luminescence signal with the luminescence signal obtained after known radiation exposure.

The instrument baseline is composed by:

- Excitation unit: LEDs;
- Detection unit: photo multiplier;
- Optical coupling unit: optical lenses;
- Irradiation unit: beta irradiator.

The small dimensions and power demand of the instrument, the low data rate and the achievable results make LUMACH a suitable instrument for Martian *in situ* exploration. In particular, if associated with a drill sampling, important information about the variation of exposure time of different layers of sediments along the vertical profile can be obtained. This will provide a good time scale of surface processes and, along with other instruments, will help in defining the evolution history of Martian surface.

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