INTIME: first steps towards in-situ OSL

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Abstract:
A precise age determination of the recent events occurred on Mars surface is fundamental to tie to time the stratigraphic successions. These successions change through time reflecting changes of processes and/or environments that in turn might depend on climate changes. Understanding the timing of climate change processes is fundamental to infer what controlled their evolution. Until present, relative dating of Mars surface has been studied with the use of crater counting. However, this approach has a very poor temporal resolution and provides a limited contribution to our understanding of the evolution of surface processes. The orientation and geometry of Martian dunes provides interesting information on the direction of sediment transport and thus aeolian processes. Active dune systems have been mostly investigated with the use of space-borne imagery. However, the migration rate appears to be a few centimetres per thousands of years: this value is too low to obtain accurate rate determinations from orbit.
On Earth, luminescence techniques are widely used to study the past of dune system in order to deduce local and global climate changes. The present study examines the potentiality of luminescence techniques for in-situ dating of modern Martian landscape.
This study describes preliminary developments for in-situ examination and assessment based on optically stimulated luminescence methods. The feasibility of a luminescence-based approach to dating of soil simulants and sediments analogues of Martian deposits is discussed. In order to minimize mass and power consumption, new techniques and procedures that involve no sample heating are discussed. Different set of LEDs emitting in visible, infrared and ultraviolet spectral ranges are used to excite different response in different samples' material. A miniaturized X-ray source is used to estimate the correct dosimetry. Martian radiation environment is taken into account with the use of a state-of-the-art radiation model and data from the latest missions.
Through the development of its innovative technology, and on top of its planetary exploration applications, this instrument would also be suitable for terrestrial field applications as a lightweight and portable dating and analysis instrument for geology and archaeology as well as a risk assessment tool for accident and emergency dosimetry and nuclear mass-casualty events.