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In situ luminescence dating on Mars: issues and challenges

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Luminescence dating plays an important role in providing absolute ages for sediments on Earth. In situ luminescence dating (LD) of Martian sediment may play a key role in understanding climatically driven changes on Mars. This application is of interest because of the potential age range, easy resetting of the 'clock' during sediment transport, and the simplicity of instrumentation. Such an instrument could provide stratigraphic ages if deployed on the European Space Agency's Nanokhod rover, with its sub-surface drilling capability. Despite this potential, the constraints on LD on Mars are considerable. The viability of LD on Mars will be critically dependent on the maximum measurable dose and signal stability. Due to the near absence of a planetary magnetic field and an atmosphere, the annual surface dose is about an order of magnitude higher than that on Earth. Similarly because of the near absence of quartz on Mars, the stability of the luminescence signal on geological time scales becomes an important consideration. This is especially important in view of the fact that all measured Martian analogue materials exhibit anomalous fading.

We provide here an overview of the issues and challenges involved in LD on Mars. New results on the luminescence properties of Martian analogue samples, and proton dosimetry applicable to cosmic ray dose rates on Mars will be presented. Also preliminary technical constraints on instrument design appropriate to remotely programmed, mobile use in the Martian environment will be discussed.