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The potential for dating sediments on the surface of Mars using luminescence

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In the last two decades, luminescence dating has become a well established method for determining the age of sediments in a variety of depositional environments at the Earths' surface. Luminescence determines the period of time that has elapsed since the mineral grains making up the sediment were last exposed to daylight. Comparison with other geochronological methods has demonstrated its accuracy over periods from a few decades to a few hundreds of thousands of years. On Earth luminescence has played a key role in providing absolute chronological control for events through the late Quaternary.

A combination of data from high resolution remote sensing and landers have demonstrated that sedimentary deposits similar to those that have been successfully dated on Earth exist on the surface of Mars. These include aeolian dunes similar to those observed in the major deserts of the Earth, and a variety of waterborne sediments. There is no evidence for any current movement of sand sized grains, nor for water at the planets surface, and thus it is suggested that these are all relict features. It has been hypothesised that, analogous to Earth, variations in the obliquity of Mars over the last few hundreds of thousands of years have controlled large scale variations in climate. Luminescence dating has the potential to provide an absolute chronology for sediments, thus testing the hypothesis that orbital variations are the drivers of climate change on Mars.

This paper describes the range of sedimentary deposits observed on the surface of Mars that may be amenable to luminescence dating, and the challenges that exist.

Principal amongst these are the paucity of quartz (the mineral of choice in terrestrial applications) in surficial deposits and the high environmental radiation dose rate (largely due to the large cosmic ray dose rate).