ODIN - A PROTOTYPE MARS IN-SITU LUMINESCENCE READER FOR GEOCHRONOLOGY AND RADIATION MEASUREMENTS

R. DeWitt¹, and S.W.S. McKeever²

¹Department of Physics, East Carolina University, Howell Sciences C-209, 1000 E. 5th Street, Greenville, NC 27858, USA; e-mail: dewitr@ecu.edu
² Department of Physics, Oklahoma State University, Venture I, Suite 201, 1110 S. Innovation Way, Stillwater, OK 74074, USA; e-mail: swsm@okstate.edu

Abstract

We present ODIN, a prototype robotic luminescence reader for dating of regolith on the surface of Mars. ODIN is based on Optically Stimulated Luminescence, a method to determine the radiation dose absorbed by insulating crystalline materials. The technique is frequently used on the surface of Mars to separate magnetic particles and with a soil tumbler assembly to radiate source for sample stimulation, a photo detector for sensing the luminescence signal, stimulation temperature, and a dosimeter for sample calibration. This project was funded by NASA, PIDDP NNX09AN28G.

What is Optically Stimulated Luminescence (OSL) Dating?

OSL dating uses minerals like quartz and feldspars as dosimeters. The minerals absorb radiation from radioactive nuclides and cosmic radiation. During burial a trapped charge population builds up, which is “bleached” when the mineral is exposed to sunlight. The dose absorbed during burial can be determined with OSL. To calculate the age the rate of irradiation must be known:

Age = Dose / Dose Rate

ODIN Prototype

in collaboration with ICx Technologies

Our Optical Dating Instrument, ODIN, is intended for a lander or rover mission to Mars. It is equipped with all necessary components for OSL dating such as light sources for sample stimulation, a photo detector for sensing the luminescence signal, a heater to control the stimulation temperature, and a radiation source for sample calibration. It is also equipped with a soil tumbler assembly to separate magnetic particles and to screen grains smaller than 250 micron.

Schematic drawing of the sample preparation unit and photo indicating the movement of the soil through the system.

Regolith is placed on the green receiving belt. Large aggregates are removed by the angled aluminum bar positioned above the belt. Magnets located in the roller behind the aluminum bar retain magnetic particles—which would skew OSL readings—while the non-magnetic particles fall into the sifter/tumbler. The tumbler runs the soil through sized screens to break up aggregates and deliver only appropriately sized particles to the aliquoting assembly. A sample aliquot is dispensed into an individual copper sample cup in the sample transport platen by running the aliquoting assembly. The platen is then rotated to the next position to prepare for receipt of another sample aliquot. By reversing the drive motors each section of the soil handling system can rid itself of unwanted regolith.