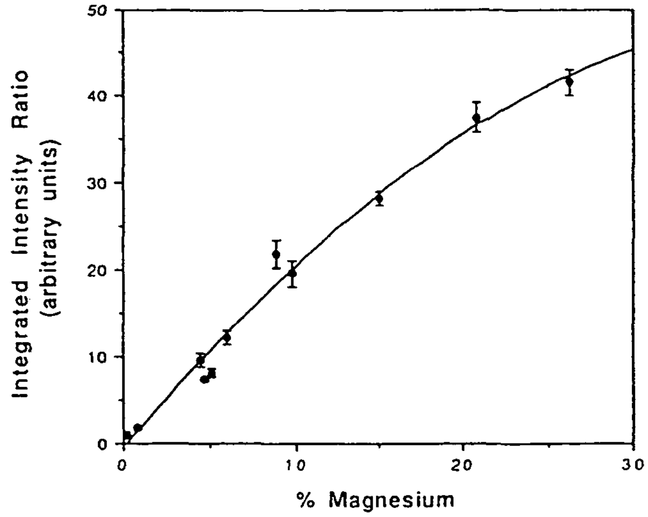

Fig. 2. Calibration curve for magnesium generated by monitoring the Mg I (285.2 nm) emission line.

intensities with negligible background interference indicating the feasibility of extending the analysis distance significantly beyond 18 m. This would require optimization of the focusing optics and an automated alignment capability to optimize light collection.

Experiments to date have proven the qualitative analysis capabilities of this technique. Preliminary calibration curves have been generated using rock powder standards to provide a quantitative measure of the technique. These curves were generated by monitoring the emission intensity of specific elemental lines. The calibration curve for magnesium is shown in Fig. 2. Similar curves have also been obtained for calcium and aluminum. Further experiments are needed to verify the quantitative capabilities of LIBS and to determine a set of optimum operating parameters.

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ROBOTIC LUNAR ROVER TECHNOLOGIES AND SEI SUPPORTING TECHNOLOGIES AT SANDIA NATIONAL LABORATORIES. Paul R. Klarer, Sandia National Laboratories, Robotic Vehicle Range, Division 9616, P.O. Box 2800, Albuquerque NM 87185, USA.

Robotic Rovers: Existing robotic rover technologies at Sandia National Laboratories (SNL) can be applied toward the realization of a robotic lunar rover mission in the near term. The facilities and robotic vehicle fleet at SNL's Robotic Vehicle Range (SNL-RVR) have been used to support technology base development in the mobile robotics field since 1984. Applications ranging from DOD battlefield and security missions to multiagency nuclear emergency response team exercises have utilized various elements of that technology base. Recent activities at the SNL-RVR have demonstrated the utility of existing rover technologies for performing remote field geology tasks similar to those envisioned on a robotic lunar rover mission. Specific technologies demonstrated include low-data-rate teleoperation, multivehicle control, remote site and sample inspection, standard bandwidth stereo vision, and autonomous path following based on both internal dead reckoning and an external position location update system. These activities serve to support the use of robotic rovers for an early return to the lunar surface by demonstrating capabilities that are attainable with off-the-shelf technology and existing control techniques. Sandia National Laboratories' Advanced Vehicle Technologies Department's extensive experience in designing and producing fieldable robotic rover systems provides a practical, realistic basis for integrating this technology within a multiagency team's scenario for a near-term robotic lunar rover mission.

SEI Supporting Technologies: The breadth of technical activities at SNL provides many supporting technology areas for robotic rover development. These range from core competency areas and microsensor fabrication facilities, to actual space qualification of flight components that are designed and fabricated in-house. These capabilities have been developed over the years to serve SNL's role in missions for a variety of customers, including U.S. industry, the U.S. Department of Defense, the U.S. Department of Energy, and elements of the nation's intelligence community.

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LUNAR PROSPECTOR: A PRELIMINARY SURFACE REMOTE SENSING RESOURCE ASSESSMENT FOR THE MOON. A. A. Mardon, Department of Space Studies, University of North Dakota, Grand Forks ND 58202, USA.

The potential existence of lunar volatiles is a scientific discovery that could distinctly change the direction of pathways of inner solar system human expansion. With a dedicated germanium gamma ray spectrometer launched in the early 1990s, surface water concentrations of 0.7% could be detected immediately upon full lunar polar orbit operations. The expense of lunar base construction and operation would be dramatically reduced over a scenario with no lunar volatile resources. Global surface mineral distribution could be mapped out and integrated into a GIS database for lunar base site selection. Extensive surface lunar mapping would also result in the utilization of archived Apollo images.

The presence or lack of solid water and other frozen volatiles at or near the surface of the Earth's nearest celestial neighbor, the Moon, will dramatically affect the way in which we will approach the surface exploration of the Moon. For almost three decades, various scholars have debated the existence of water ice at the lunar poles. A variety of remote sensing systems and their parameters have been proposed for use in the detection of these lunar ice masses. The detection or nondetection of subsurface and surface ice masses in lunar polar crater floors could dramatically direct the development pathways that the human race might follow in its radiation from the Earth to habitable locales in the inner terran solar system.

Over time, the lunar surface soil is turned over in a process called gardening, which results in lunar regolith. It has been proposed that this process involves lunar material overlying cometary, asteroidal frozen, and condensed volatiles that would have impacted over the entire lunar surface. The three potential sources of lunar volatiles, especially water, are in lunar polar crater bottoms, transient lunar phenomena (TLP), and a thin layer of ice distributed broadly over the lunar globe at a depth of 200 m. The proposed lunar sensing devices could only detect the first two volatile deposit regimes. The depth of surface penetration of the gamma ray spectrometer is 1 m with a sodium iodine scintillator and up to several meters with a germanium solid-state detector. This will mean that lower deposits cannot be detected until there has been on-site base development. The polar ice would form at the base of small lunar polar craters where the measured ambient