CHEMCAM AS THE INSTRUMENT TO SELECT SAMPLES AND ENABLE MARS SAMPLE RETURN R.C. Wiens[1], S. Clegg[1], S. Maurice[2], and the ChemCam team; [1]Los Alamos National Laboratory (Los Alamos, NM 87545 USA; rwiens@lanl.gov, sclegg@lanl.gov), [2]Centre d'Etude Spatiale des Rayonnements (31028 Toulouse Cedex 4, France; Maurice@cesr.fr)

Introduction: Mars Sample Return will utilize laboratory instruments to investigate Mars samples from known locations with precisions not obtainable with in-situ instruments on Mars. However, given the return sample limitations, it is imperative that the most revealing samples are returned. Sample caches on MSL and/or ExoMars are planned to be used for collecting desirable samples. If MSR does not pick up these caches, some analytical instrumentation will be required to determine the best samples to return. This instrument or instrument suite should minimally provide elemental abundances including those of astrobiological importance (e.g., H, C, N, O) and mineral identification. However, in-situ instruments should be minimized to avoid complexity and cost increases to MSR. For this reason, a single instrument with widely ranging capabilities and minimal sample handling/processing needs would be the best option. Here we suggest ChemCam or a ChemCam-like instrument as the best option.

ChemCam is an active remote sensing instrument suite being built for MSL [1,2]. It uses laser pulses to remove dust and to profile through weathering coatings of rocks up to 9 m away. Laser-induced breakdown spectroscopy (LIBS) obtains emission spectra of materials ablated from the samples in electronically excited states over an analysis spot < 1 mm in diameter at the focal point of the incident laser beam. A great advantage of LIBS is its sensitivity to H, C, N, O, Li, Be, and B as well as the heavier elements. The light elements are critically important to searching for samples of astrobiological interest, and are not detected by most in-situ techniques. LIBS analyses are rapid, requiring only several minutes to point at the target, focus, and shoot. ChemCam also includes a remote micro-imager (RMI) to provide context images of the target. The RMI has a field of view of 20 mrad (20 cm @ 10 m) and a resolution of ~80 μrad (< 1 mm @ 10 m).

A key feature in suggesting ChemCam as the instrument to enable Mars Sample Return is its versatility. The small analysis footprint allows ChemCam to act as a contact instrument when samples are within the workspace of the rover's sample arm. Because of this, the MSL mission planning calls for ChemCam to operate during drive sols, remote sensing sols, and during contact sols. Another important feature is the combined imaging and chemical analyses. The RMI resolution is more than an order of magnitude better than that of PanCam, and is within a factor of three of the Microscopic Imager. At this resolution, the microscopic texture of the rocks becomes visible.

ChemCam is a collaboration between NASA and CNES. ChemCam's cost to NASA is under $9M, a small fraction of the cost of many instruments.

References: [1] Maurice S., Wiens R., Manhès G., Cremers D., et al. (2005) *Lunar Planet. Sci. XXXVI*, 1735. [2] Wiens R., Maurice, et al. (2005) *Lunar Planet. Sci. XXXVI*, 1580.