ONBOARD CALIBRATION SILICATE TARGETS FOR THE CHEMCAM LIBS INSTRUMENT (MSL ROVER) C. Fabre[1], S. Maurice[2], V. Sautter[3], R. Wiens[4], J. Dubessy[1], M.C. Boiron[1] and the CHEMCAM team, [1]G2R (Nancy Université, France, cecile.fabre@g2r.uhp-nancy.fr), [2]CESR (Toulouse, France), [3]Museum d'Histoire Naturelle (Paris, France), [4]LANL (Los Alamos, NM).

Introduction: To be launched in 2011, the ChemCam (Chemistry Camera) instrument suite will provide remote sensing for the Mars Science Laboratory (MSL) rover [1, 2]. ChemCam consists of a laser-induced breakdown spectroscopy (LIBS) instrument and a remote micro-imager to supply close-up context images of the LIBS analysis spots [1]. The laser spot radius will be between 60 and 200 µm at distances of 1-7 m and to obtain an estimate of whole rock analyses, numerous shots may be done. The high laser irradiance at the surface will provide the removal of the weathering layers or dust and then the sampling of the rock composition many microns below the surface. As the LIBS technique is applicable to nearly every element, it will be of great help for the MSL mission to fulfill its role in finding organic materials and evidence of aqueous processes. The lander will carry rover-mounted calibration targets. This abstract describes the realization and the composition of the basaltic targets.

Basaltic calibration targets: To enlarge the choice of the analyzed elements and for the reproducibility of the analysis on the onboard targets, synthetic silicate targets have been produced. Their compositions have been chosen to simulate the expected rocks on the Mars surface. The typical compositions are : i) Picritic basalt, which is the most abundant igneous rock on the martian surface on both hemispheres, ii) Basaltic shergottite that resembles Bounce rock ejecta on Meridiani planum and iii) Norite that could be considered a good analog of the primitive noachian crust. To replicate alteration products on Mars surface, trace elements such as Ba, Sr, Cr, or Li, from hundreds to thousands of ppm, have been added to the major elements (Si, Na, Ca, K, Mg, Fe, Ti, O) in the basaltic targets.

These synthetic silicate glasses are prepared from carbonate, oxide or sulfur powders. Six duplicates are required to be present in the different laboratories of the ChemCam Team (LANL, CESR, G2R) to control the composition and realize the calibration curves. All of the duplicates for each target are done using the same powder. After decarbonation at 800°C, the powders are melted twice in carbon crucibles placed in an oven at 1350°C during 5 minutes. After the first melt, the glasses are finely ground down to 50 µm to homogenize them, and then they are melted again. To obtain the required dimensions of the disks, the carbon crucible diameter is 22.0 +/- 0.5 mm and the glasses are only polished down to 6 mm. A few vesicles are present in one sample, but their size (smaller than 10 µm) will not effect the analyses. The unpolished surfaces are exposed for LIBS analysis. A natural obsidian (Macusanite) without Fe is also integrated to the onboard standards as silicate [3]. Eight samples were obtained from one fragment using a 22 mm diameter drill core.

A graphite disk and a Titanium plate complete the onboard targets. The four last standards are ceramic obtained from mixtures of nontronite, montmorillonite, basalt and anhydrit to simulate the Noachian alteration. They are described in detail elsewhere [4].

Realization of the basalt calibration targets: The ChemCam calibration targets were shock tested at JPL in a Tunable Beam Shock Test Facility during 1880 cycles. They were subjected to a 2000g shock exploratory test in the z-direction then 4000g shock in the same z-direction twice. The silicate targets have successful passed the shock and temperature cycle tests.

Now, as these glasses will be used as calibration targets for the in situ LIBS analyses, their composition must be controlled. To check their chemical compositions, electron microprobe analyses were done in a 50µm * 40µm square (with a 5 µm analysis spot) shape to check at scales slightly smaller than the laser ablation spot.

The chemical composition was checked in one square (20 analyses), and also between three different squares on the same sample to control the future LIBS reproducibility. Then, to certify that all the basalt target duplicates are indistinguishable, even if they are produced from the same carbonate powder, their compositions were compared (and must be identical).

Analysis of the basalt calibration targets: The chemical composition obtained for 20 electron microprobe analyses in one square show that the glasses are very homogenous. Table 1 reports the concentration obtained in the picritc basalt. The Relative standard Deviations (RSD) in one square do not exceed 13% for major elements, and are as low as 2%. Table 1 presents the chemical compositions in oxide weight % for the major elements and in ppm for trace elements. The RSD represent the variation in % of the concentration between the three squares (except for the Norite, only one point). RSD are very low, and usually do not exceed 5% for major elements and 20% for trace elements. Figure 1 illustrates that the homogeneity required for these targets is obtained, and the highest RSD is observed for macusanite, a natural sample with only a trace of Mg.

As observed in Figure 2, all of the duplicates present identical composition from target to target, permitting to be used in different laboratories for the calibration work [5]. Further analyses will be undertaken on trace element cartographies to control their homogeneity. Considering that the homogeneity of these samples are very good, even for the macusanite natural sample, they can be used as calibration targets for in situ Mars surface analysis or for realization of LIBS calibration curves in the ChemCam laboratories.

References [1] Wiens et al. (2005), *LPSC XXXV1*, #1580. [2] Maurice et al. (2005), *LPSC XXXVI*, #1735. [3] Pichavant et al. (1987*) Magmatic processes The Geochemical Society*, 359-373. [4] Wiens et al. (2009) *LPSC XXXX* this volume. [5] Cousin A. et al. (2009) *LPSC XXXX*, this volume.

Picritic basalt	**Na_2O**	**MgO**	**Al_2O_3**	**SiO_2**	**K_2O**	**CaO**	**TiO_2**	**FeO**	**Cr_2O_3**	**SrO**	**BaO**
square 1	2,98	10,26	12,05	42,23	0,08	8,89	0,42	18,80	0,07	0,07	0,14
deviation	0,10	0,81	0,30	0,36	0,03	0,43	0,03	0,55	0,03	0,03	0,01
RSD	*3,4%*	*7,9%*	*2,5%*	*0,8%*	*33,6%*	*4,9%*	*6,0%*	*2,9%*	*50,8%*	*51,1%*	*6,4%*
square 2	2,83	11,09	11,74	41,94	0,08	8,50	0,42	19,62	0,06	0,05	0,13
deviation	0,18	1,13	0,60	1,59	0,03	0,71	0,04	1,25	0,02	0,02	0,01
RSD	*6,4%*	*10,2%*	*5,1%*	*3,8%*	*37,8%*	*8,4%*	*9,8%*	*6,3%*	*27,5%*	*31,0%*	*7,5%*
square 3	3,02	10,06	11,94	41,48	0,09	8,60	0,42	19,06	0,07	0,06	0,14
deviation	0,18	1,26	0,49	0,79	0,03	0,63	0,04	0,57	0,04	0,03	0,01
RSD	*5,9%*	*12,5%*	*4,1%*	*1,9%*	*29,7%*	*7,4%*	*8,9%*	*3,0%*	*60,4%*	*39,7%*	*5,9%*

Table 1 : Chemical analyses for three analysis locations on the picritic basalt target

	Na_2O	**MgO**	**Al_2O_3**	**SiO_2**	**K_2O**	**CaO**	**TiO_2**	**FeO**	**Cr_2O_3**	**MnO**	**SrO**	**BaO**
Macusanite	4,17	0,02	16,35	73,29	3,86	0,21	0,03	0,51	-	580 ppm	630 ppm	-
RSD	*0,1%*	*33,6%*	*0,8%*	*0,9%*	*1,7%*	*5,2%*	*9,2%*	*3,0%*		*1,6%*	*2,3%*	
Picritic basalt	3,06	10,90	12,39	43,59	0,09	9,02	0,44	19,94	650 ppm	-	620 ppm	1360 ppm
RSD	*3,4%*	*5,2%*	*1,3%*	*0,9%*	*6,0%*	*2,3%*	*1,0%*	*2,2%*	*8,1%*		*13,6%*	*3,3%*
Shergottic basalt	1,61	6,62	10,83	48,41	0,10	14,15	0,45	17,65	-	-	160 ppm	1390 ppm
RSD	0,6%	1,1%	1,2%	1,4%	6,3%	1,2%	1,0%	0,7%			9,9%	1,7%
Norite (one square)	*1,51*	*9,43*	*14,66*	*45,64*	*0,04*	*12,57*	*0,75*	*15,37*	-	-	-	*310 ppm*

Table 2 : Reproducibilty of the chemical compositions for the onboard basaltic targets.

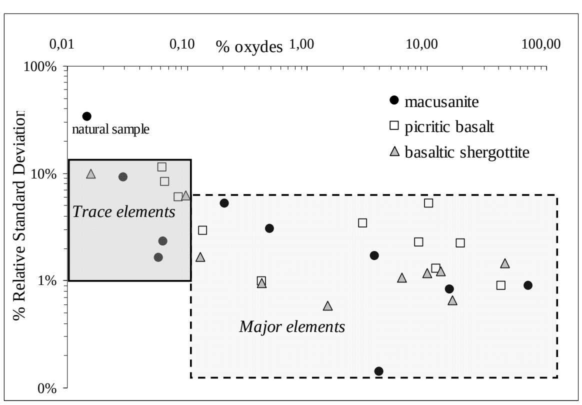

Figure 1 : Variation of the composition for three silicate targets

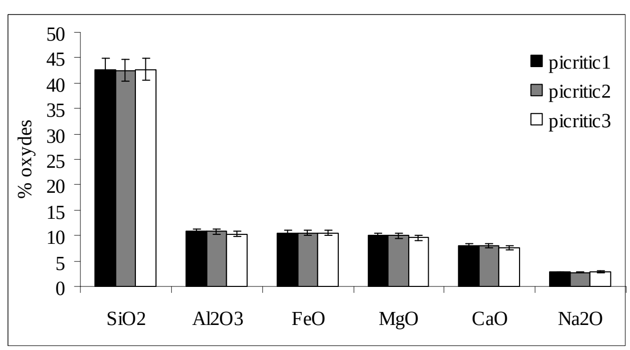

Figure 2 : Variation of the compositions for three picritic targets obtained in three carbon crucibles, from the same carbonate powder