**Using ChemCam Remote Micro-Imager Onboard MSL for Long Distance Reconnaissance Campaigns.** S. Le Mouélic[1], O. Gasnault[2], K.E. Herkenhoff[3], N.T. Bridges[4] ,Y. Langevin[5], N. Mangold[1], S. Maurice[2], R.C. Wiens[6], P. Pinet[2], H.E. Newsom[7], J.R. Johnson[4], R. Anderson[3], J.F. Bell III[8]. [1]Laboratoire de Planétologie et Géodynamique, CNRS, Université de Nantes, France, [2]IRAP, Toulouse, France. [3]USGS, Astrogeology Science Center, Flagstaff, AZ, USA. [4]Johns Hopkins University Applied Physics Lab., Laurel, MD 20723, USA. [5]IAS, Orsay, France. [6]LANL, New Mexico, USA. [7]University of New Mexico, Albuquerque, USA. [8]School of Earth & Space Exploration Arizona State University, USA. [stephane.lemouelic(at)univ-nantes.fr]

**Introduction:** The ChemCam instrument onboard Curiosity is a package of a Laser-Induced Breakdown Spectrometer (LIBS) coupled to the Remote Micro-Imager (RMI) [1,2]. Its main objective is to remotely determine the elemental composition of soils and rocks situated at distances up to 7 meters from the rover, without contact. The objectives of the RMI are to provide geomorphologic context for the LIBS analyses, locate the laser pits, document the changes induced by the laser shots on the target, and study the Martian rocks and soils at high resolution [3, 4, 5, 6]. During the first year of operations on Mars, it was recognized that RMI can also serve as a long distance reconnaissance tool. RMI has a pixel angular size of 19.6 µrad/pixel, on a 1024x1024 grayscale detector. This corresponds to a pixel size of ~2 mm when observing targets at 100 meters from the rover.

**Observations at long distance with RMI:** The first long distance experiment has been carried out during Sol 284 on a target called Green_Head (Fig. 1).

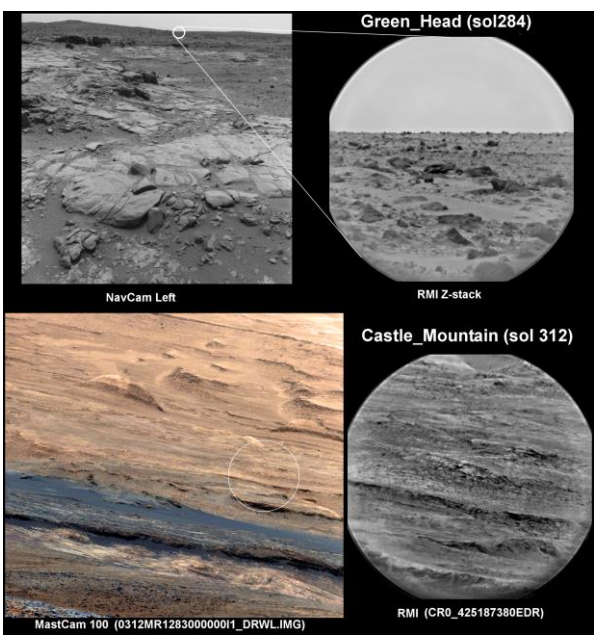


*Figure 1. Example of ChemCam RMI images at long distance on targets Green_Head (~100-300 m) and Castle_Mountain (4.7 to 6 km)*

The foreground rocks in this RMI image are located at ~100 m from the rover, and the horizon line is located at several hundreds of meters. The RMI of Green_Head in Fig. 1 is a focus merge of images taken at three different focus positions (a "Z-stack" [7]), to increase the depth of field of the camera.

On sol 312, the second, long distance imaging experiment was designed using a Z-stack sequence, to pinpoint the infinity position of the focus mirror. The geological layers at the base of Mount Sharp were selected as a distant target (called "Castle_Mountain"). The Castle_Mountain observation (Fig. 1, bottom) contains landscape elements that can be recognized using the HiRISE orbital imagery. The layers in the bottom part of the RMI image are at 4.7 km from the rover, and the layers on the upper part are at a distance of ~6 km. The RMI image shown in the bottom right part of Fig. 1 is a single frame, in which all the scene elements are in focus despite the fact that they are located at distances separated by more than 1.3 km. This indicates that the depth of field of RMI at distances of a few kilometers is large enough to allow the imaging of the landscape in good focus.

**Mosaics acquired at infinity focus:** Following this successful imaging at a distance far enough to be considered as representative of infinity, several other imaging campaigns at long distance were planned, using mosaics of RMI images organized either in 1x10 or 2x10 vertical strips. An offset of more than half of the field of view is introduced in both directions to optimize the overlap between adjacent frames. An example of this optimized design is shown in Fig. 2. A Mastcam-34 context image is shown in Fig. 3. An enlargement and a color merge are shown in Fig. 4. The features in the RMI mosaic are located at distances ranging from 4 km (dune field at the bottom) up to ~10 km (layers at the top of the mosaic). Several geological features, which cannot be seen in the HiRISE or Mastcam images, such as ripples on the dune field, and layers and boulders, are visible in this mosaic.

**Perspectives :** The RMI has the highest spatial resolution of the cameras on MSL's remote sensing mast, and can therefore play a major role in the investigation of distant areas of geological interest, either for scientific studies, or for the rover traverse planning.

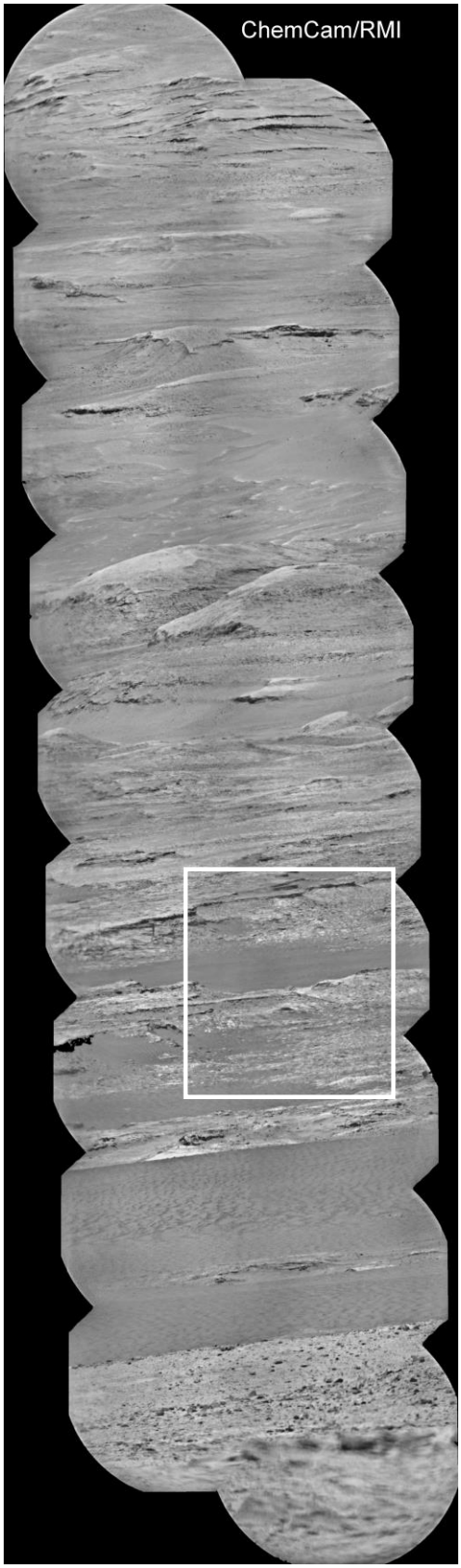


*Fig. 2 : RMI 10* x *2 mosaic of Mount Sharp base.*

*Fig. 3 : M-34 image 0432ML175900000E1giving the context of Fig 2.*

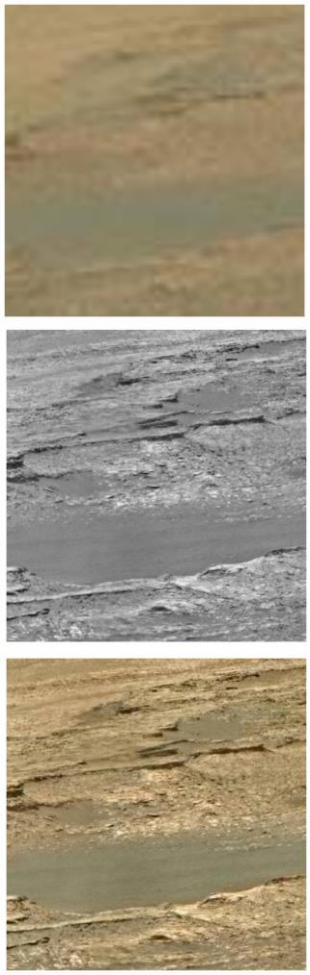

*Fig. 4 : subset of a Mastcam-100 image (top), subset of the RMI mosaic (center) and RMI merged with M-100 using a pansharpening algorithm (bottom).*

**Bibliography**: [1] Maurice et al., Space Sci. Rev. 170, 95-166, 2012. [2] Wiens et al., Space Sci. Rev., 170, 167-227, 2012. [3] Le Mouélic et al., Icarus, submitted, *2013*. [4] Sautter et al., *JGR 2013*. [5] Yingst et al., JGR, 2013 [6] Cousin et al., Icarus, submitted. [7] Herkenhoff et al., JGR, 111, E02S04, 2006