Geophysical Research Abstracts
Vol. 17, EGU2015-5849, 2015
EGU General Assembly 2015

Mafic and felsic igneous rocks at Gale crater

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The Curiosity rover landed at Gale, an early Hesperian age crater formed within Noachian terrains on Mars. The rover encountered a great variety of igneous rocks to the west of the Yellow Knife Bay sedimentary unit (from sol 13 to 800) which are float rocks or clasts in conglomerates. Textural and compositional analyses using MastCam and ChemCam Remote micro Imager (RMI) and Laser Induced Breakdown Spectroscopy (LIBS) with a $\sim$300-500 μm laser spot lead to the recognition of 53 massive (non layered) igneous targets, both intrusive and effusive, ranging from mafic rocks where feldspars form less than 50% of the rock to felsic samples where feldspar is the dominant mineral. From morphology, color, grain size, patina and chemistry, at least 5 different groups of rocks have been identified: (1) a basaltic class with shiny aspect, conchoidal frature, no visible grains (less than 0.2mm) in a dark matrix with a few mm sized light-toned crystals (21 targets) (2) a porphyritic trachyandesite class with light-toned, bladed and polygonal crystals 1-20 mm in length set in a dark gray mesostasis (11 targets); (3) light toned trachytes with no visible grains sometimes vesiculated or forming flat targets (6 targets); (4) microgabbro-norite (grain size < 1mm) and gabbro-norite (grain size >1 mm) showing dark and light toned crystals in similar proportion (8 targets); (5) light-toned diorite/granodiorite showing coarse granular (>4 mm) texture either pristine or blocky, strongly weathered rocks (9 rock targets). Overall, these rocks comprise 2 distinct geochemical series: (i) an alkali-suite: basanite, gabbro trachy-andesite and trachyte) including porphyritic and aphyric members; (ii) quartz-normative intrusives close to granodioritic composition. The former looks like felsic clasts recently described in two SNC meteorites (NWA 7034 and 7533), the first Noachian breccia sampling the martian regolith. It is geochemically consistent with differentiation of liquids produced by low degrees of partial melting of the primitive martian mantle. The latter rock-type is unlike anything proposed in the literature for Mars but resembles Archean TTG's encountered on Earth related to the building of continental crust. This work thus provides the first in-situ detection of low density leucocratic igneous rocks on Mars in the southern highlands.