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Spectrometric characterization of basaltic rock alteration in cold and wet (Baikalian) and hot and dry (Ogadenian) conditions: implications for alteration of Martian mafic rocks

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Introduction

In order to characterize the alteration conditions of the Martian basaltic rocks obtained using OMEGA/MEx and CRISM/MRO spectrometers and during future *in situ* investigations, a study of alteration of terrestrial basalts in two different extreme climatic conditions that may have been approached on Mars has been undertaken.

Study areas

The Udokan volcanic field, which is located in the northeastern part of the Baikal Rift Zone, is being altered in conditions of seasonal temperature variations, with cold winter (< 20°C) and hot summer (20°C), and precipitations between 250 and 1000 mm/year [1]. Alteration is a consequence of rainfall and snow. The Ogaden region in southeast Ethiopia displays lava flows exposed to hot and semi-arid conditions, with mean the temperature 27-30°C. Mean rainfall is < 200 mm/year, and is zero or almost zero over at least 9 months a year [2,3]. Alteration is thought to result mainly from early morning dew. The sampled basalts are located on hills [4], which means that during torrential rains there is no ponding on the basalts. The basalt alteration products are periodically washed out and form small pans that dry up and leave basaltic clays downstream.

Methods

During the field work basaltic rocks at various states of alteration have been sampled. Twenty four samples have been studied: five from Udokan and nineteen from Ogaden. The mineral composition and structure of these rocks have been identified using polarization microscopy, then the reflectance was measured using spectrometer ASD FieldSpec® 3 in the spectral range of 0.35-2.5μm, with 1 nm spectral resolution in the visible range and 3 nm in the infrared. For more detailed observations of the mineral composition of the groundmass, the mineralogy of samples from the Baikal Rift Zone has been also analyzed by X-ray diffractometer SIEMENS D5005. The powder mounts of the whole-rock samples were scanned from 4-75$^o\theta$ at a speed of 1.2$^o\theta$/minute. A similar treatment will be given to the samples from the Ogaden, and independent compositional analysis will be obtained with the use of electron microscopy.

Results

The basalts from the Udokan volcanic field are vesicular. The main components of the groundmass are plagioclases and pyroxenes in varying proportions, as well as opaques, and sometimes glass. Olivines occur less frequently and they are altered. The phenocrysts include mainly plagioclases and smaller amount of pyroxenes and altered olivines (iddingsite). Numerous minerals which are the result of alteration have been found: vermiculite, analcime or ferrihydrite. The Ogaden basalts display a variety of structures, from microgranular to doleritic. Alteration minerals include iddingsite, chlorite and rhönite. Some samples have carbonate infilled vesicles and veins. Reflectance spectra of the Udokan basalts show absorption bands of the main minerals which contain the iron, such as pyroxenes or olivines (Fig. 1). In some spectra characteristic absorption bands indicate the

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presence of altered minerals, mainly clays (montmorillonite/illite). A 1.9 µm absorption band is systematically and clearly observed (Fig. 1). A shallow 1.4 µm band is also observed in 3 of the 5 samples. Both absorption bands are characteristic for hydrated materials, and the depth of the bands reflect the stage of hydration. The positions of shallow absorption bands in one of the samples suggest that they might belong to ferrihydrite, which has been observed by X-ray diffractometer. The salient feature of the altered Ogaden basalts spectra is the strength of the 1.4 and 1.9 µm hydration bands (Fig. 1).

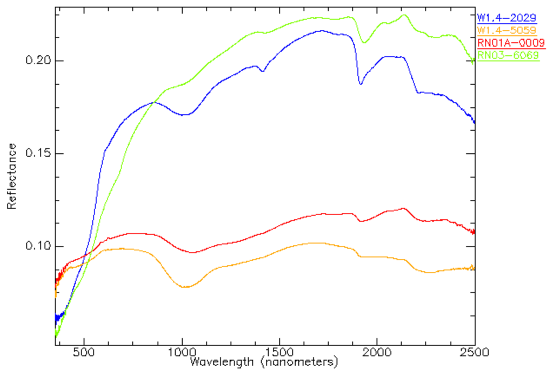

Fig. 1 Reflectance spectra of the basalt samples from the Udokan volcanic field, Baikal Rift Zone (non-altered - red, altered - green) and the Ogaden region, Ethiopia (non-altered - orange, altered - blue).

Discussion

Basalts from both Udokan and Ogaden display evidence of aqueous alteration. The obtained two -OH bands are significantly deeper for the Ogaden samples than for the Udokan samples, which is surprising given the overall dry climate of the Ogaden. The preliminary results reported here suggest that strong hydration bands on Martian spectra interpreted to be basalts [5,6] are not necessarily evidence of a past wet climate characterized by persistent water runoff during long-lasting wet seasons, they are also consistent with dry conditions with only very limited or no precipitation.

References

[1] Galaziy, G. I. (1993) *Baikal Atlas, Federal Agency for Geodesy and Cartography, Moscow.*

[2] Kohler, T. and Krauer, J. (1996) *Landesbericht der Schweizerischen Gesellschaft für Kartographie, Switzerland, Kartographische Publikationsreihe* 13, 34-38.

[3] http://www.cpc.noaa.gov/products/fews/AFR_CLIM/afr_clim.html#seasonal_archived

[4] Mège, D. et al. (2008) *Field Work Rept, Pexco Exploration East Africa NV, Addis Ababa, Ethiopia,* 1-66.

[5] Wyatt, M. B. and McSween, H. Y. (2002) *Nature*, 417, 263-266.

[6] Bibring et al. (2005) *Science*, 307, 1576-1581.