Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

PPS25-P18 Room:Convention Hall Time:May 23 17:15-18:30

Vertical trend of modal mineralogy and Mg# of the lunar highland crust estimated from Kaguya spectral data

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Mg# (Mg/[Mg+Fe] in mole percent in mafic minerals) is a key geochemical parameter of lunar highland rock for addressing the crustal formation process because it provides the degree of differentiation of the magma ocean at the time of its solidification. In a previous study, we reported the mafic mineral abundance and the Mg# distribution of the lunar highlands, which clearly indicates a dichotomic distribution, with a higher Mg# in the farside highlands than in the nearside [1]. A simple yet plausible model for interpreting the observation is dichotomic crustal growth from the magma ocean.

This study investigates the vertical trend of mafic mineral abundance and Mg# of the lunar highland crust using Kaguya spectral data. We utilize a new algorithm that derives Mg# from spectral reflectance data to develop a global map of mafic mineral abundance and Mg# at high spatial resolution [1]. From the generated global map, we checked 1) the correlation between the basin radius (excavation depth) and the averaged mafic abundances and Mg#s of the major highland basin ejecta (averages were derived for the region from one to two radii from the basin center), and 2) the correlation between distance from the basin center, and mafic abundances and Mg#s of the individual basin ejecta (ejecta deposited nearer the rim are assumed to be excavated from deeper within the crust).

The results indicate a vertical trend within the highland crust; the mafic mineral abundance decreases with depth while the Mg# increases with depth. These results are inconsistent with previous studies about trends of mafic mineral abundance [2][3] and with the simple crustal formation (Mg#) model explained by flotation of plagioclase crystal, suggesting a need for further study.

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Keywords: Moon, Kaguya, highland crust, Mg#, spectral data