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SELENE-2 でめざすガンマ線・中性子線分光計による月面元素分析
Elemental analysis of the lunar surface rocks and regolith by Gamma-ray/Neutron Spectrometer (GNS) for SELENE-2

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We have proposed a gamma-ray/neutron spectrometer system (GNS) to analyze elemental abundance of the lunar surface rocks and regolith for SELENE-2 mission. The GNS primarily analyzes K, Th and U abundances of the lunar surface and also can measure Fe and possibly other major elements. In the presentation, we will summarize the scientific objectives and the design and the current status of GNS. The significance of the GNS mission is briefly mentioned here.

K, Th and U are distinctive elements in geochemistry because of their moderately volatility or refractory, incompatibility and radioactivity. Thus, the abundance of K, Th and U in the lunar crust and mantle is the key to address the important issues related to the origin and evolution of the Moon, such as bulk lunar chemistry, crystallization of lunar magma ocean, volcanic activity etc [J.J. Gillis et al. JGR 2004, S. Kobayashi et al., Abstract for 42th LPSC (2011) 1721]. In addition, K, Th and U are symbolic elements on the Moon because it represents the lunar dichotomy (See attached figure, Th map obtained by Kaguya gamma-ray spectrometer)?the western hemisphere of the nearside called Procellarum KREEP Terrain (PKT) is considerably enriched in Th, whereas the other region, Feldspathic Highland Terrain (FHT) is extremely depleted in it [B.L. Jolliff et al. JGR (2000)]. It is important to know where and how much K, Th and U are concentrated on the Moon

The gamma-ray remote sensing has the limitation of the spatial resolution, which seems to be currently at best 40 km by applying an image deconvolution analysis [e.g. D.J. Lawrence et al. GRL (2008)]. Thus, we still have not known the abundance and the distribution of K, Th and U within small, but geologically distinctive regions, such as crater floors (~ dozens of km), central peaks (~ several km) and domes (~ dozens of km), even though we have lunar samples of Apollo and Luna mission, lunar meteorites and enormous remote sensing data. Further the local variation of K, Th and U abundances on FHT where we have never explored by landing mission is also unknown. The investigation of a local geology by the GNS would yield meaningful and new scientific data

The local geology is important now that we have the global K, Th and U map at our hands. Our scientific objectives, although they depend on the landing site of SELENE-2 that has not determined currently, are as follows:

(1) To investigate the elemental abundance of K, Th and U of the deep crust of PKT by exploring a crater with high/low Th feature within PKT to restrict the models of the lunar thermal history, the formation of PKT and the bulk chemistry of the Moon [S. Kobayashi et al., Abstract for 42th LPSC (2011) 1721, Y. Karouji, Proposal documents for SELENE2 landing site (2010) #21, #22].

(2) To know the lower limit of Th abundance and elemental abundance of major elements (e.g. Mg#) of rocks and regolith on the lunar surface within FHT to limit the model of the lunar magma ocean [H. Takeda et al. in this session].

(3) To understand comprehensively the variety of lunar volcanism by exploring silicic, nonmare, volcanic constructs, such as Hansteen Alpha, where K, Th and U are considered to be highly concentrated [T. Arai, Proposal documents for SELENE2 landing site (2010) #34].

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