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かぐや月レーダサウンダによる月地表・地下構造の観測

Observations of the lunar surface and subsurface structures by Lunar Radar Sounder (LRS) onboard the Kaguya (SELENE)

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Lunar radar sounder (LRS) onboard the Kaguya (SELENE) spacecraft [Ono et al., 2000; 2008; Kumamoto et al., 2008; Kasahara et al. 2008] successfully obtained 2363-hours worth of radar sounder data and 6570-hours worth of natural plasma wave data in the nominal operation period from October 29, 2007 to September 10, 2008 and 2390-hours worth of natural plasma wave data in the extended operation period until June 10, 2009. Based on the initial analyses of radar sounder data, we have reported that LRS has observed distinct subsurface reflectors with a depth of several hundred meters below the surface of the nearside maria, which are inferred to be old regolith layers covered by basalt layers [Ono et al., 2009]. After the initial report, the several studies have been performed based on radar sounder data obtained in wide area of the lunar surface.

It has been found that clear subsurface echoes are well found especially in 10% of the western nearside maria such as Mare Humorum, Mare Imbrium, and Oceanus Procellarum [Oshigami et al., 2009]. By comparison with surface age determined by crater counting, it is inferred that the clear subsurface echoes are caused by thick regolith layers formed during dormant volcanic period before 3.0 billion years ago. On the other hand, it is also suggested that the surface materials such as TiO_2 and FeO affect the detectability of the subsurface echoes due to power loss by those materials [Pommerol et al., 2010].

Thickness of surface regolith: Based on the difference of altitudes measured by laser altimeter (LALT) and LRS, the thickness of the regolith in four maria has been estimated [Kobayashi et al., 2010]. Because the range resolution of LRS is 75 m, the regolith layer thickness, which is several m, can not be determined by usual analyses. It becomes however possible by analyzing LRS echo peak delay caused by interferences of sounder waves reflected at upper and lower boundaries of the thin regolith layer. This new method will be useful for discussions on evolution rate of regolith layer in each mare.

In order to take advantage of lunar global subsurface radar soundings performed by the Kaguya spacecraft, we have to establish the analysis methods of radar sounder data obtained not only in nearside maria but also in farside highland regions and polar regions. We have two strategies: (a) Echo simulation based on subsurface models and surface topographic data obtained by LALT [Araki et al., 2008; 2009] and Terrain Camera (TC) [Haruyama et al., 2008; 2009], and (b)

synthetic aperture radar (SAR) analyses [Kobayashi et al., 2002a; 2002b; 2006; 2007]. The LRS Level-2 data has been opened to any researchers since November 2009. We hope that LRS datasets are utilized for further studies on lunar geological features associated with the origin and evolution of the moon, and physical processes of plasma waves around the moon.

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