Studies based on global subsurface radar sounding of the Moon by SELENE (Kaguya) Lunar Radar Sounder (LRS): A summary

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The Lunar Radar Sounder (LRS) onboard the SELENE (Kaguya) spacecraft successfully performed subsurface radar sounding of the Moon and passive observations of natural radio and plasma waves from the lunar orbit. The operation of LRS started on October 29, 2007. Until the end of the operation on June 10, 2009, 2363 hours worth of radar sounder data and 8961 hours worth of natural radio and plasma wave data were obtained [Ono et al., 2010]. We found subsurface regolith layers at depths of several hundred meters, which were interbedded between lava flow layers in the nearside maria. [Ono et al., 2009]. Using the measured depths and structures of the buried regolith layers, we could determine several key parameters on tectonics, surface layer evolution, and volcanism in the maria: Base on the determined parameters such as the formation age of the ridges, effective permittivity of the uppermost basalt layers, and the lava flow volumes in the nearside maria, we made the following suggestions: (1) Global cooling, which forms ridges in southern Serenitatis, became dominant after 2.84 Ga. [Ono et al., 2009], (2) The porosity of the uppermost basalt layer in Mare Humorum was estimated to be 19-51%, much more than the average of Apollo rock samples (7%) [Ishiyama et al., 2013], and (3) The average eruption rate of the lava flow in the nearside maria was 10^{-3} km^{-3}/yr. at 3.8 Ga and decrease to 10^{-4} km^{-3}/yr at 3.3 Ga [Oshigami et al., 2014]. Thanks to the high downlink rate from the SELENE/LRS (0.5 Mbps), we could obtain almost raw (simply pulse-compressed) waveform data from the lunar subsurface radar sounding. Using this dataset, synthetic aperture radar (SAR) processing was applied with trying several permittivity models in the analyses on the ground [Kobayashi et al., 2012]. This dataset is provided via SELENE Data Archive (http://l2db.selene.darts.isas.jaxa.jp/index.html.en), which will be useful for researchers who have new ideas for applying them to the investigations of the lunar surface structures and there evolutions.

Keywords: SELENE (Kaguya), Lunar Radar Sounder (LRS), Tectonics in the maria, Volcanism in the maria

