LUNAR FAR SIDE GRAVITY FROM THE KAGUYA (SELENE) MISSION AND DICHOTOMY OF THE MOON.

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Introduction: Current lunar gravity field models include large uncertainties on the far side of the Moon. This is because synchronous rotation of the Moon inhibits a direct link between a ground tracking station and a spacecraft over the far side. In order to compensate for the lack of tracking data on the far side, all previous workers [e. g., 1] advocated an a priori constraint [4] in processing tracking data to produce the global lunar gravity field.

RSAT experiment. In order to track a spacecraft over the lunar far side, we developed a satellite-to-satellite Doppler tracking sub-system (RSAT) on KAGUYA (SELENE) [2,]. Main function of RSAT is to relay Doppler tracking signals between the main orbiter (MAIN) over the far side and ground-based antenna. When MAIN is orbiting over the far side of the Moon, tracking signal in S band transmitted from Usuda Deep Space Center of JAXA [] is relayed by RSAT-1 on Rstar to RSAT-2 on MAIN. Then RSAT-2 returns the tracking signal to RSAT-1, and RSAT-1 translates the S band signal into X band to downlink a coherent Doppler signal to UDSC. We call this tracking system four-way Doppler measurement. RSAT realizes the first direct observation of the gravity field over the far side of the moon [5, 6].

SELENE Gravity Model: most recent lunar gravity field model from KAGUYA (SGM90d) enables global gravity anomaly mapping of the Moon up to degree as high as . Gravity anomaly of SGM90d on near side is almost identical with that of Lunar Prospector, however, gravity anomaly map on far side reveals dramatic improvement. Gravity signatures over far-side basins, such as Korolev, Mare Moscovience, Mendeleev, Apollo, that used to be recognized as linear features are now identified as circular anomaly. Presently equatorial area have been better covered by four-way Doppler than at high latitude, however, entire far side will be covered by the end of nominal mission [5, 6].

Lunar Dichotomy: new gravity model reveals a marked difference of gravity signatures between near side and far side. It has been well known that near-side gravity anomaly is dominated by mascons, that is, positive gravity anomaly indicating mantle uplift beneath basins [7]. In contrast, far-side gravity field is characterized by rings of negative free-air anomaly over basins and large craters. Bouguer gravity anomaly map shows that such negative anomaly can be mostly attributed to topographic depression of basin, and that contribution of Moho variation is minor. Thus SGM90d suggests that elastic thickness of lithosphere was thin on near side while was thick on far side 3.9 Gy ago, and propose an important constraint on the origin of dichotomy.

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