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Localized Gravity/Topography Correlation and Admittance Spectra one the Moon

Y. Ishihara (1), N. Namiki (2), S. Sugita (3), K. Matsumoto (1), S. Goossens (1), H. Araki (1), H. Noda (1), S. Sasaki (1), T. Iwata (4), and H. Hanada (1)

(1) National Astronomical Observatory of Japan, RISE Project Office, Oshu, Japan (ishihara@miz.nao.ac.jp), (2) Kyushu Univ., 6-10-1 Hakozaki, Higashi, Fukuoka 812-8581, Japan, (3) Univ. of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8561, Japan, (4) ISAS/JAXA, 3-1-1 Yoshinodai, Sagamihara, Kanagawa 229-8510, Japan

Lunar surface and structure can be separate into two parts. The lunar near side crust and far side crust differ remarkably in thickness. This difference probably caused by difference of thermal evolution and state (elastic thickness) and catering history on both side.

The correlations and admittance between the topography and gravity anomalies provide important information on the level of isostatic compensation of the lithosphere at the geological timescale, and reflect its thermo-mechanical state. Therefore, localized correlation and admittance analysis is one of the most important studies of selenodesy.

A global correlation between topography and gravity of the Moon obtained by Clementine and Lunar Prospector missions, respectively, reveals high value at long wavelength and low value at short wavelength. Such characteristics are distinguished from those of the Earth and other terrestrial planets, whose global correlation between topography and gravity is low at long wavelength. The distinct correlation between topography and gravity of the Moon may indicate that the lunar topography is supported by multiple compensation mechanism. Further, an incomplete coverage of Doppler tracking data prior to Kaguya (SELENE) gravity experiment probably contributed to the correlation. Because the Moon is synchronously rotating with its revolution around the Earth, a spacecraft orbiting over the far side is not visible from ground stations. In either case, it is significant to decompose local correlation from global ones in order to investigate internal structure of the Moon from spherical harmonic model of gravity (LP75G [1]) and topography (GLTM-2 [2]).

Japanese lunar exploration Kaguya (SELENE) has two kinds of selenodesical experiments. One is RSAT/VRAD (gravity mapping with direct tracking over far-side) experiment and another is Laser ALTimeter (LALT; topography mapping) experiment. These two experiments enable us to conduct localized analysis for the Moon. Therefore we attempt localized spectral analysis of the Moon first and then apply possible compensation mechanisms to explain the observed admittance.

Kaguya mission has been yielding representation of lunar gravity and topography (shape) substantially superior in resolution and accuracy to earlier solutions. For global lunar gravity field, an accurate spherical harmonic model of gravitational potential up to degree and order 100 (SGM100g) was derived from one year tracking (including 4-way Doppler) data [3]. For topography, LALT has obtained more than 6 million altitude measurements with 5 m precision, from which a spherical harmonic expansion of topography to degree and order 359 (STM359_grid-02) has been determined [4]. In this study, we use those new models.

We employ the spatio-spectral localization technique [5] to obtain gravity/shape correlation and admittance spectra as function of position on the Moon. In this analysis, we localize harmonic field with axisymmetric windows of constant diameter, described by L_{win} zonal harmonic coefficients. This restricts the permissible range of l in the windowed fields at both the low- ($l > L_{win}$) and high-wave number ends ($l < L_{obs}–L_{win}$, ; L_{obs} is the maximum degree of observation) . We chose four fixed windows with L_{win} = 5, 10, 17, 26 (equivalent to spatial scales 2200, 1100, 640 and 420 km, respectively). These window sizes correspond to huge-, large-, middle-, and small-size of impact basins.

For up to degree 50 with L_{win} = 5 scale, it is clearly shown that the near-side contains distinct anti-correlation

regions whereas the far-side is mostly occupied by high correlation regions. This difference is mainly due to large mascon basins in near-side, such as mare Imbrium. For L_{win} = 10 and 17 scales, we can see anti-correlation regions at not only near-side but also far-side. Locations of anti-correlation regions in the far-side correspond to impact basins (Type II basin [6]). However, lots of far side basins (Type I basin [6]) are not indicated by anti-correlations for these window sizes. For L_{win} = 26 scale, we can see weak and spatially small anti-correlation at center of Type I basins. This difference mainly due to spatial size of anti-correlation. In contrast, almost all near-side basins show anti-correlations for all window sizes. This difference is probably due to the difference of elastic thickness between near-side and far-side during the age of impact basin formation. It provides important information on the origin of lunar dichotomy and lunar thermal history.

The admittance spectra of the South Pole-Aitken basin (SPA) and far-side highland terrain (FHT) show no significant difference. This means that elastic thickness of two regions are not so different. On the other hand, crustal thickness of two regions are drastically different. It suggests that elatic part of upper mantle of SPA region is probably thicker than FHT.

Acknowledgements: SHTOOLS2.4 [7] was used for calculating localized correlation and admittance spectra.

References: [1] A. S. Konopliv et al. (1998) *Science*, **281**, 1476-1480. [2] D. E. Smith et al. (1997) *JGR*, **102**, 1591-1611. [3] K. Matsumoto et al. this meeting. [4] H. Araki et al. *Submitted to Science*. [5] M. Simons et al., (1997) *Geophys. J. Int.*, **131,** 24-44. [6] N. Namiki et al. *Science in press*. [7] M. Wieczorek, (2007) http://www.ipgp.jussieu.fr/∼wieczor/SHTOOLS/SHTOOLS.html.