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Consideration of the seismic moment distribution of deep moonquake and the lunar deep structure

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The Apollo seismic network consists of 4 seismic stations (Apollo12, 14, 15 and 16) have observed deep moonquakes which occur repeatedly from specific source regions at depth of 700-1200 km in the lunar deep region. The deep moonquake occurs periodically related with positions of the Earth, the Moon and the Sun; that is tidal forces (e.g., Lammlein, 1977, Bulow et al., 2007). The 106 deep moonquake sources are currently located (Nakamura, 2005), the activity and largeness of the deep event and maybe occurrence mechanism are different among the sources (Araki, 2001).

Yamada et al., (2013) have investigated seismic moment of each deep event occurred from active and well-located 15 deep sources from analysis of data obtained in Apollo 12 station. To derive the seismic moment, we have to correct for characteristics of the Apollo seismometers, elastic and attenuation parameters of the lunar interior where the seismic phase passes, geometrical spreading and radiation pattern of the fault at source region from amplitude of the seismic event (Goins et al., 1981). In Yamada et al., (2013), recent lunar interior model VPREMOON (Garcia et al., 2013) are used, and the results have shown that the values of seismic moments are different among active 15 sources and far deep sources occur the events which have larger seismic moment than near sources.

In this study, we have derived the seismic moments of identical deep events observed in Apollo 15 and 16 stations to verify the previous results derived from analysis of Apollo 12 data. This analysis indicates that the values of seismic moments derived from each station data are respectively different from even if the events are identical. We found a tendency which deep moonquakes occur from far sources indicates larger differences in seismic moments derived from each station data than near source events. This may mean that the recent lunar interior model applied in this study has some problems. Especially, seismic quality factor in the mantle mainly affects on amplitudes of the seismic events. Previous studies (e.g., Nakamura and Koyama, 1982) have described that values of seismic quality factor had large uncertainty in lunar deep region. We, therefore, derived appropriate seismic quality factor so as to minimize differences of the seismic moments derived from each station data. In this analysis, we considered effects of possible radiation patterns because these values also have large uncertainty and effect on derivation of the seismic moments. We will report and discuss our new seismic moment distribution of deep moonquakes and new values of seismic quality factor in this presentation.

Keywords: Deep Moonquake, Seismic Moment, Lunar Seismic Activity, Lunar Mantle, Lunar Seismic Quality Factor, Lunar Deep Structure