The viscosity structure of the low-viscosity zone of the Moon derived from the tidal response

*Yanxia Tan[1], Yuji Harada[1]

1. State Key Laboratory of Lunar and Planetary Sciences, Macau University of Science and Technology

The effect on the tidal response of the low-viscosity zone at the deep interior of the Moon is investigated, in particular from the viewpoint of its possible viscosity structure on a few simple assumptions of some hypothetical temperature profiles. Based on the Love number theory, the tidal parameters are computed numerically in order to demonstrate their structure dependences on the low-viscosity zone as well as the frequency dependence. Unlike the earlier consideration, the viscosity structure of the low-viscosity zone here is not assumed to be fully uniform any longer but linked with either a couple of temperature profiles, namely, the thermal boundary layer model or the convective layer model. The calculations show that the latest observational ranges of the frequency-dependent quality factors can be satisfied only by the convective layer model with some viscosity value for the interlayer but not by the thermal boundary layer model for any structure. The approximate viscosity solution is estimated to be 3.3×10^{16} Pa s. If considering also the observational ranges of the Love numbers together with those of the quality factors, the solution of the outer radius of the low-viscosity zone is approximately 560 km. These solutions are almost identical to those based on the previous uniform model. It is concluded that in the Maxwell model the thermal state of the bottom layer of the lunar mantle is predicted to be mainly controlled by the local convection, and possibly maintained by the energy balance between convective cooling and tidal heating, as previously suggested.

This work was financially supported by the Research Funding Projects (No. 007/2016/A1, No. 119/2017/A3, and No. 187/2017/A3) at the Science and Technology Development Fund, the Macau Special Administrative Region.

Keywords: Geophysics, Interior, Moon, Tides, Solid body

