Constraints on the Moon's deep interior from tidal deformation A. Briaud[1], A. Fienga[1,2], D. Melini[3], N. Rambaux[2], A. Mémin[1], G. Spada[4], C. Saliby[1], H. Hussmann[5], and A. Stark[5].

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We use the tidal deformations of the Moon induced by the Earth as a tool for studying our satellite's inner structure. Based on measurements of the degree-two tidal Love numbers k_2 and h_2 and dissipation coefficients from the GRAIL mission, Lunar Laser Ranging and Laser Altimetry on board of the Lunar Reconnaissance Orbiter spacecraft, we perform Monte Carlo samplings for 120,000 possible combinations of thicknesses, densities and viscosities for two classes of Moon's models, one including a undifferentiated core and one including an inner and outer core, with both classes assuming a low-viscosity zone (LVZ) at the core-mantle boundary. All models are consistent with the Moon total mass as well as its moment of inertia. By comparing predicted and observed tidal deformation parameters we find that the existence of an inner core cannot be ruled out. Furthermore, by deducing temperature profiles for the LVZ and the mantle following Earth assumptions, we obtain stringent constraints on the radius (500 ± 1) km, viscosity, (4.5 ± 0.8) 10^{16} Pa•s and the density (3400 ± 10) kg/m^3 of the LVZ. We also infer the first estimation for the outer core viscosity, (2.07 ± 1.03) 10^{17} Pa•s , for two different possible scenarios: a Moon with a 70 km thick outer core and large inner core (290 km radius with a density of 6000 kg/m^3), and a Moon with a thicker outer core (169 km thick) but a denser and smaller inner core (219 km radius for 8000 kg/m^3).

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