Supporting Information for "Tidal heating in a subsurface magma ocean on Io revisited"

B. Aygün[1]and O. Čadek[1]

[1]Department of Geophysics, Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic

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Introduction

Table S1 summarizes the parameters of Io used in the main text. Figure S1 illustrates the sensitivity of the results to a change in viscosity in the sub-ocean mantle. Finally, figure S2 shows the distribution of tidal dissipation in a weak, 100-km thick "magmatic sponge" layer located under the magma ocean.

Symbol	Parameter	Value
ω	Angular velocity	$4.1106\ \mathrm{s}^{-1}$
e	Eccentricity	0.0041
R_s	Radius of Io	1821.6 km
R_m	Outer radius of magma ocean	1791.6 km
R_c	Radius of core	927 km
d	Thickness of magma ocean	$0.1 - 10$ km
ρ	Density	
	$r > R_m$	$3000\ \mathrm{kg\,m}^{-3}$
	$r \in \langle R_c, R_m \rangle$	$3295\ \mathrm{kg\,m}^{-3}$
	$r < R_c$	$5167\ \mathrm{kg\,m}^{-3}$
μ	Shear modulus	
	$r > R_m$	65 GPa
	$r \in (R_c, R_m - d)$	60 GPa
η	Viscosity	
	$r > R_m$	10^{23} Pa s
	$r \in \langle R_m - d, R_m \rangle$	$10^2 - 10^7$ Pa s
	$r \in (R_c, R_m - d)$	10^{20} Pa s

Table S1. Parameters of the model

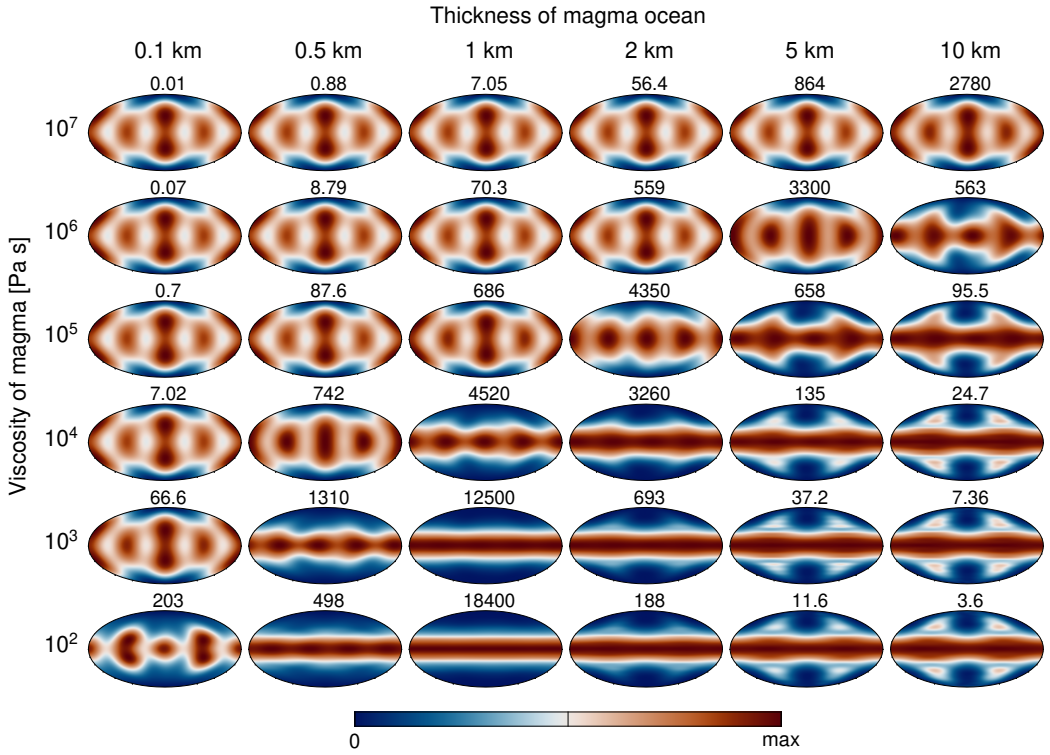

Figure S1. As in figure 1 in the main text but with a 100-km thick low viscosity "magmatic sponge" layer beneath the ocean. Comparison with figure 1 shows that the presence of a weak layer underlying the magma ocean affects the dissipation in the ocean in a minor way. The layer is treated as an incompressible Maxwell viscoelastic solid with $\rho = 3295$ kg/m^3, $\mu = 60$ GPa and $\eta = 10^{16}$ Pa s. The distribution of tidal dissipation in this layer is shown in figure S2.

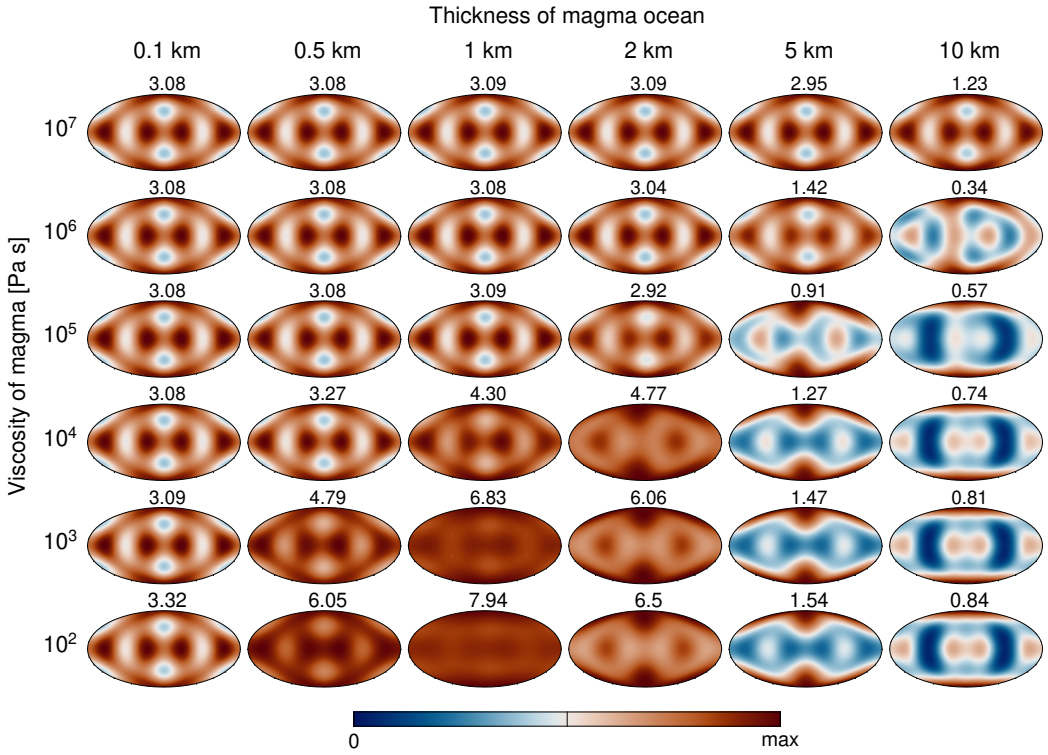

Figure S2. Distribution of tidal dissipation in the low viscosity sub-ocean layer described in the caption to figure S1. The numbers above each map represent the total heat production in the layer. Note that the heating pattern and the total dissipation strongly depend on the thickness and viscosity of the magma ocean.