Supplementary material: Microwave-heating laboratory experiments for planetary mantle convection

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ΔT_H	Ra_H	$\Delta T_{TBL}/\Delta T_H$	δ_{TBL}/h	μ_0 (Pa s)	$\mu_0/\mu_{T_{max}}$	α_0 (K^{-1})	$\alpha_0/\alpha_{T_{max}}$
94	5.72×10^4	0.2142	0.430	10.6	2.62	1.75×10^{-4}	0.46
75	4.17×10^5	0.1444	0.289	0.789	2.10	1.63×10^{-4}	0.53
94	6.69×10^5	0.1178	0.238	0.744	2.03	1.75×10^{-4}	0.46
136	9.73×10^5	0.1052	0.223	0.769	2.66	1.68×10^{-4}	0.48
131	1.80×10^6	0.0959	0.211	0.585	2.51	1.82×10^{-4}	0.52
248	3.98×10^6	0.0922	0.195	0.839	3.29	1.50×10^{-4}	0.41
249	1.09×10^7	0.0674	0.148	0.368	6.79	1.44×10^{-4}	0.44

Table S1: Numerical simulations using experimental parameters. Ra_H is calculated with fluid parameters at mean temperature T_{mean} at steady state, μ_0 and α_0 are the viscosity and the thermal expansivity at the surface temperature T_0. Also indicated the ratio of viscosity and thermal expansivity at T_{max} with respect to the values at T_0 to quantify the departure from the Boussinesq approximation.

ΔT_H	Ra_H	$\Delta T_{TBL}/\Delta T_H$	δ_{TBL}/h
90	3.16×10^4	0.225	0.445
94	5.72×10^4	0.207	0.430
94	1.41×10^5	0.192	0.383
94	2.20×10^5	0.153	0.320
94	6.69×10^5	0.117	0.242
101	1.00×10^6	0.105	0.211
248	3.11×10^6	0.0800	0.180
278	1.41×10^7	0.0563	0.117
370	7.50×10^7	0.0361	0.0780
40	1.00×10^9	0.0180	0.0390

Table S2: Numerical simulations using constant fluid parameters and rigid boundary conditions.

ΔT_H	Ra_H	$\Delta T_{TBL}/\Delta T_H$	δ_{TBL}/h
90	3.16×10^4	0.176	0.367
94	5.72×10^4	0.169	0.367
94	1.41×10^5	0.129	0.289
94	2.20×10^5	0.116	0.258
101	1.00×10^6	0.0750	0.190
113	1.88×10^6	0.0647	0.164
278	1.41×10^7	0.0393	0.102
370	7.50×10^7	0.0260	0.0704
40	1.00×10^9	0.0143	0.0330

Table S3: Numerical simulations using constant fluid parameters and free-slip boundary conditions.

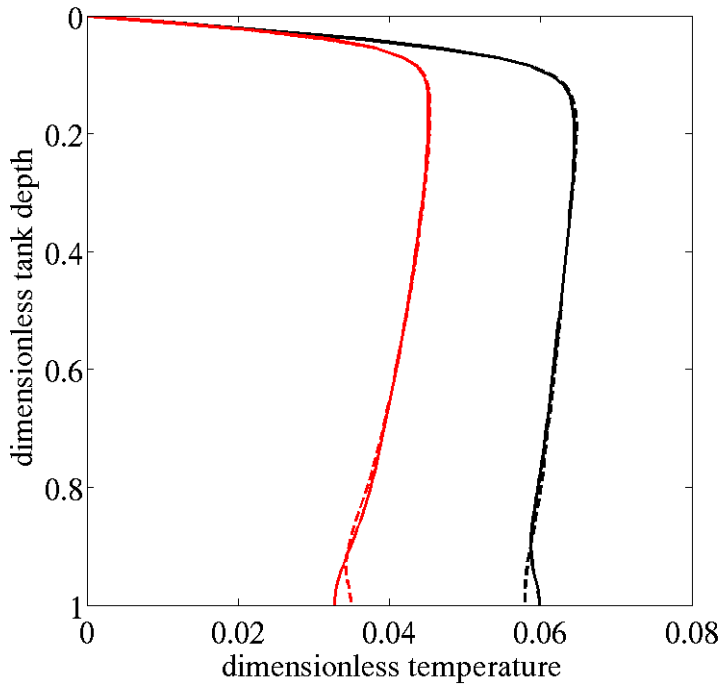

Figure S1: Influence of the mechanical boundary condition (BC); numerical results for RaH=$10^{6.9}$: solid black line = top and bottom rigid BC, solid red line = top and bottom free-slip BC, dashed black line = top rigid BC and bottom free-slip BC, dashed red line = top free slip BC and bottom no slip BC.