Supplementary Materials for

**Thermal coupling mode in mantle-outer core convection predicted from an ultra-high-resolution numerical simulation of two-layer convection with a large viscosity contrast**

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 I have prepared two supplementary tables (Tables S1 and S2).

Table S1. Physical quantities used in the numerical model.

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| Property and symbol | Value |
| Radius of the top surface boundary, *rtop* | 6.371×106 m  |
| Radius of the interface between the two layers, *rintf* | 3.480×106 m |
| Radius of the bottom surface boundary, *rbot* | 1.2215×106 m |
| Thickness of the HVL, *bH* | 2.891×106 m |
| Thickness of the LVL, *bL* | 2.2585×106 m |
| Thickness of the convection layer, *b* | 5.1495×106 m |
| Density of the HVL, *ρH*0 | 3.3×103 kg m–3 |
| Density of the LVL, *ρL* | 7.63704×103 kg m–3 |
| Density difference between the two layers, *ΔρL* | 4.33704×103 kg m–3 |
| Viscosity of the HVL, *ηH*0 | 1022 Pa s |
| Viscosity of the LVL, *ηL* | 1018 Pa s |
| Viscosity ratio between the two layers, *ΔηL* | 104 |
| Coefficient of thermal expansion of the HVL, *α*0 | 3.0×10–5 K–1 |
| Gravitational acceleration, *g*0 | 9.81 m s–2 |
| Potential temperature at the top surface boundary, *Ttop*  | 273 K |
| Potential temperature at the bottom surface boundary, *Tbot* | 2773 K |
| Temperature drop across the convection layer, *ΔT* | 2500 K |
| Specific heat at constant pressure, *cp*0 | 1.25×103 J kg–1 K–1 |
| Thermal diffusivity, *κ*0 | 10–6 m2 s–1 |
| Degree of layering, *Ξ* | −5.0×107 kg m–1 s–2 K–1 |
| Half width of the transition boundary, *ω* | 10 km |

Subscript “0” indicates the reference value in the HVL. HVL: high-viscosity layer; LVL: low-viscosity layer.

Table S2. Dimensionless parameters used in numerical model.

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| Symbol | Definition | Value |
| *Ra* | Thermal Rayleigh number | 3.315×107 |
| *Rb* | Boundary Rayleigh number | 5.810×108 |
| *γ* | Layering parameter | −0.750 |
| *ξ* | Spherical-shell ratio | 0.192 |