

1 **Onset of Double Subduction Controls Plate Motion Reorganization**

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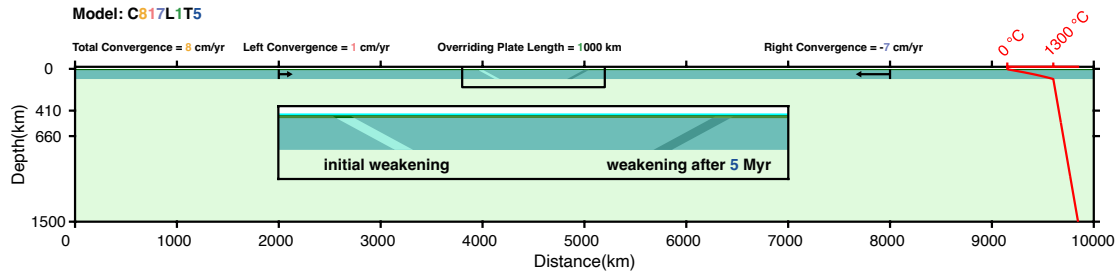
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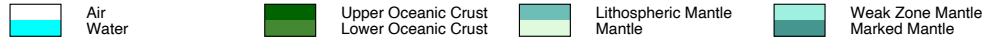
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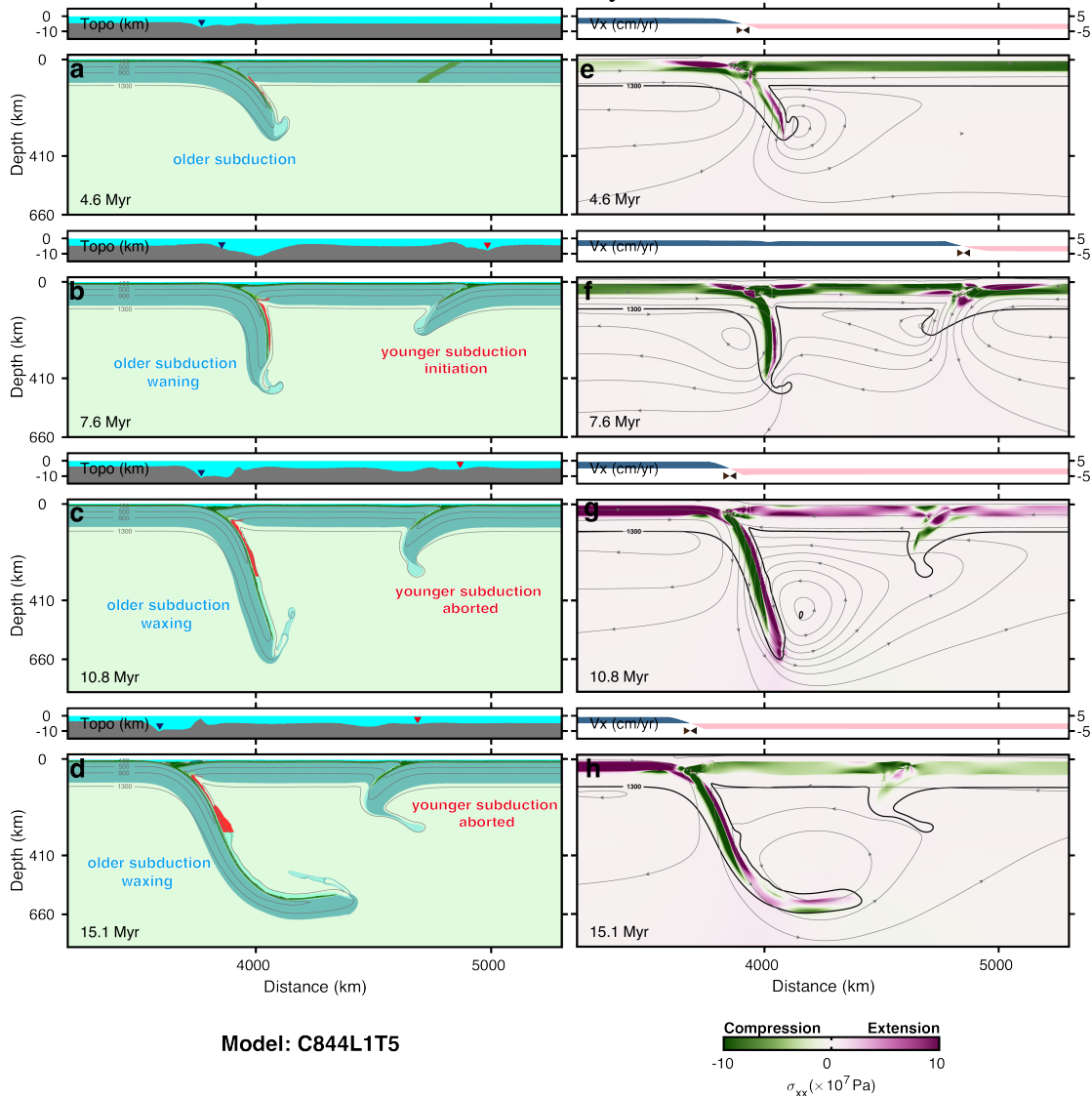
Supplementary Information



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Supplementary Fig.1 Model Setup. Red line shows geothermal gradient. Weak zone induced older subduction and marked mantle will weaken after 5 Myr in model to induce second subduction.

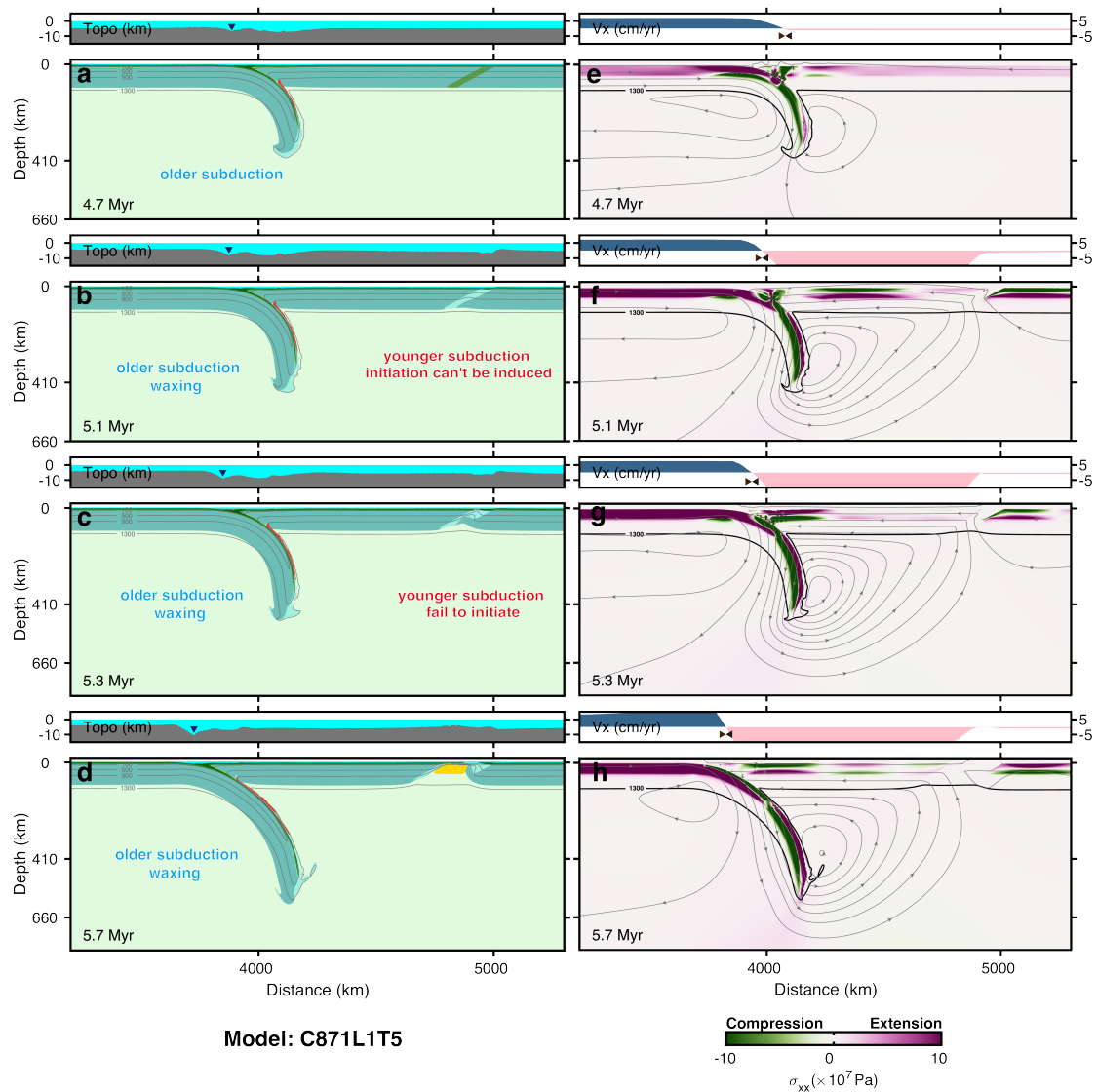


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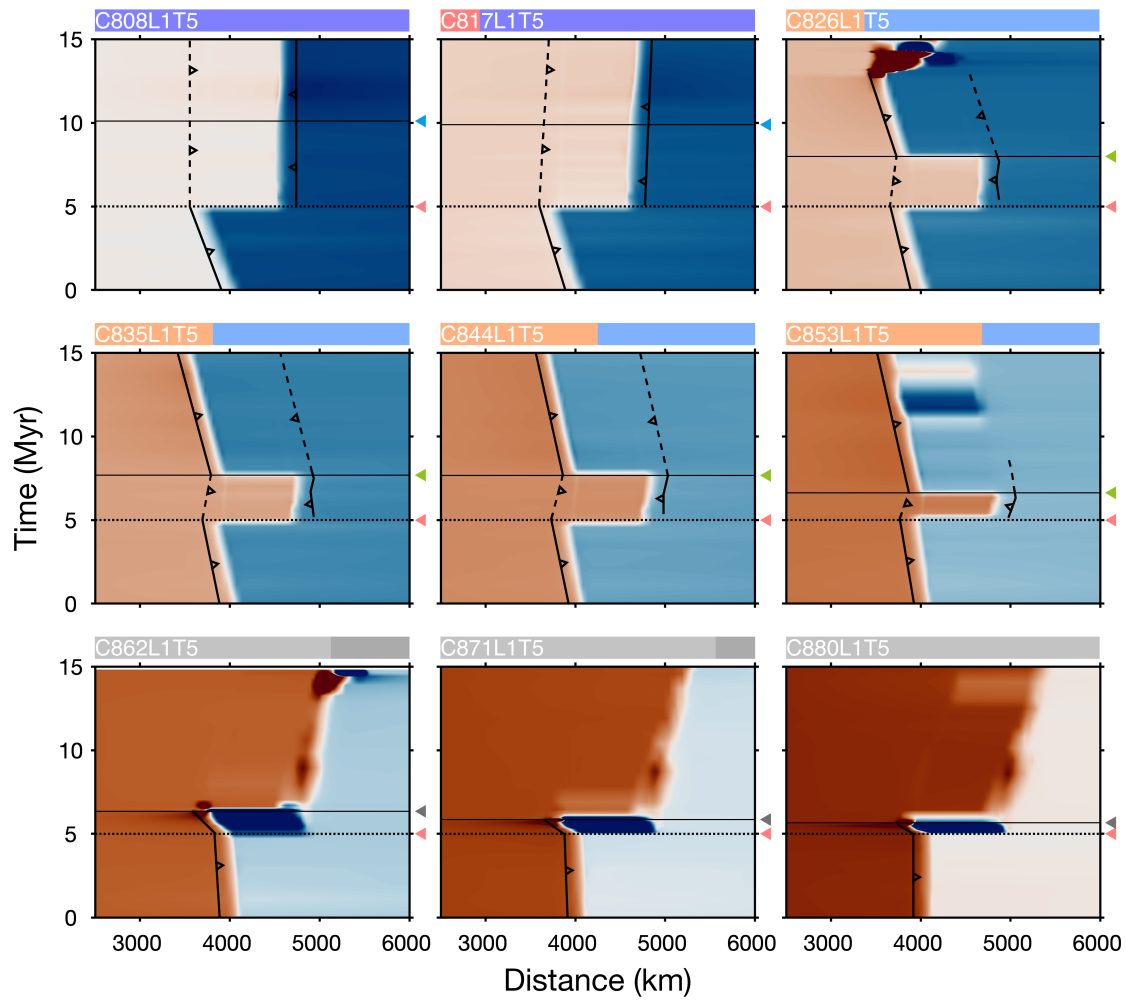
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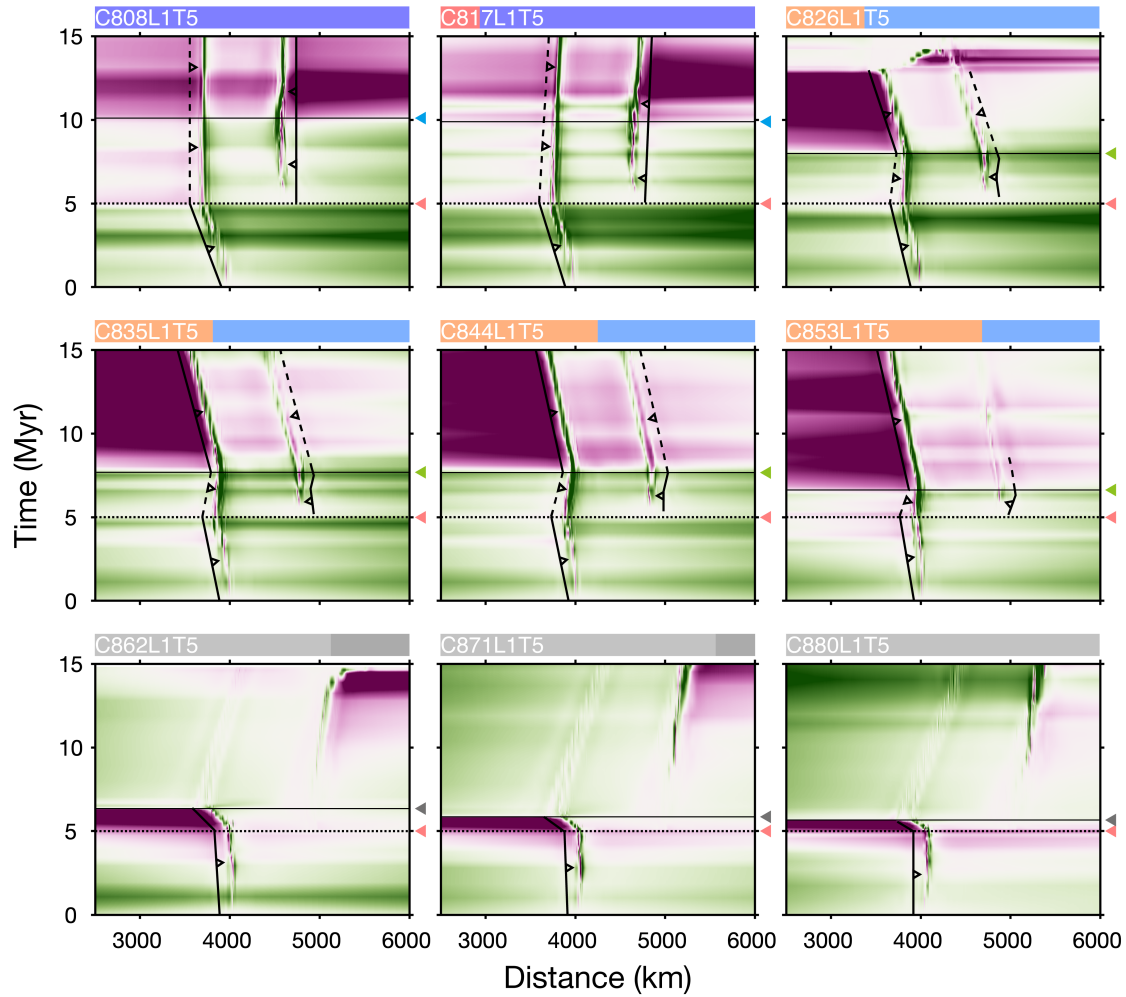
Supplementary Fig. 2 Model (C844L1T5) results showing the dynamic evolution of younger subduction initiation induced but aborted.



Supplementary Fig. 3 Model (C871L1T5) results showing the dynamic evolution of younger subduction initiation can't be induced.



Supplementary Fig. 4 Plate motion over time in the models with the overriding plate length of 1000 km, the total convergence of 8 cm/yr and the onset time of the younger subduction of 5 Myr. The partition of plate convergence varies in these models.

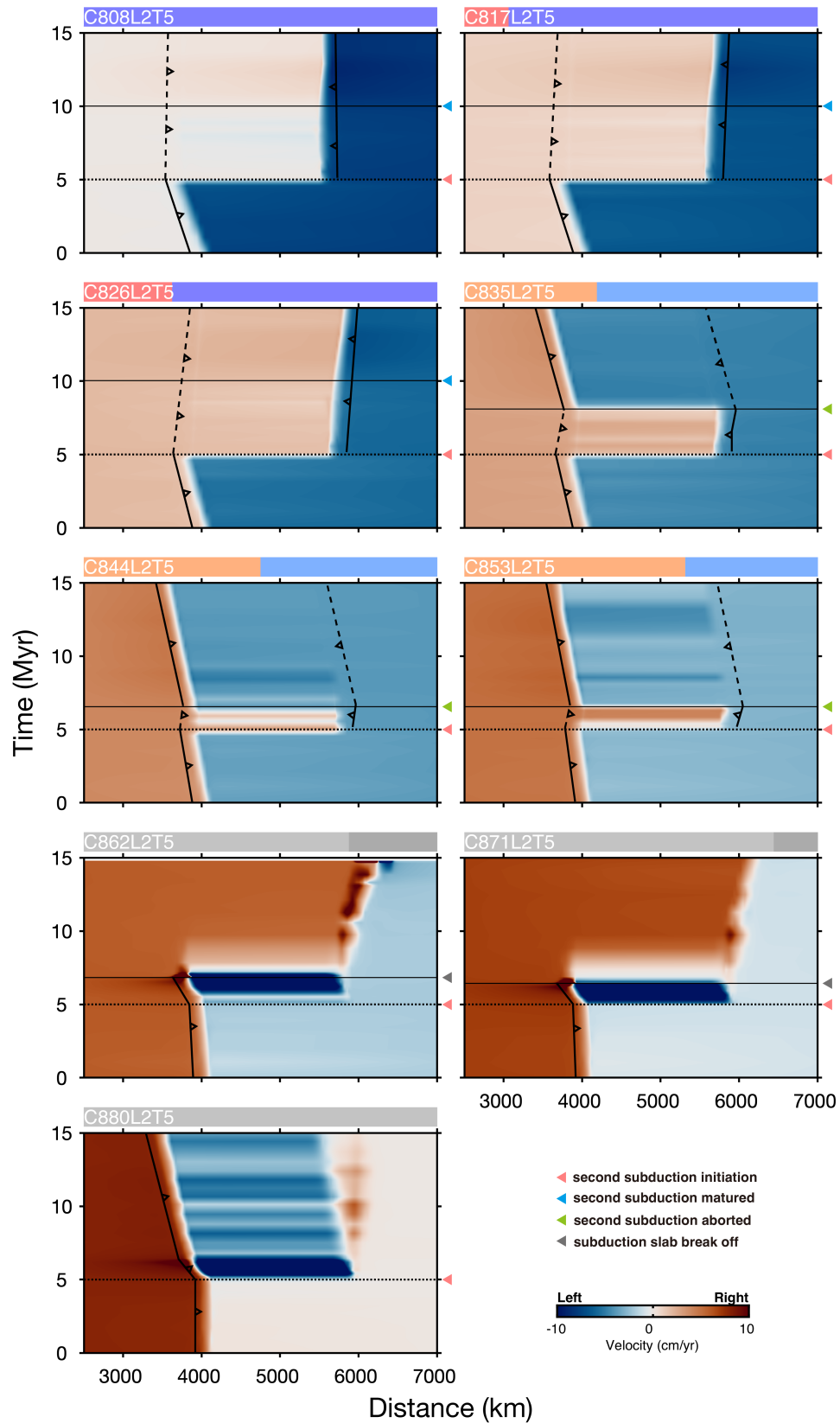


◀ second subduction initiation
 ▶ second subduction matured

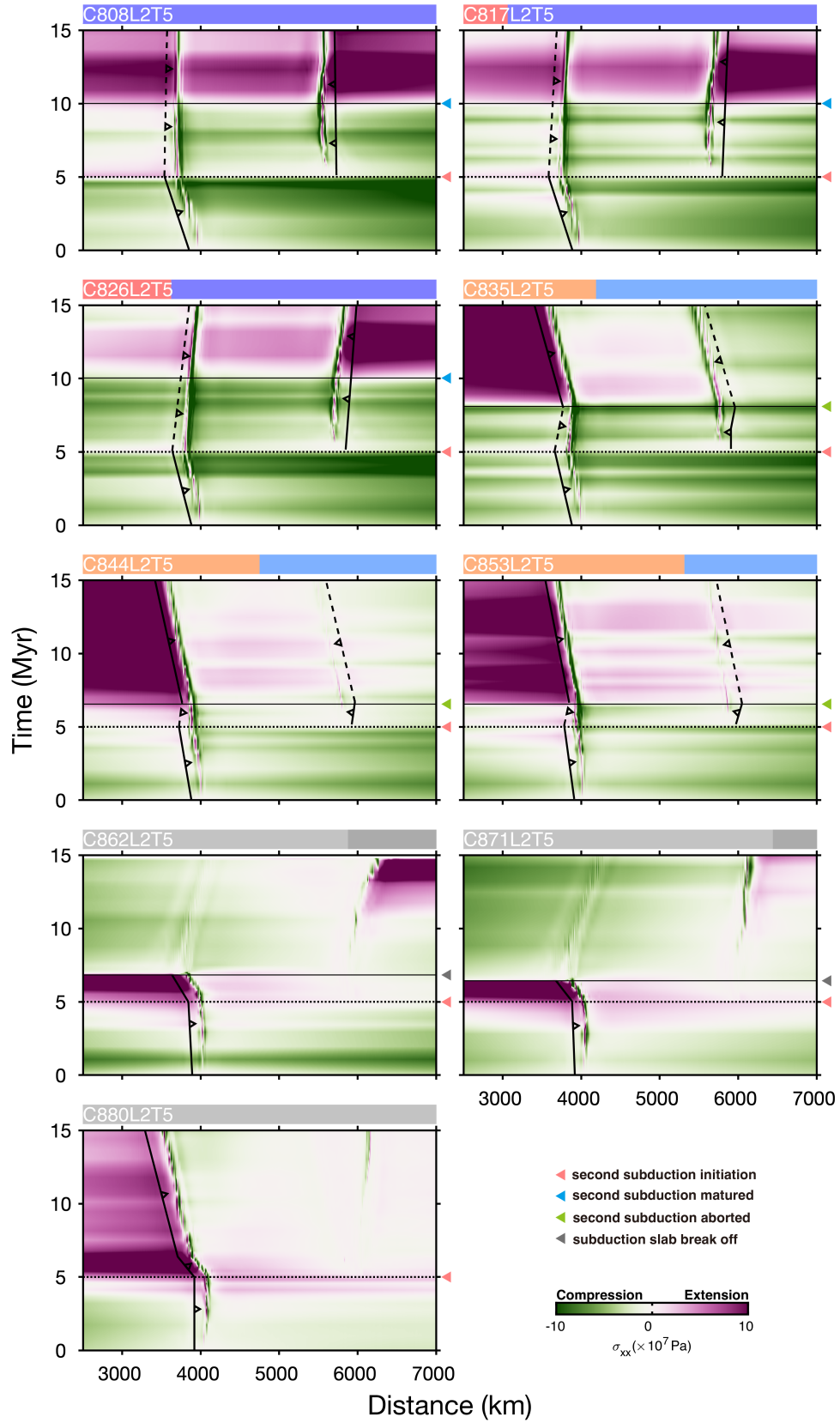
◀ second subduction aborted
 ▶ subduction slab break off

Compression Extension
 -10 0 10
 $\sigma_{xx} (\times 10^7 \text{ Pa})$

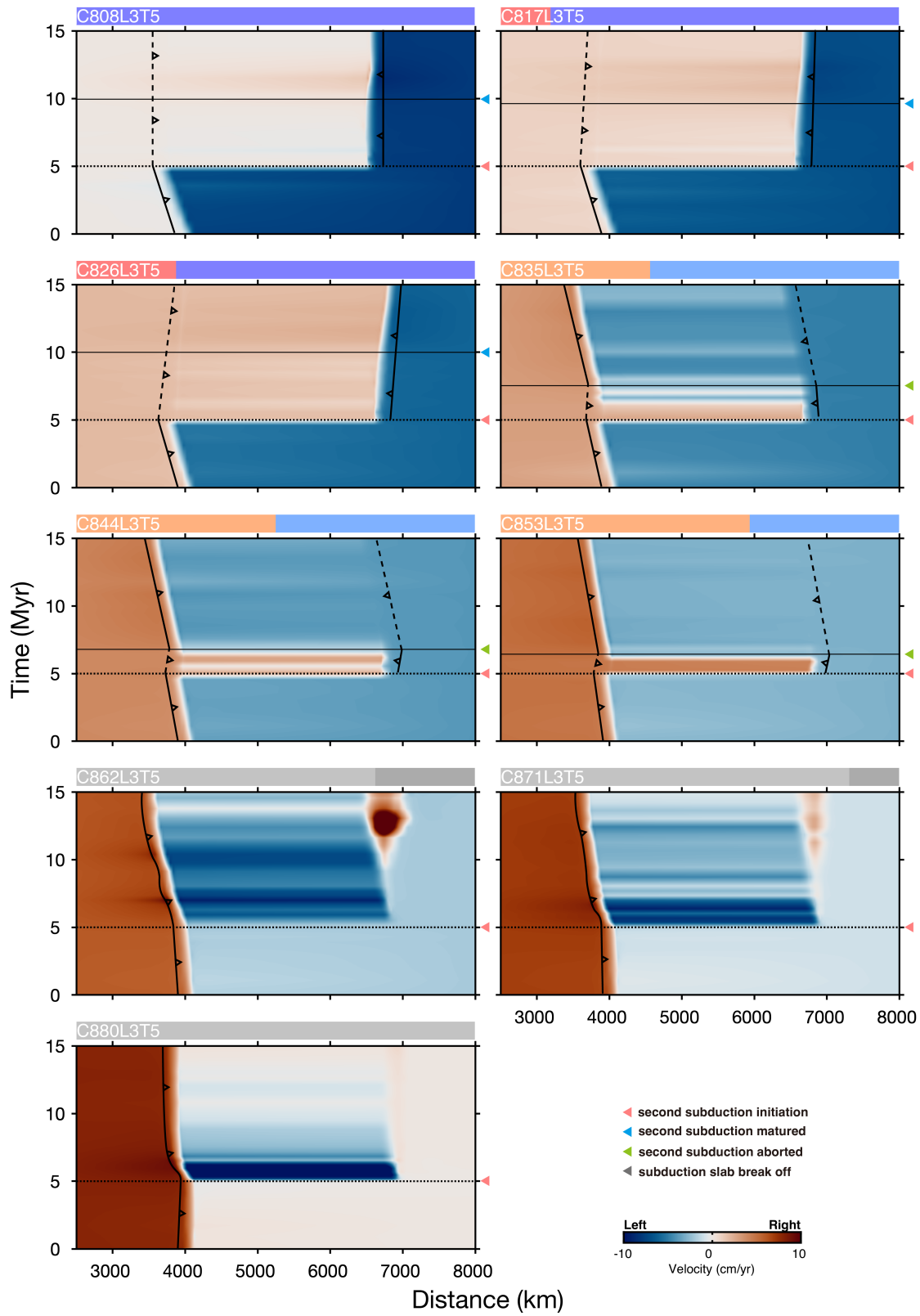
Supplementary Fig. 5 Plate stress evolution in the models with the overriding plate length of 1000 km, the total convergence of 8 cm/yr and the onset time of the younger subduction of 5 Myr. The partition of plate convergence varies in these models.



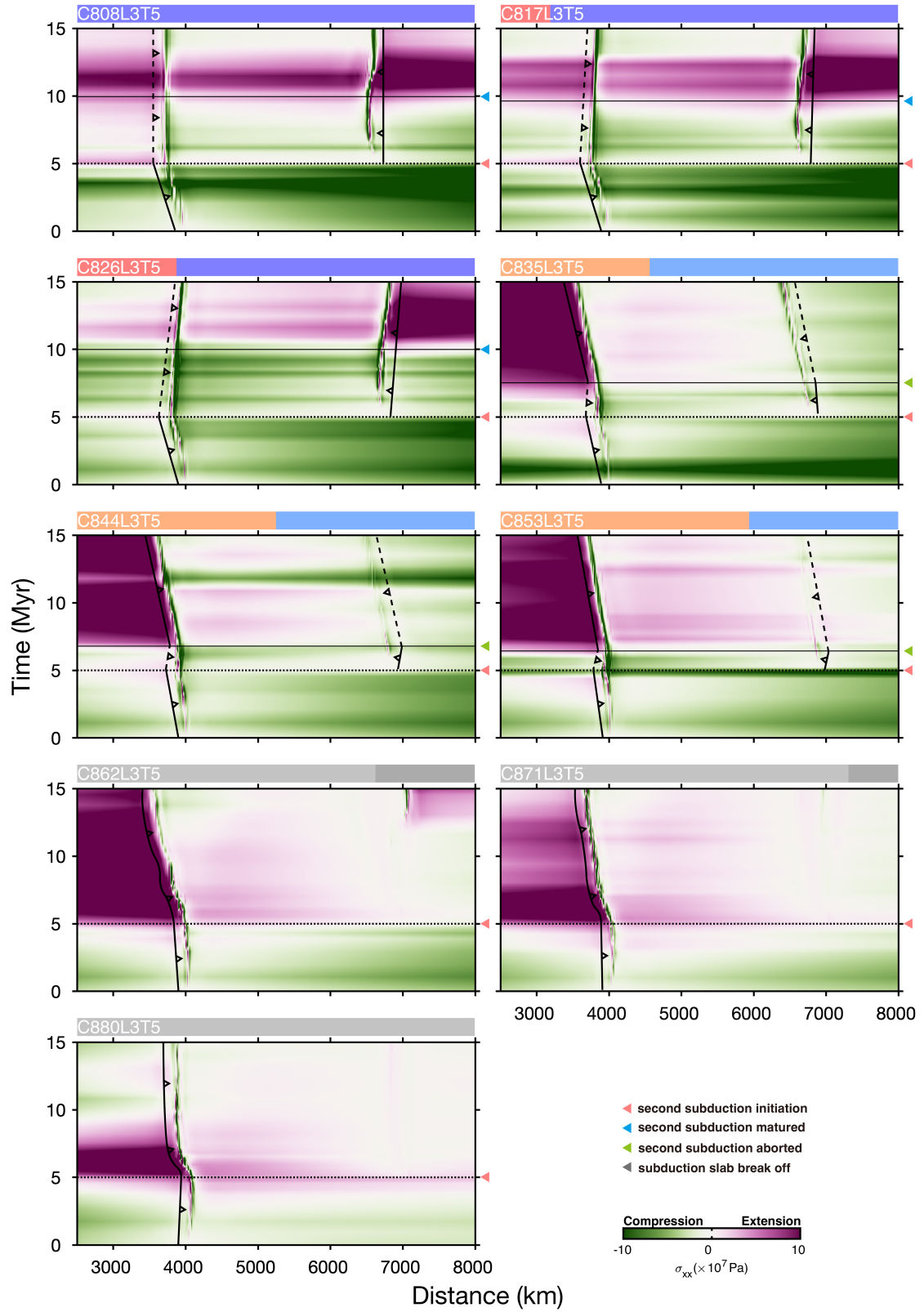
Supplementary Fig. 6 Plate motion over time in the models with the overriding plate length of 2000 km. The rest parameters are identical with those in the models in Supplementary Figs. 4,5.



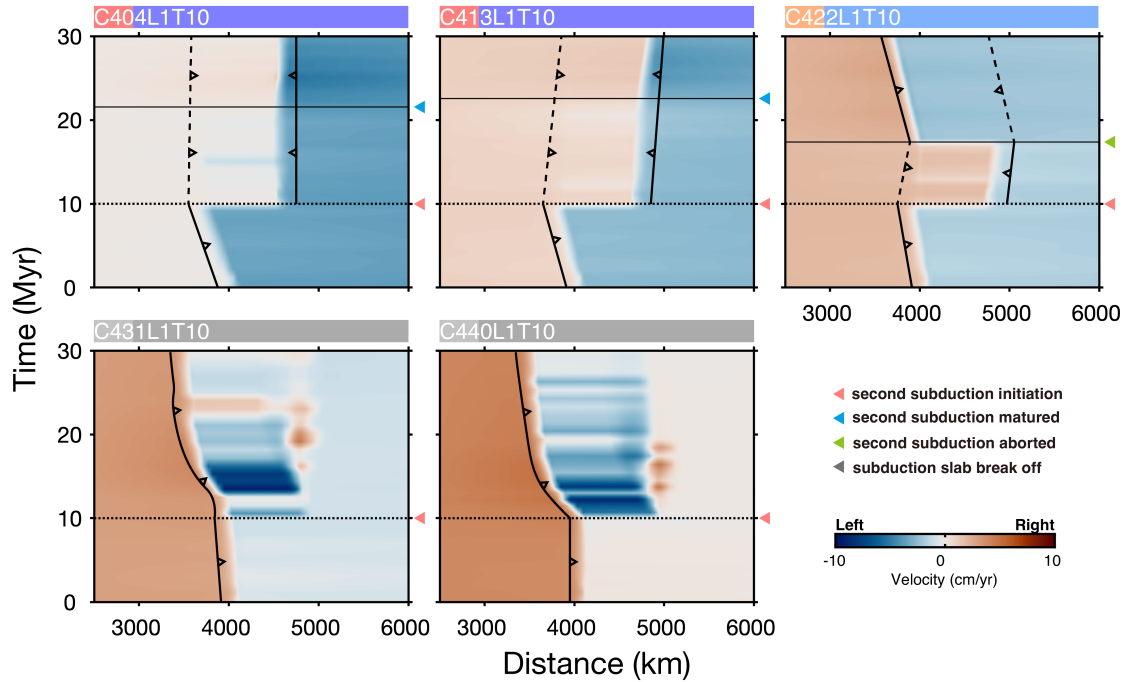
Supplementary Fig. 7 Plate stress evolution in the models with the overriding plate length of 2000 km. The rest parameters are identical with those in the models in Supplementary Figs. 4,5.



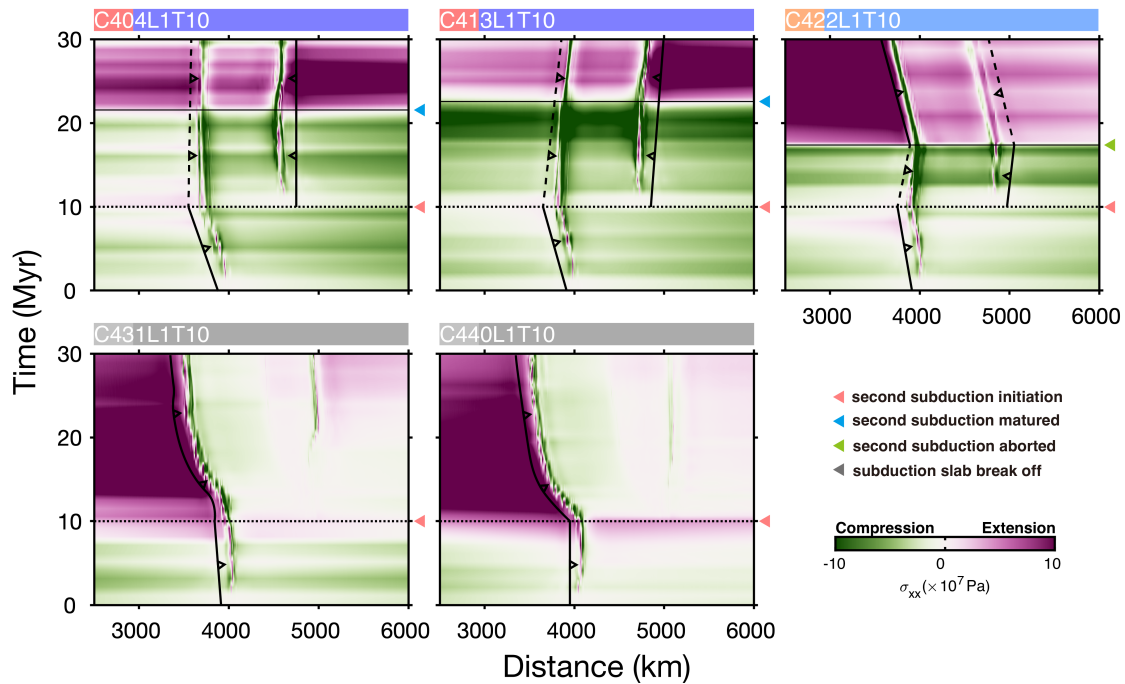
Supplementary Fig. 8 Plate motion over time in the models with the overriding plate length of 3000 km. The rest parameters are identical with those in the models in Supplementary Figs. 4,5.



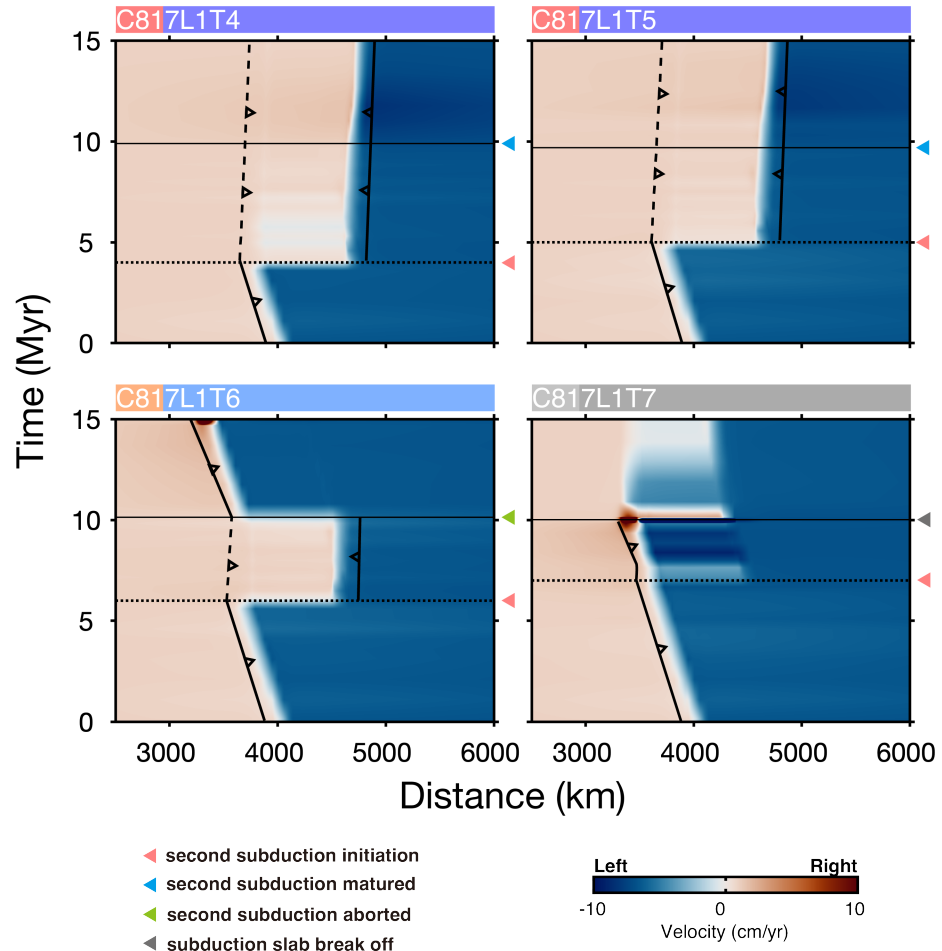
Supplementary Fig. 9 Plate stress evolution in the models with the overriding plate length of 3000 km. The rest parameters are identical with those in the models in Supplementary Figs. 4,5.



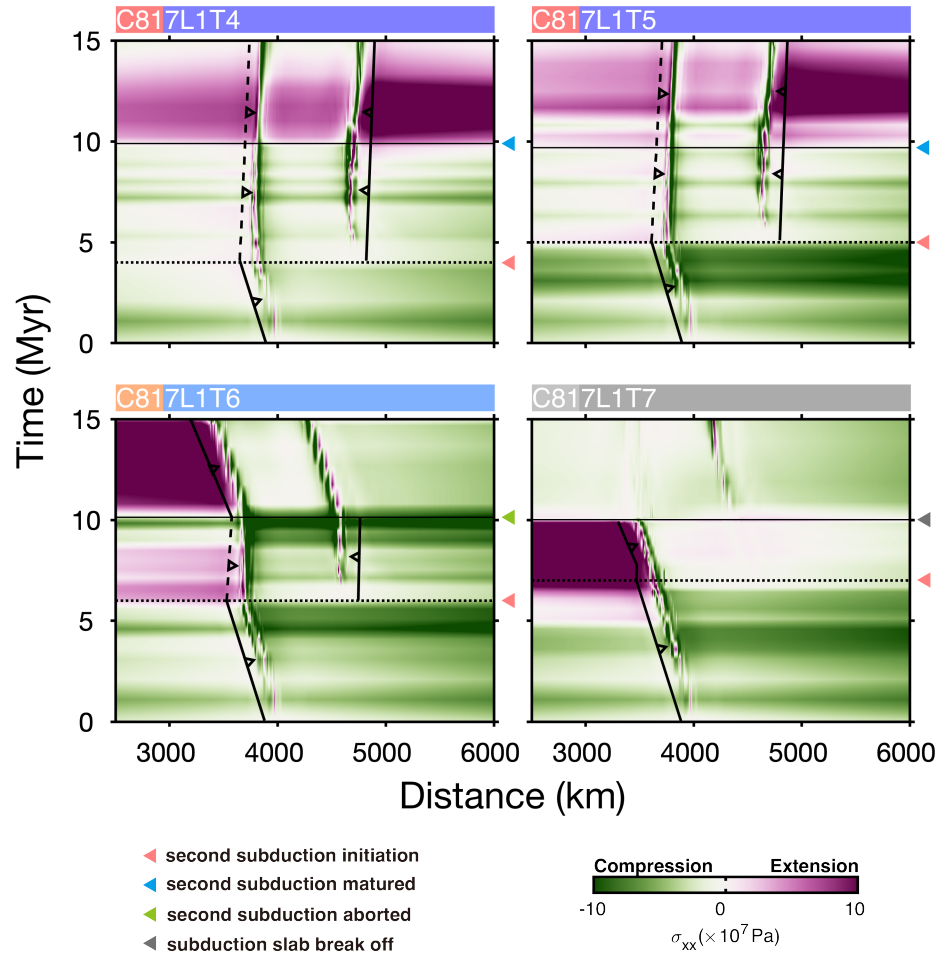
Supplementary Fig. 10 Plate motion over time in the models with the overriding plate length of 1000 km, the total convergence of 4 cm/yr and the onset time of the younger subduction of 10 Myr. The partition of plate convergence varies in these models.



Supplementary Fig. 11 Plate stress evolution in the models with the overriding plate length of 1000 km, the total convergence of 4 cm/yr and the onset time of the younger subduction of 10 Myr. The partition of plate convergence varies in these models.



Supplementary Fig. 12 Plate motion over time in the models with the overriding plate length of 1000 km, the total convergence of 8 cm/yr (1 cm/yr from left and 7 cm/yr from right). The onset time of the younger subduction varies in these models.



Supplementary Fig. 13 Plate stress evolution in the models with the overriding plate length of 1000 km, the total convergence of 8 cm/yr (1 cm/yr from left and 7 cm/yr from right). The onset time of the younger subduction varies in these models.

59 Supplementary Table 1 Physical properties

Material	ρ_0 (kg/m ³) ^{1,2}	$k \times \exp(4 \times 10^{-5} P)$ (W/(m·K)) ^{3,4}	T_{solidus} (K, at P MPa) ^{5,6}	T_{liquidus} (K, at P MPa) ^{5,6}	H_f (μW/ m ³) ¹	H_L (kJ/kg) ^{1,2}	Flow law ⁷
Sediment	2,600 (solid) 2,400 (molten)	0.64 $+\frac{807}{T+77}$	$889 - \frac{18,900}{(P+54)} + \frac{20,200}{(P+54)^2} \text{ at } P \leq 1,200$ $831 + 0.06 \cdot P \text{ at } P > 1,600$	1,262 $+ 0.009 \cdot P$	2	300	Wet quartzite $c_0 = 1 \text{ MPa}, c_1 = 1 \text{ MPa},$ $\mu_0 = 0, \mu_1 = 0$
Basalt	3,000 (solid) 2,900 (molten)	1.18 $+\frac{474}{T+77}$	$973 - \frac{70,400}{(P+354)} + \frac{77,800,000}{(P+354)^2} \text{ at } P \leq 1,600$ $935 + 0.0035 \cdot P + 0.0000062 \cdot P^2 \text{ at } P > 1,600$	1,423 $+ 0.105 \cdot P$	0.250	380	Wet quartzite $c_0 = 1 \text{ MPa}, c_1 = 1 \text{ MPa},$ $\mu_0 = 0.01, \mu_1 = 0.01$
Gabbro	3,000 (solid) 2,900 (molten)	1.18 $+\frac{474}{T+77}$	$973 - \frac{70,400}{(P+354)} + \frac{77,800,000}{(P+354)^2} \text{ at } P \leq 1,600$ $935 + 0.0035 \cdot P + 0.0000062 \cdot P^2 \text{ at } P > 1,600$	1,423 $+ 0.105 \cdot P$	0.250	380	Plagioclase An ₇₅ $c_0 = 10 \text{ MPa}, c_1 = 10 \text{ MPa},$ $\mu_0 = 0.6, \mu_1 = 0.6$
Lithosphere- asthenosphere mantle	3,300 (solid) 2,900 (molten)	0.73 $+\frac{1293}{T+77}$	P -H ₂ O-dependent		0.022	400	Dry olivine $c_0 = 20 \text{ MPa}, c_1 = 20 \text{ MPa},$ $\mu_0 = 0.6, \mu_1 = 0.6$
Hydrated mantle/Weak zone/serpenti- nized mantle	3,250/ 3,300/ 3,250/	0.73 $+\frac{1293}{T+77}$	P -H ₂ O-dependent		0.022	400	Wet olivine $c_0 = 10 \text{ MPa}, c_1 = 1 \text{ MPa},$ $\mu_0 = 0.1, \mu_1 = 0.05$ $c_0 = 1 \text{ MPa}, c_1 = 1 \text{ MPa},$ $\mu_0 = 0, \mu_1 = 0 \text{ (weak zone)}$

60 Flow law⁷:

61 Wet quartzite: $A = 1.97 \times 10^{17} \text{ Pa}^n \text{s}, n = 2.3, E = 154 \text{ KJ mol}^{-1}, V = 8, 3.2 \text{ (serpentinized) J mol}^{-1}$

62 MPa⁻¹.

63 Plagioclase An₇₅: $A = 4.80 \times 10^{22} \text{ Pa}^n \text{s}, n = 3.2, E = 238 \text{ KJ mol}^{-1}, V = 8 \text{ J mol}^{-1} \text{ MPa}^{-1}$.

64 Dry olivine: $A = 3.98 \times 10^{16} \text{ Pa}^n \text{s}, n = 3.5, E = 532 \text{ KJ mol}^{-1}, V = 10 \text{ J mol}^{-1} \text{ MPa}^{-1}$.

65 Wet olivine : $A = 5.01 \times 10^{20} \text{ Pa}^n \text{s}, n = 4.0, E = 470 \text{ KJ mol}^{-1}, V = 8 \text{ J mol}^{-1} \text{ MPa}^{-1}$.

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Reference

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