SUPPLEMENTARY MATERIALS

Movie DR1: The evolution of dynamic topography since the Eocene from our preferred model (M2). Reconstructed plate tectonic boundaries, continents and the Queensland and Marion Plateaus are (red outline) are shown at different time intervals since the Eocene.

Movie DR2: Left) Cross section from the preferred geodynamic model (M2) showing the evolution of non-dimensional mantle temperature since the Eocene. Depth is also non-dimensionalised and extends from 0.99 (where 1 is the earth surface) and 0.65 (where 0.55 is the core mantle boundary). Right) assimilated age grids through time, showing the location of the cross section (blue line).

Table DR1: Variable geodynamic model parameters.

Model ID	Non-Dimensional Layered Viscosity ($\eta'_{0-100}, \eta'_{100-410}, \eta'_{410-660}, \eta'_{660-2800}$)	410 Clapeyron Slope (MPa/K)	660 Clapeyron Slope (MPa/K)
M1	100,1,5,10	4	-2
M2	100,1,5,50	4	-2
M3	100,0.1,5,50	4	-2

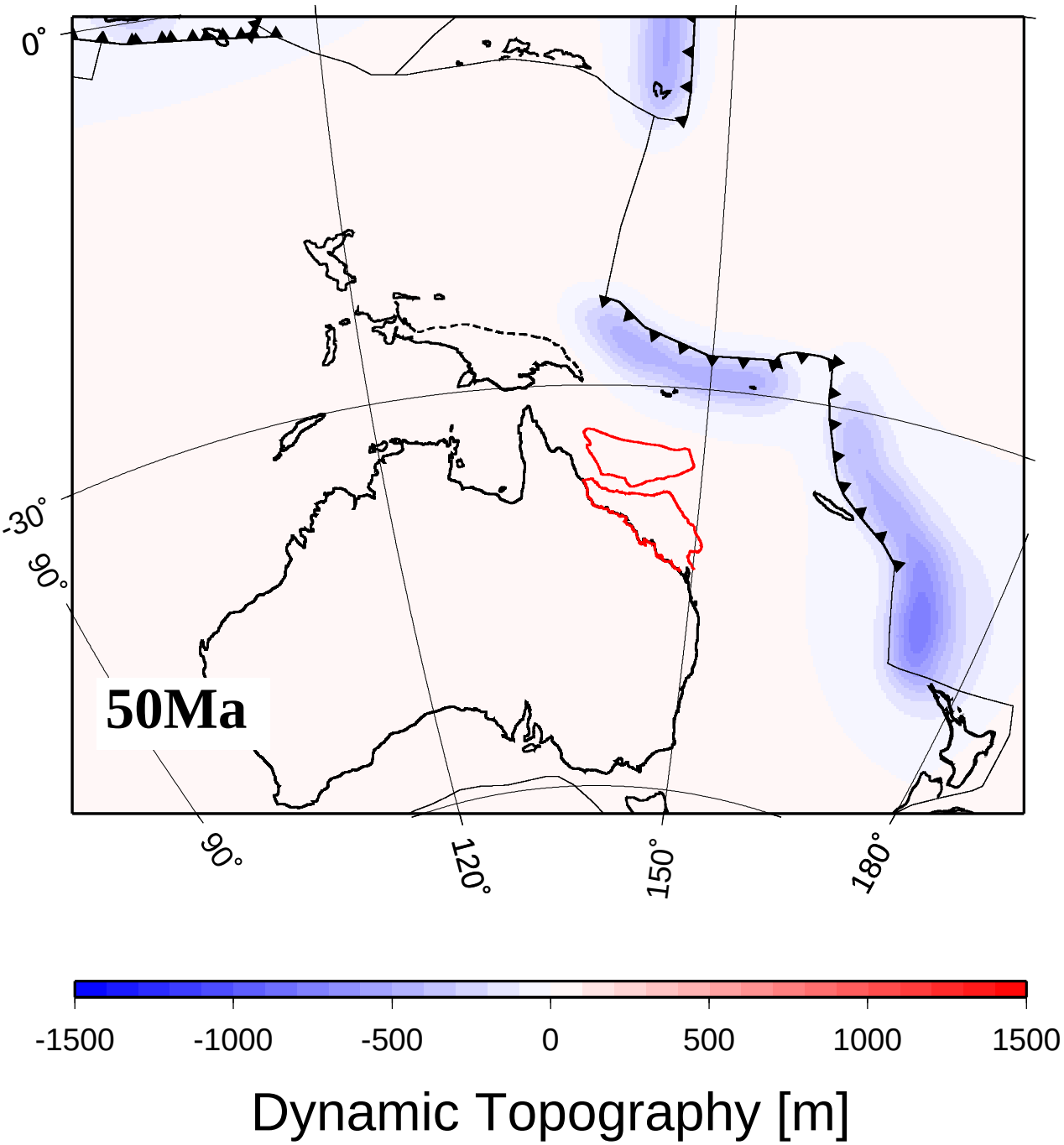
NB: Viscosity is non-dimensionalised using $\eta' = \frac{\eta}{\eta_0}$ where η_0 is the reference viscosity

$\eta_0 = 2e^{+21}$, and η is dimensionalised viscosity.

Table DR4: Lithologic and biostratigraphic information used to perform tectonic subsidence calculations summarized from Isern et al., (2002)

Site	**Age (oldest) (Mya)**	**Unit Depth (mbsf)**	**Lithology and seismic mega-sequence**	**water depth error (m)**
1193				
	0.7	0-3.5	I: Limestone	0-30
	2.9	3.5-35	II:Packstone	0-30
	5.6	35-167	IIIA:Limestone/ Dolostone/ Packstone	0-30
	?12	167-229	IIIB:Rudstone/ Packstone/ Grainstone/ Floatstone	30 -120
	16.35	229-249	IV: Mudstone	200
	16.45	249-385	V: Packstone	120
	17.5	385-529	VIA: Grainstone/ Sandstone	0-120
	?28.4	529-531	VIB:Sandstone	
	?28.4	531-544	VII: Basement, volcanic	
1198				
	0.06	0-62	IA: Wackestone/ Grainstone	200
	1.0	62-200.6	IB: Mudstone/ Packstone	200
	3.8	200.6-234.0	IIA: Packstone/ Grainstone	200

	8.3	234.0-330.3	IIB: Packstone/ Grainstone	200
	12.0	330.3-397.6	IIC: Grainstone/ Packstone	200
	15.5	397.6-455.2	IIIA: Mudstone/ Packstone	200
	17.1	455.2-503.6	IIIB: Packstone/ Grainstone	200
	18.5	503.6-513.2	IV: Floatsone/ Rudstone	200
	18.8	513.2-522.6	V: Basalt	150-200


0°
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50Ma
-1500
-1000
-500
0
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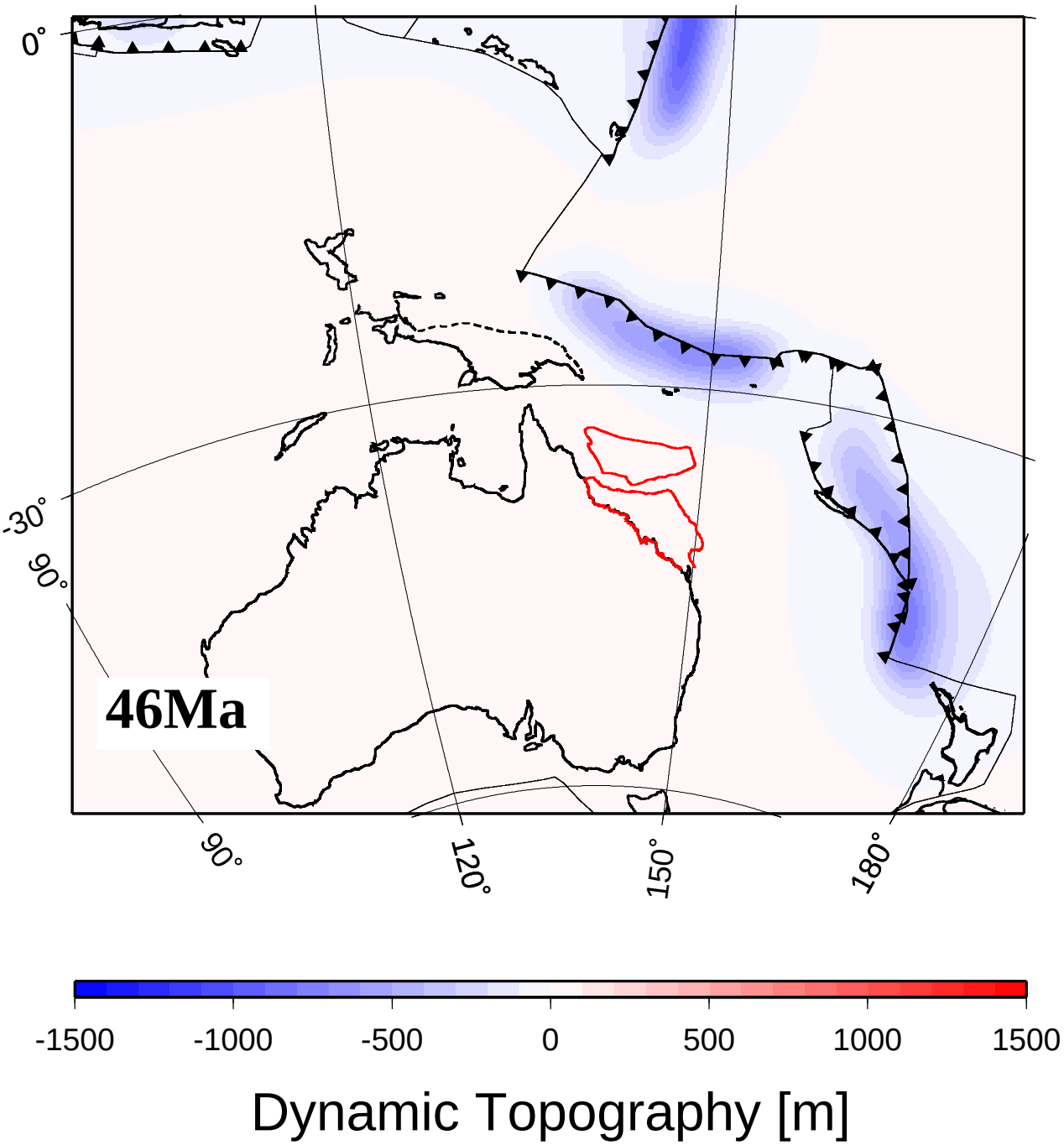
1500
Dynamic Topography [m]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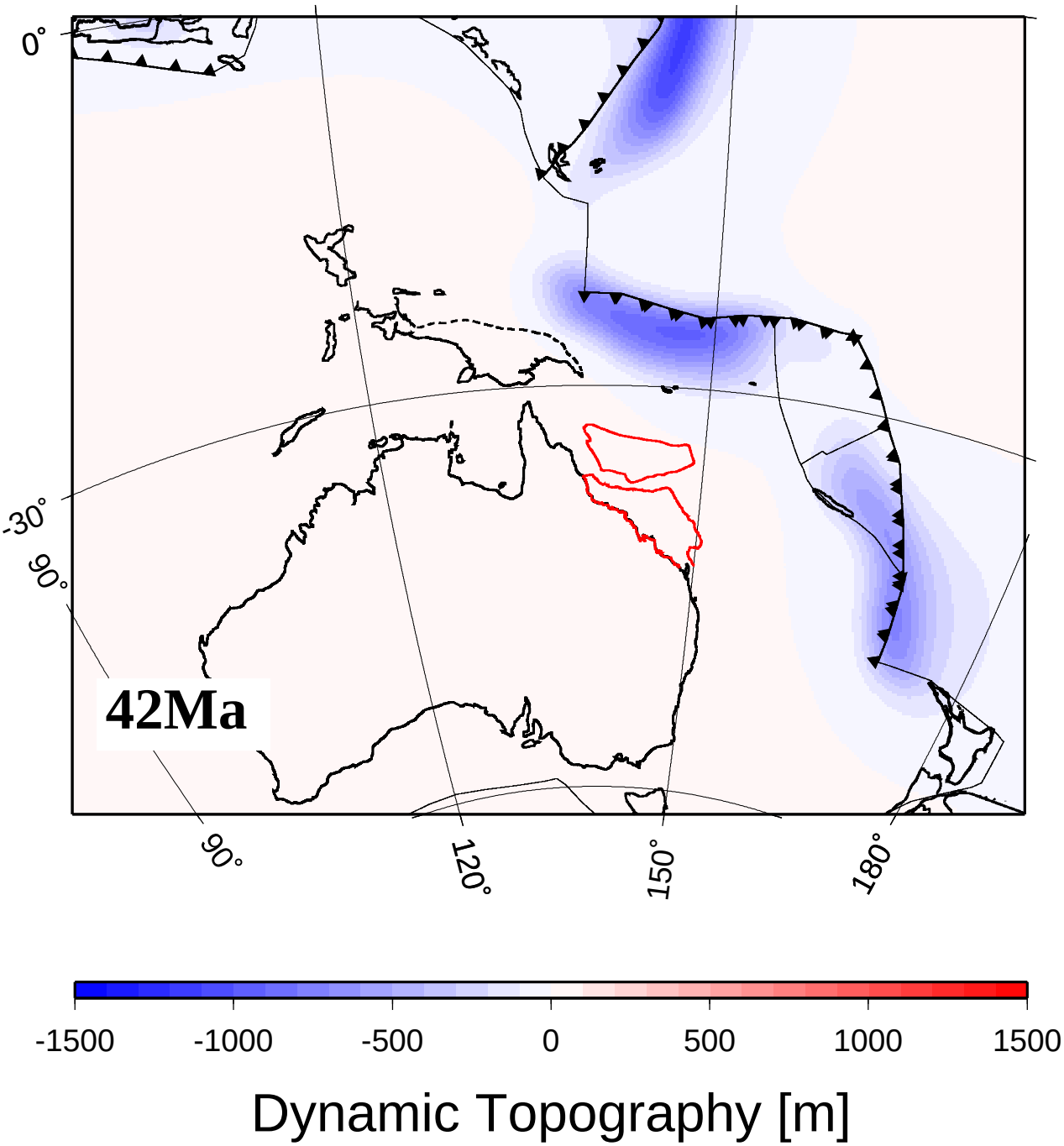
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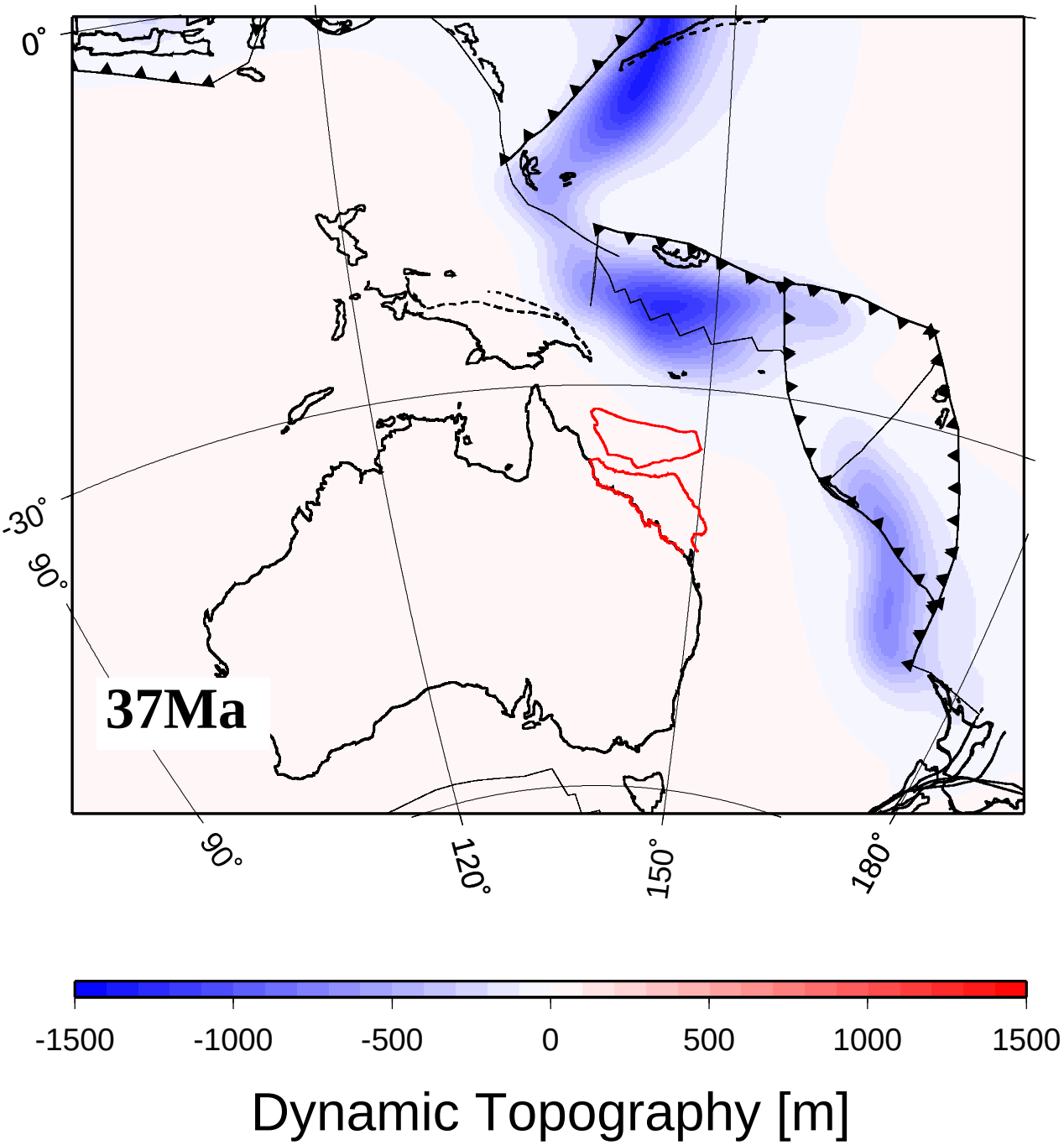
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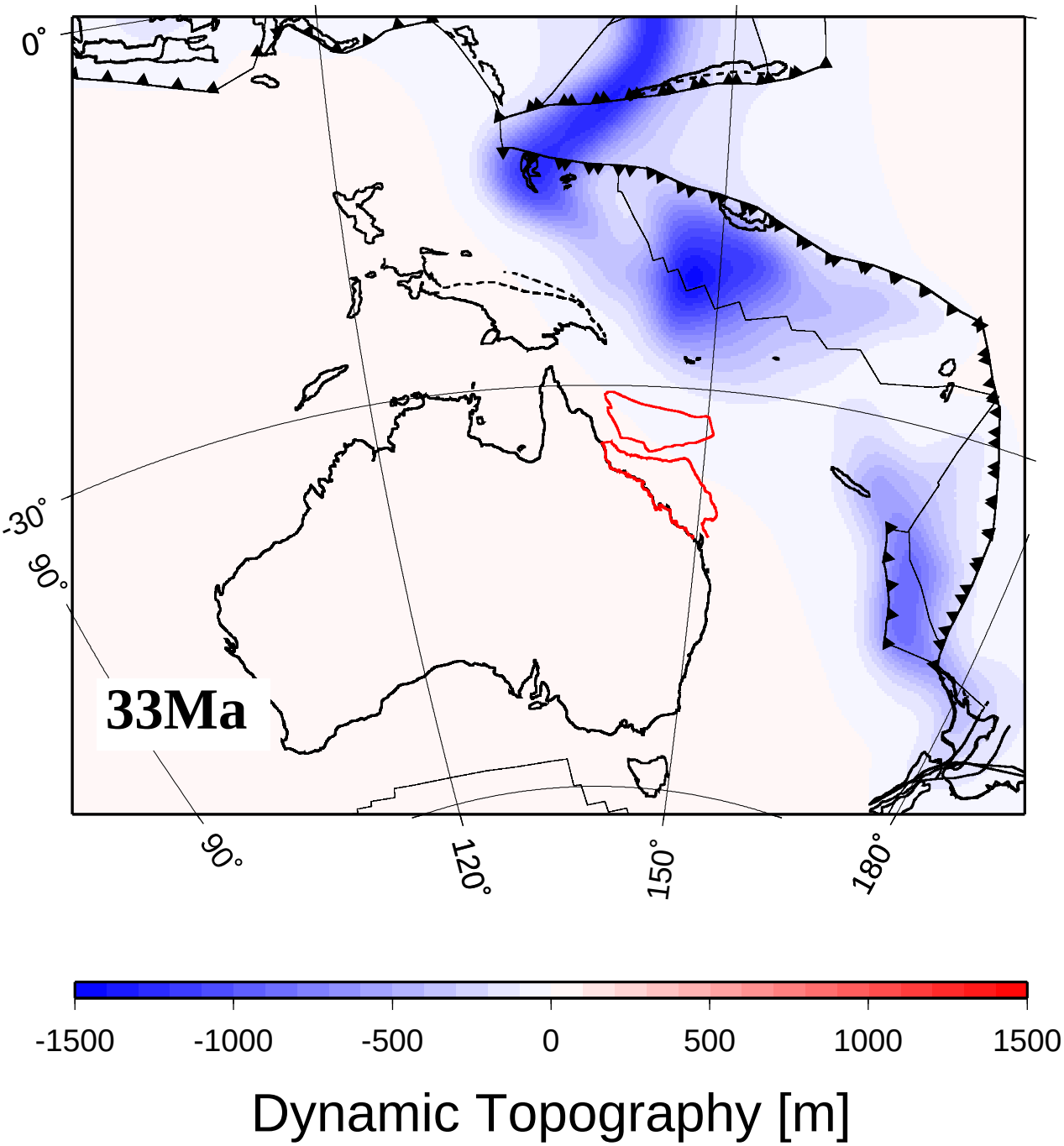
Dynamic Topography [m]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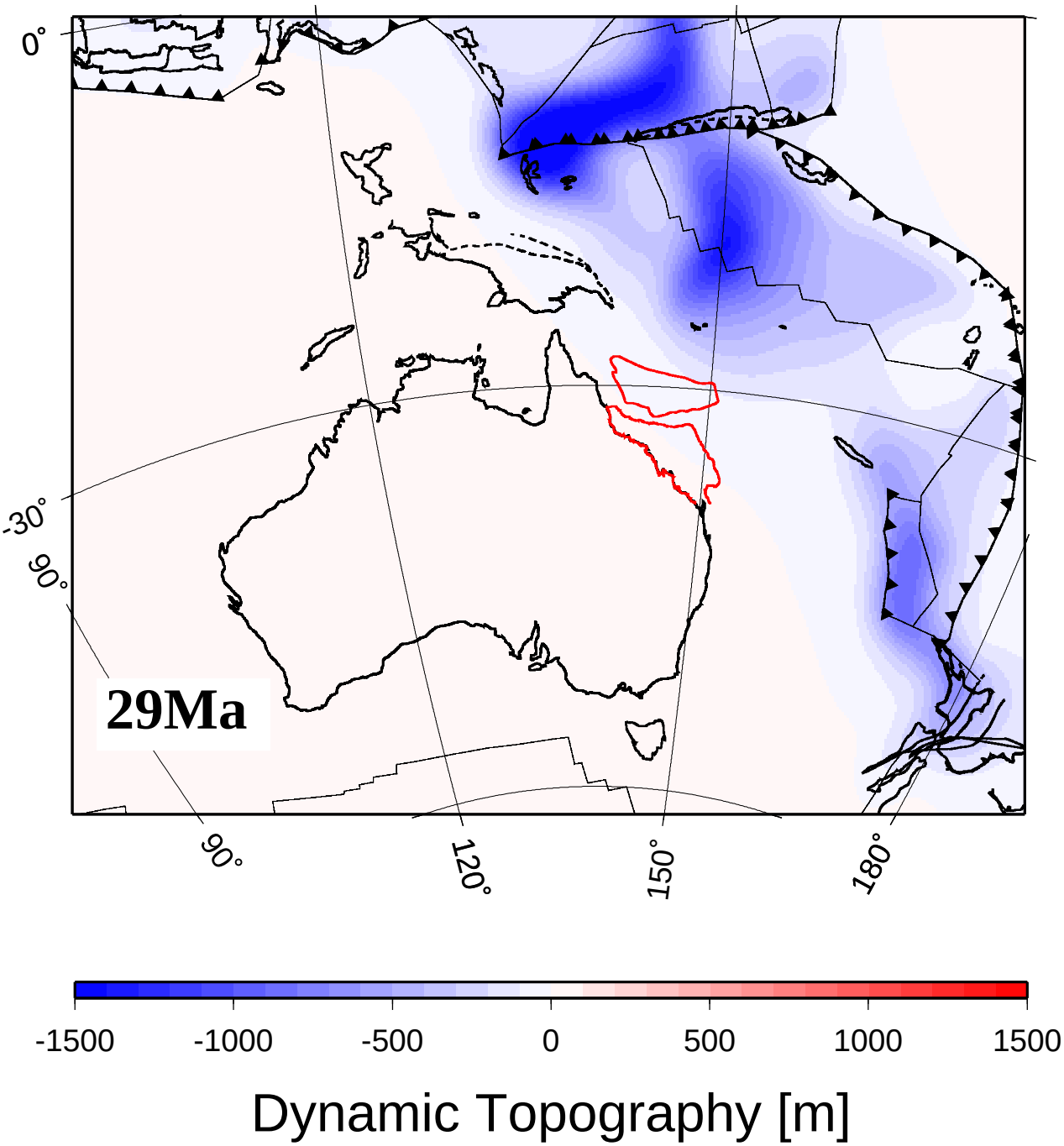
Dynamic Topography [m]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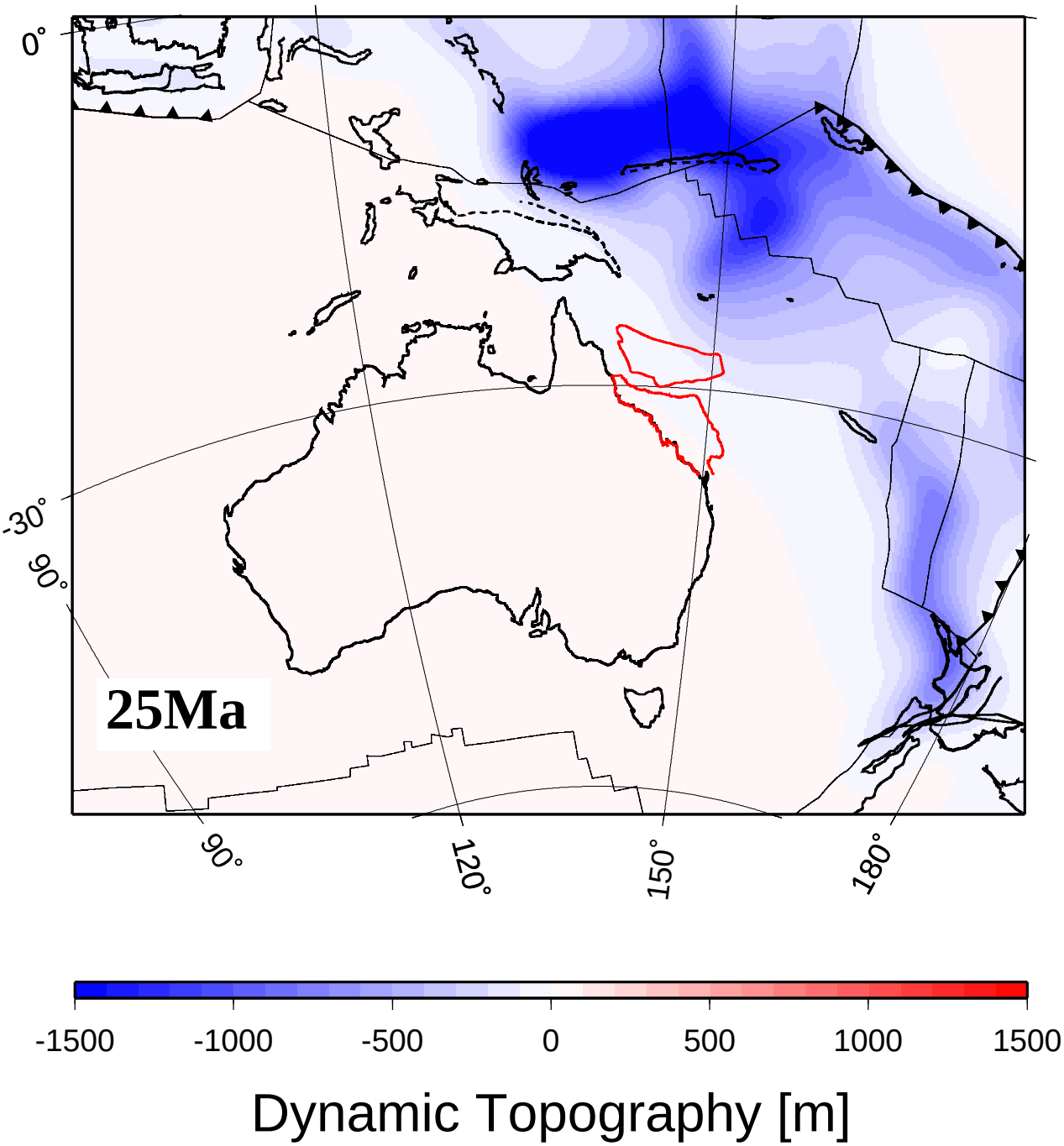
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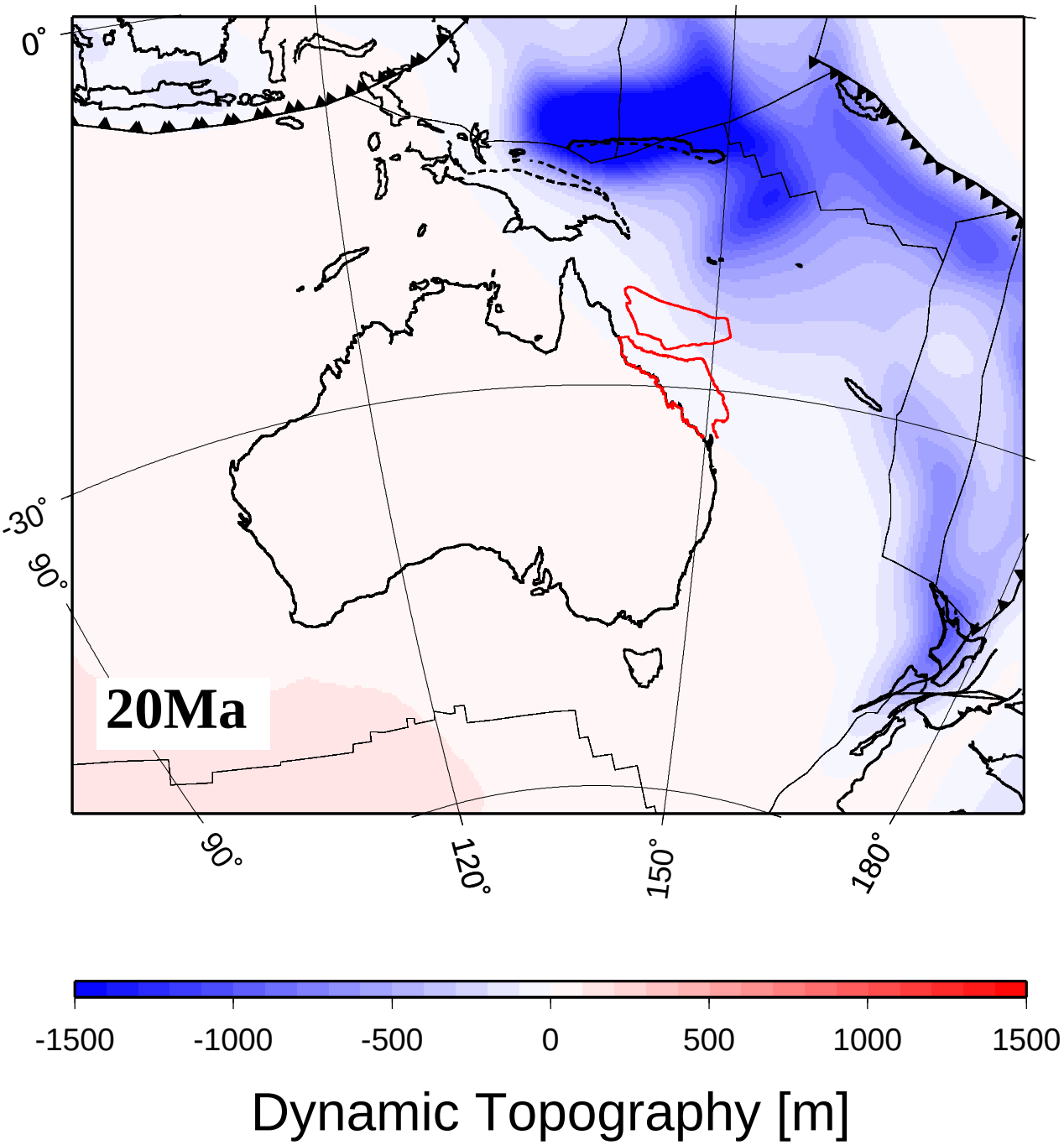
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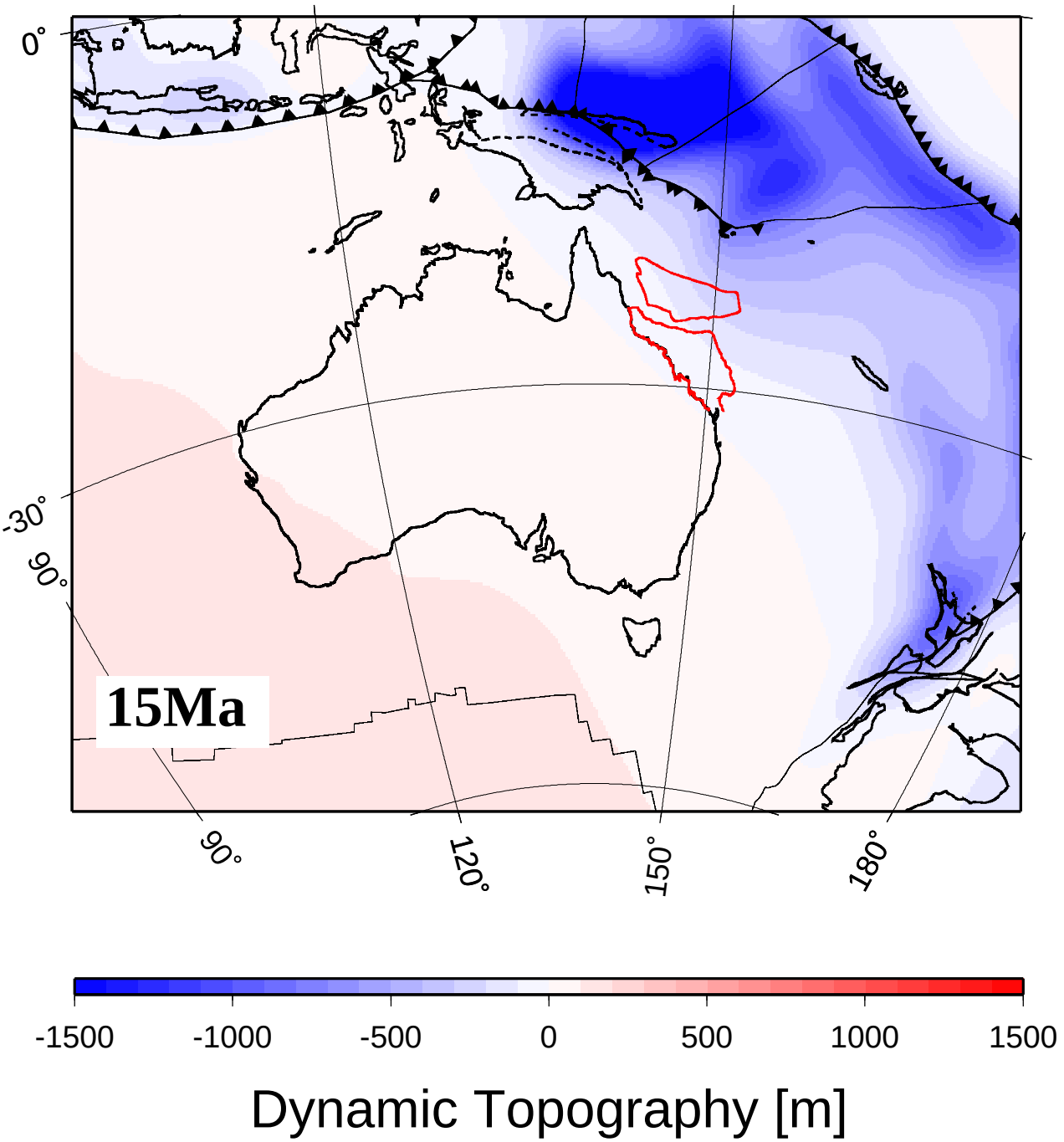
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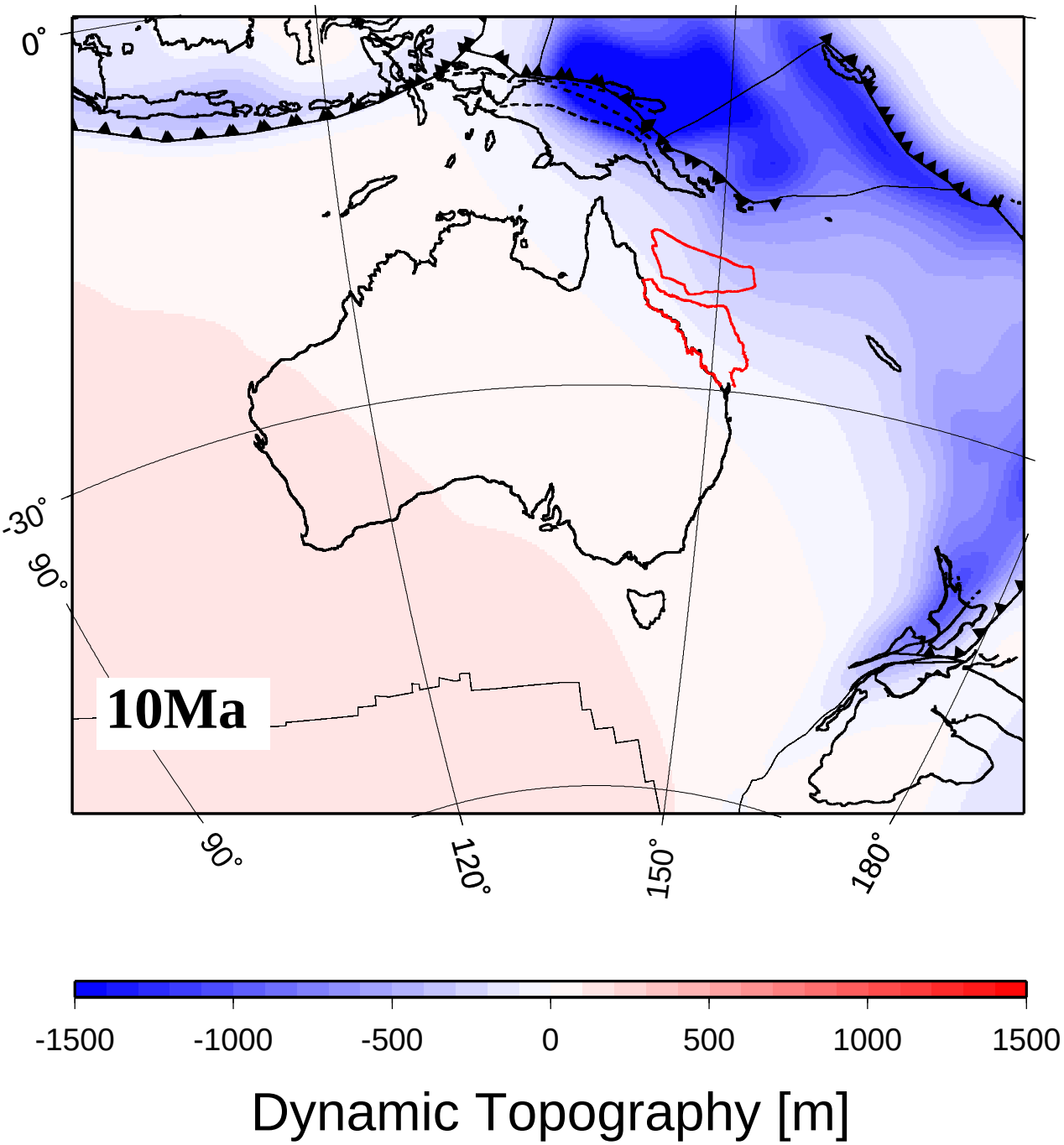
Dynamic Topography [m]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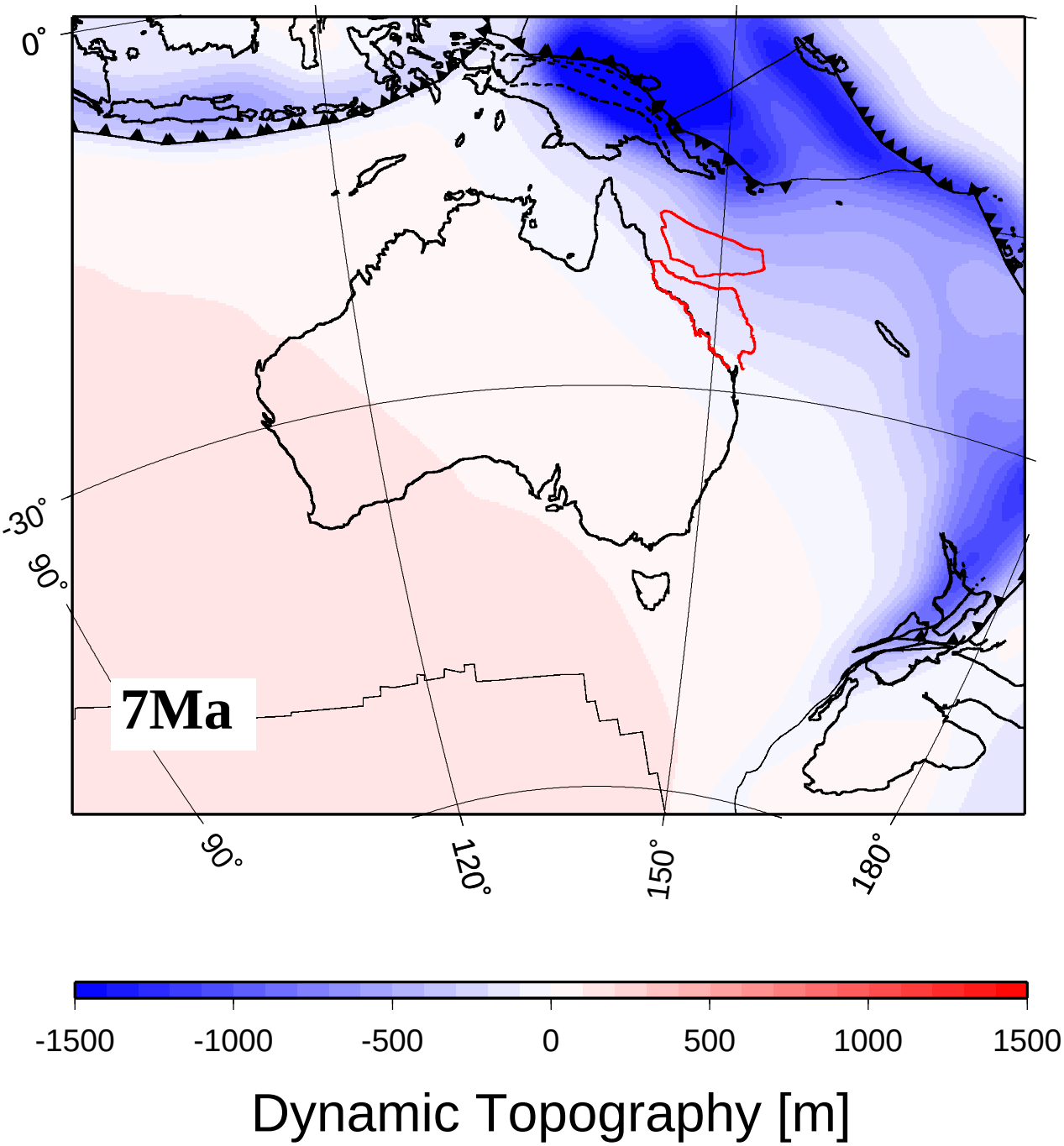
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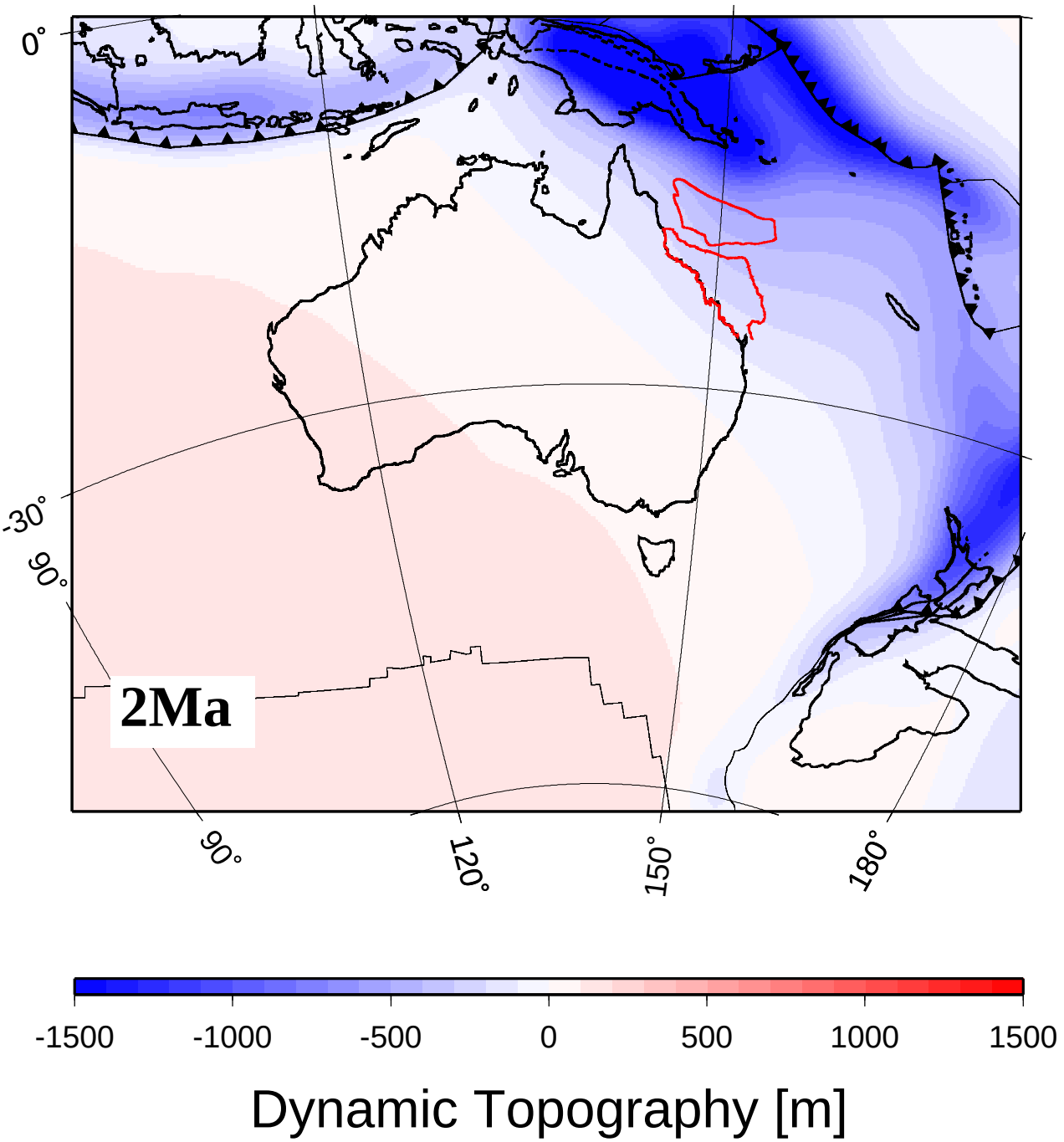
Dynamic Topography [m]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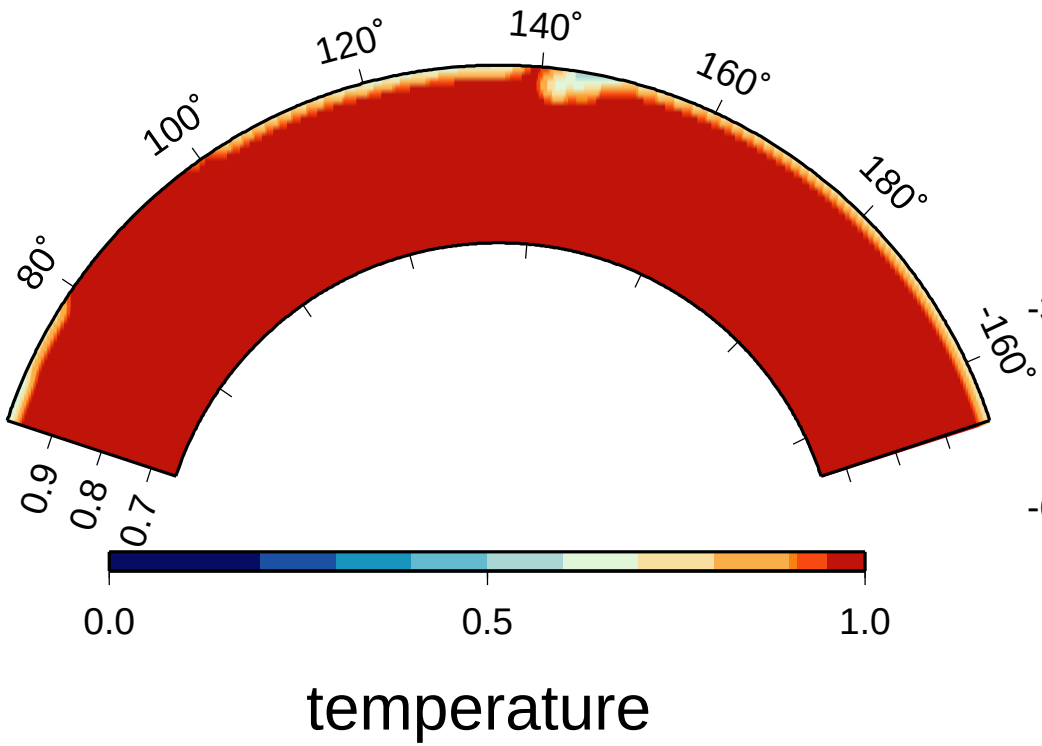
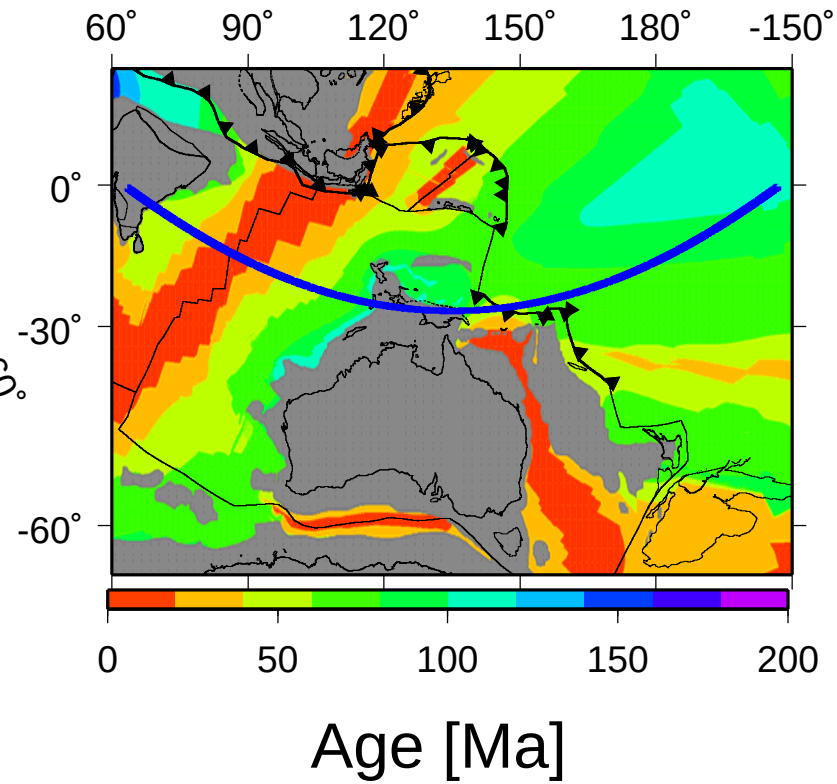
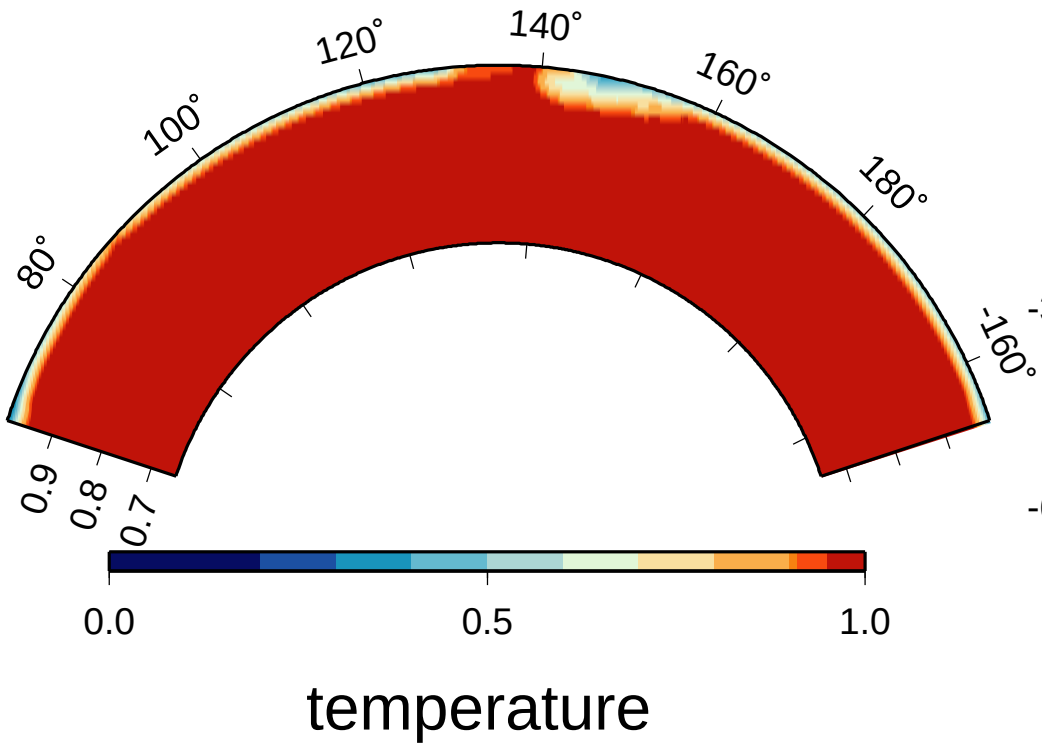
Dynamic Topography [m]

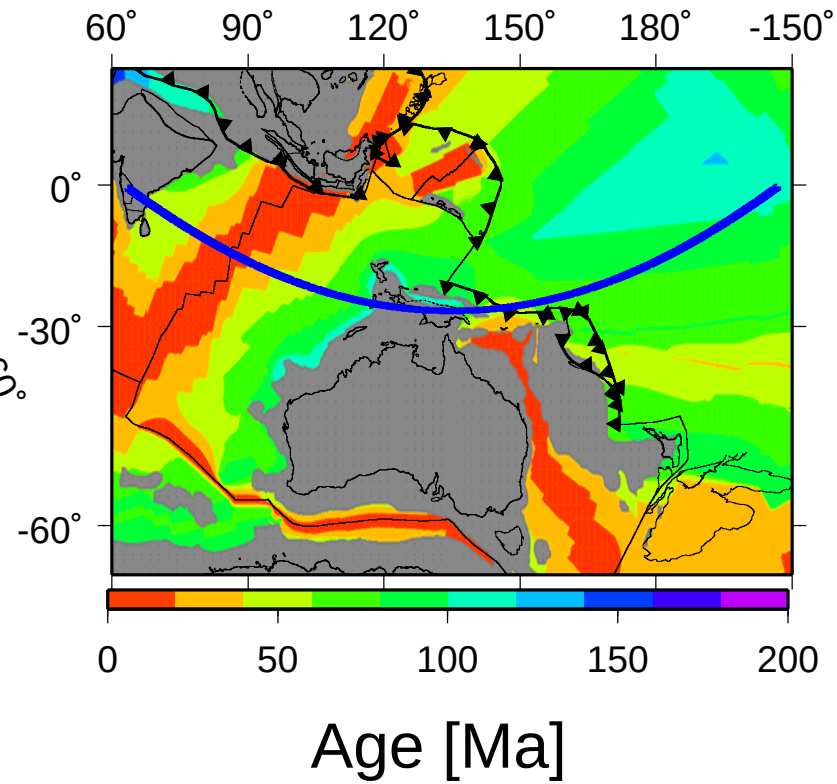
Temperature slice at 50 Ma



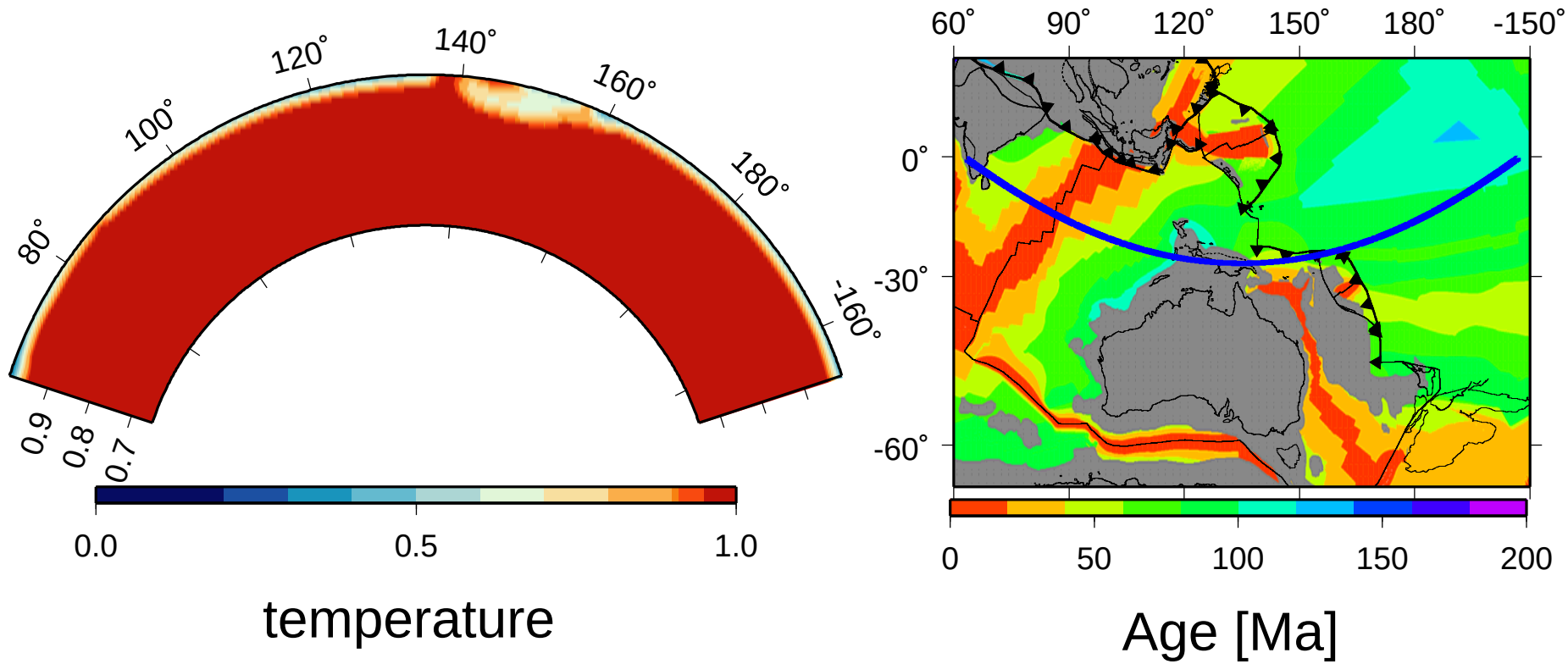


Temperature slice at 46 Ma

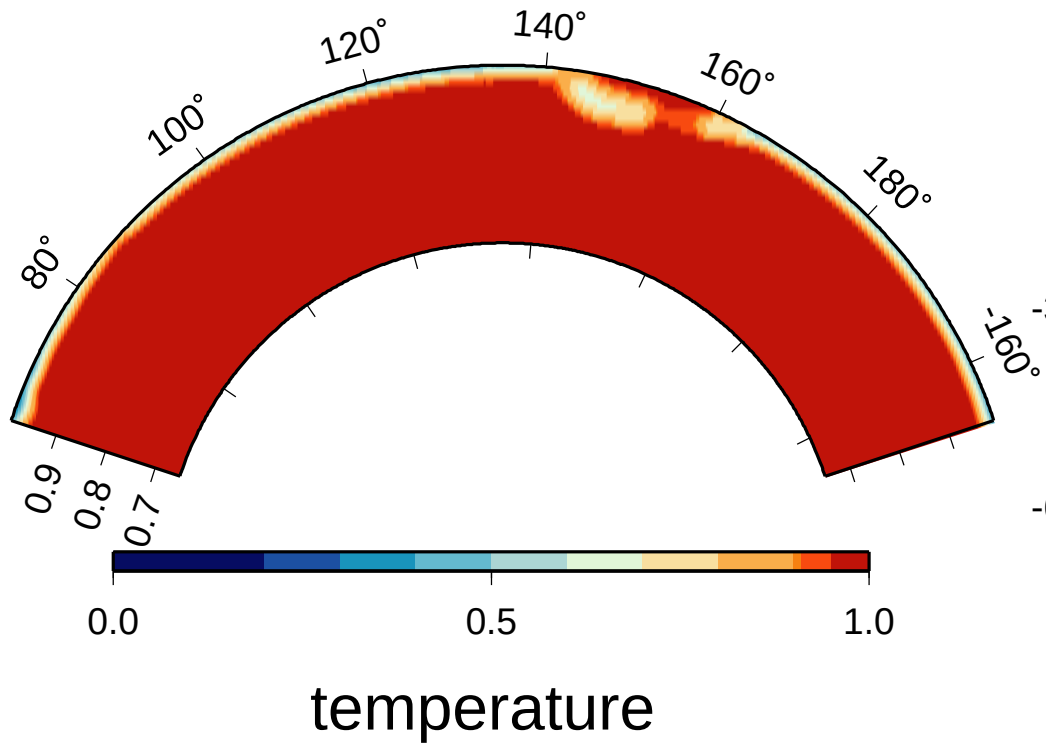


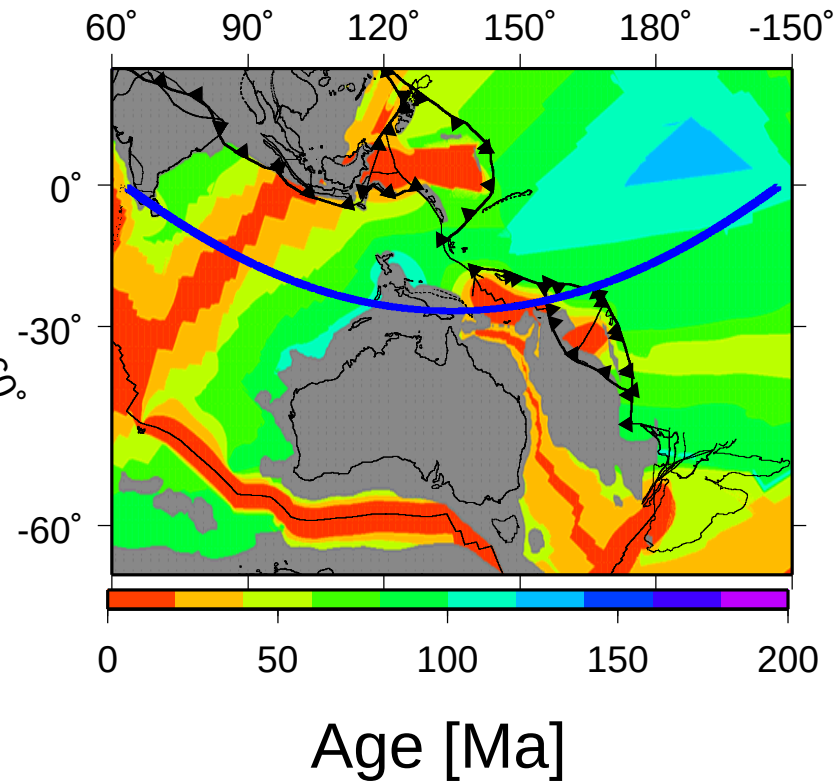


Temperature slice at 42 Ma

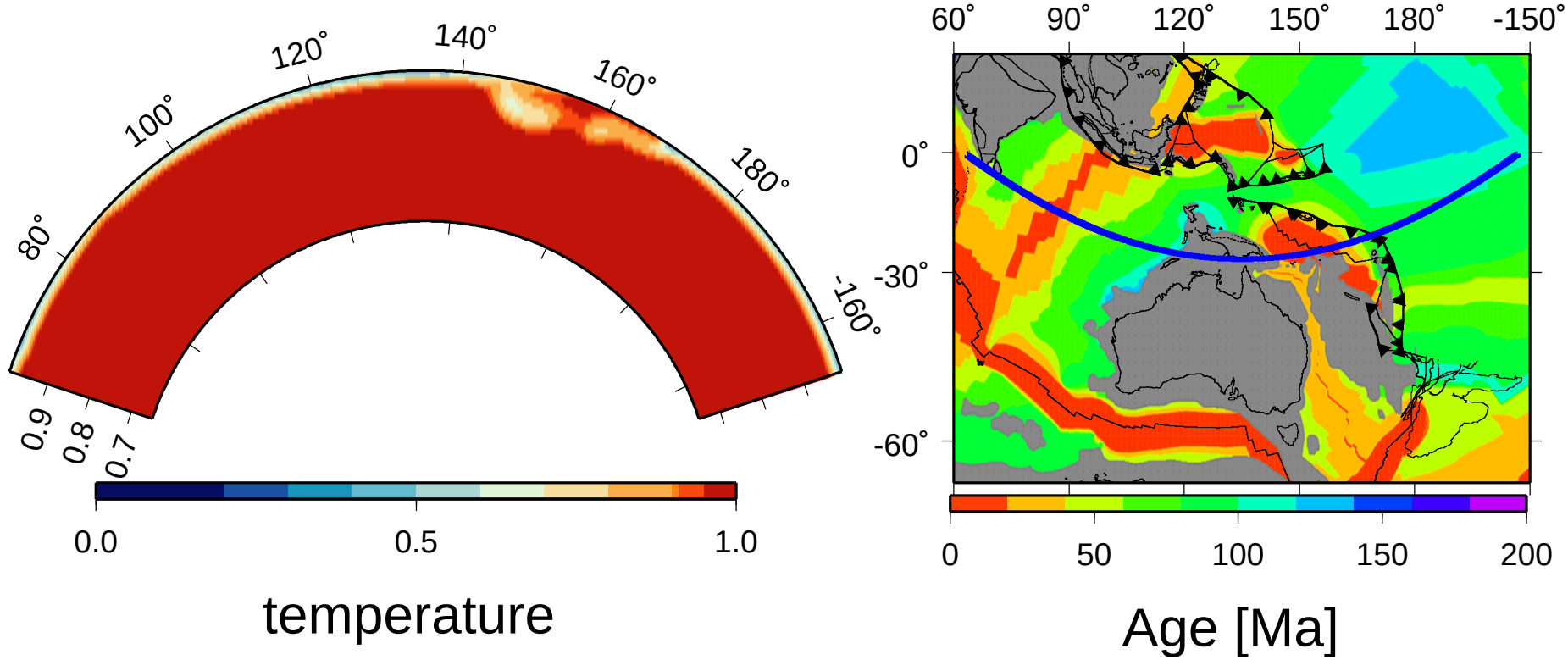


Temperature slice at 37 Ma

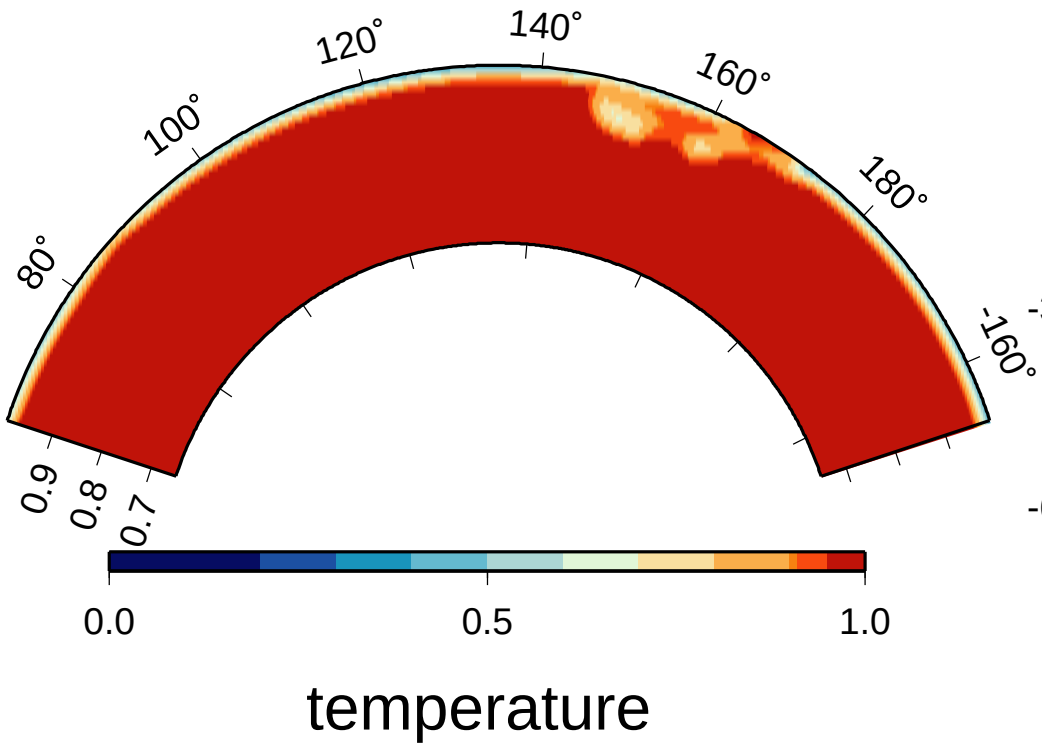


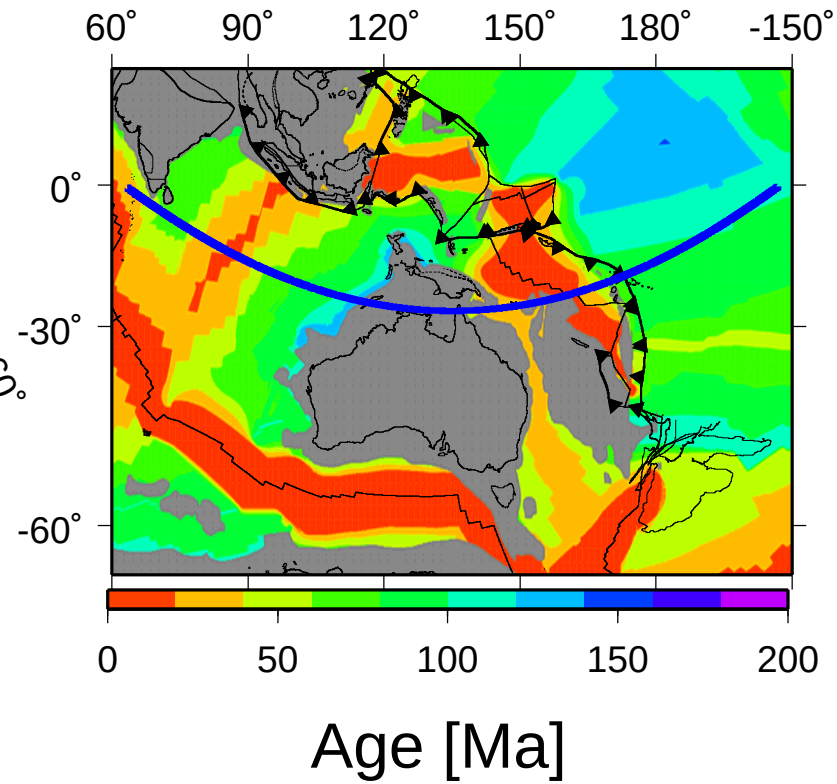


Temperature slice at 33 Ma

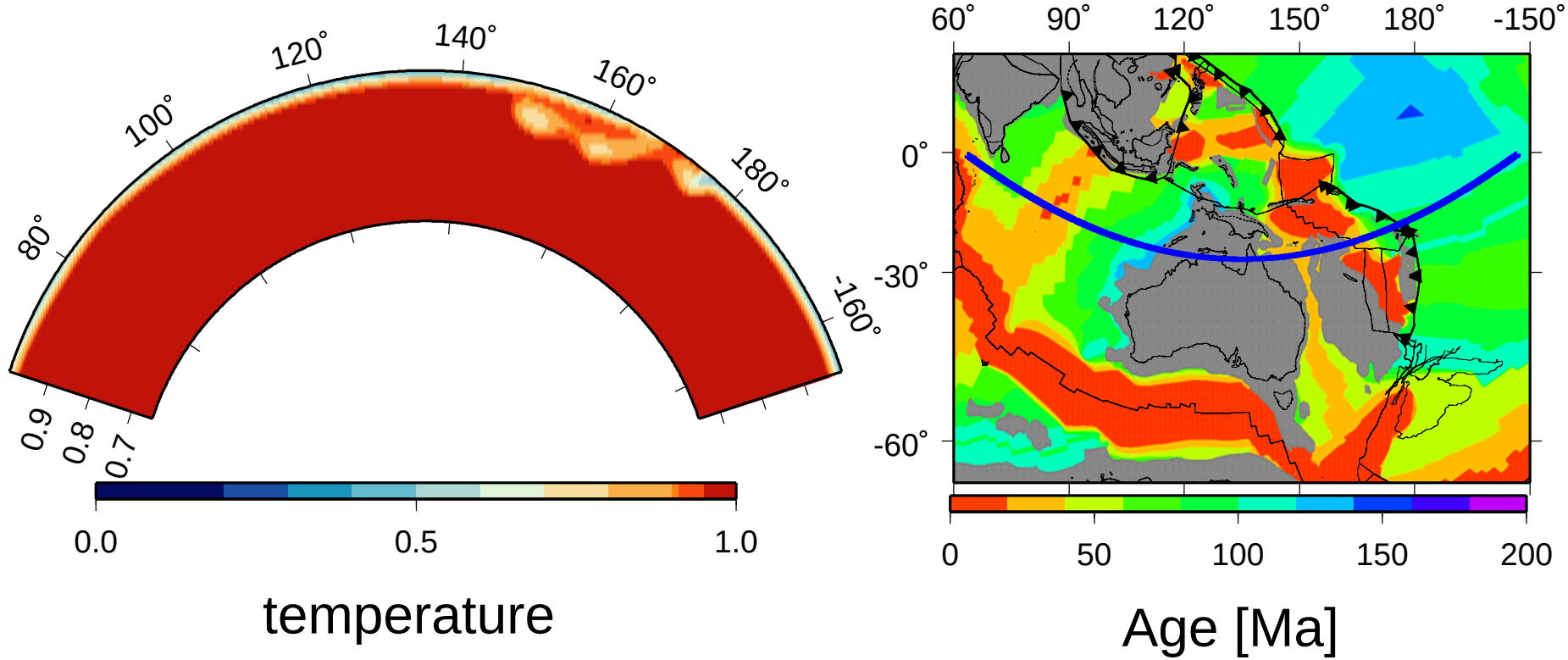


Temperature slice at 29 Ma

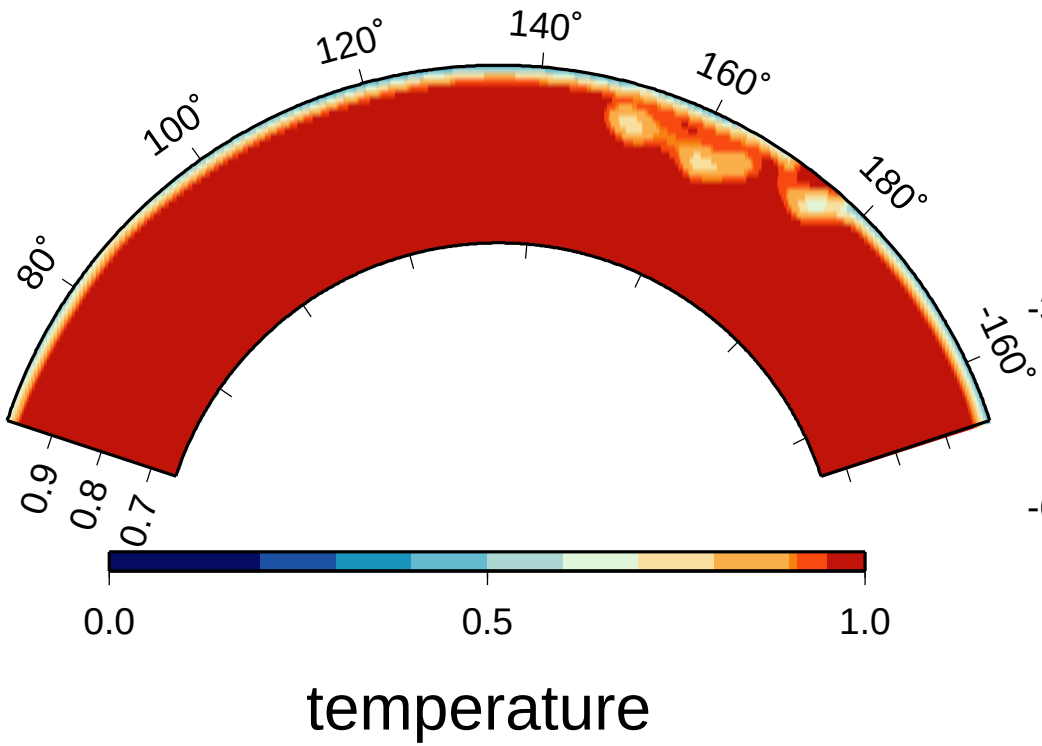


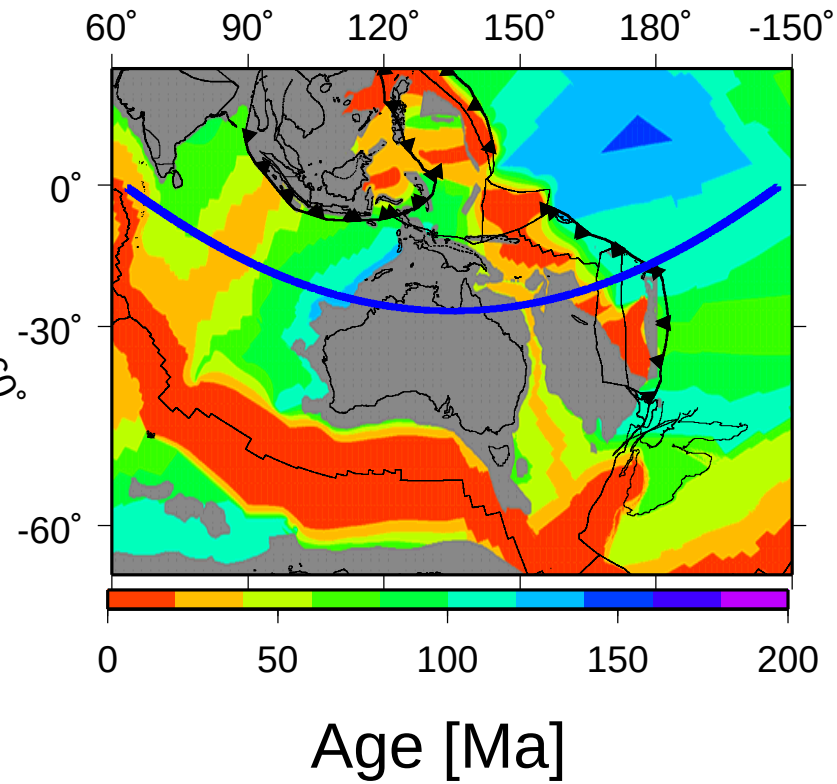


Temperature slice at 25 Ma

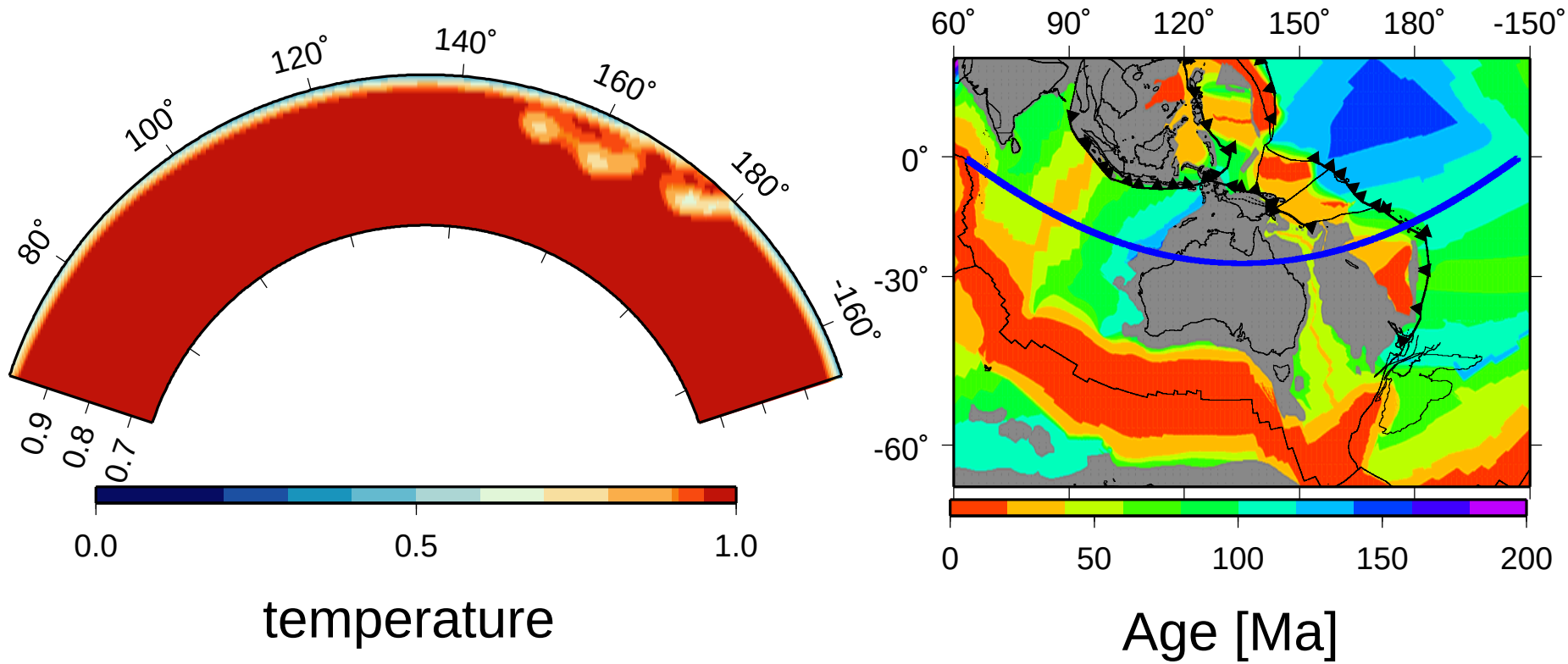


Temperature slice at 20 Ma

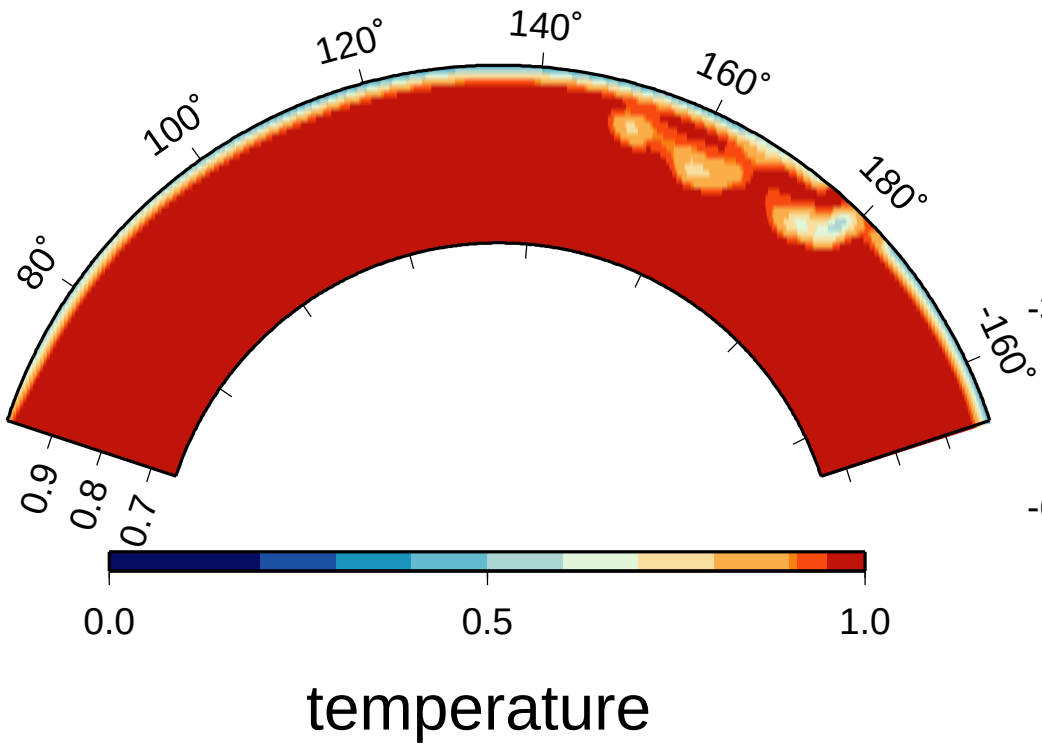


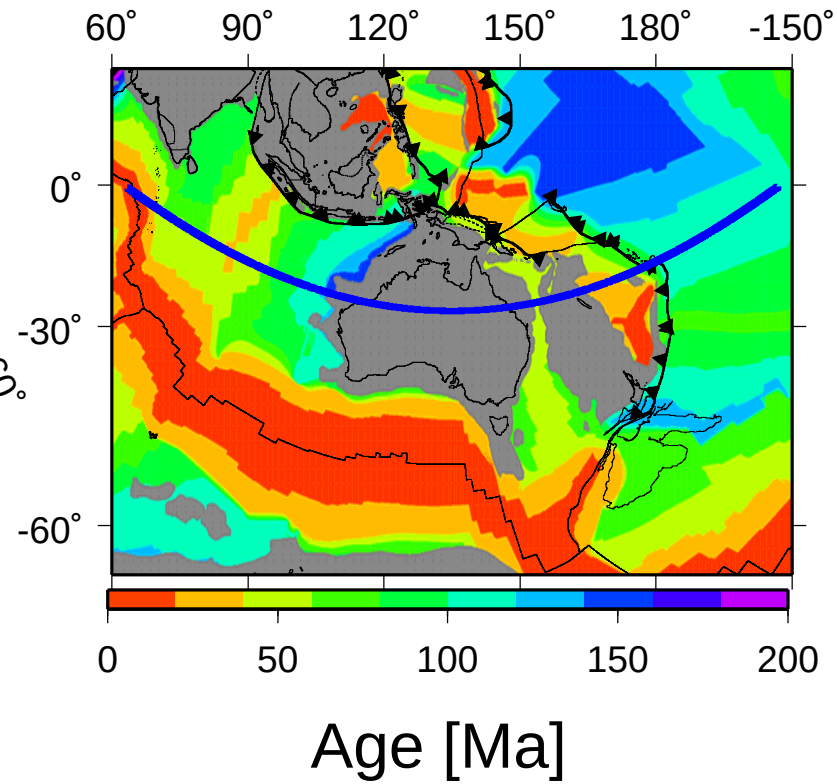


Temperature slice at 15 Ma

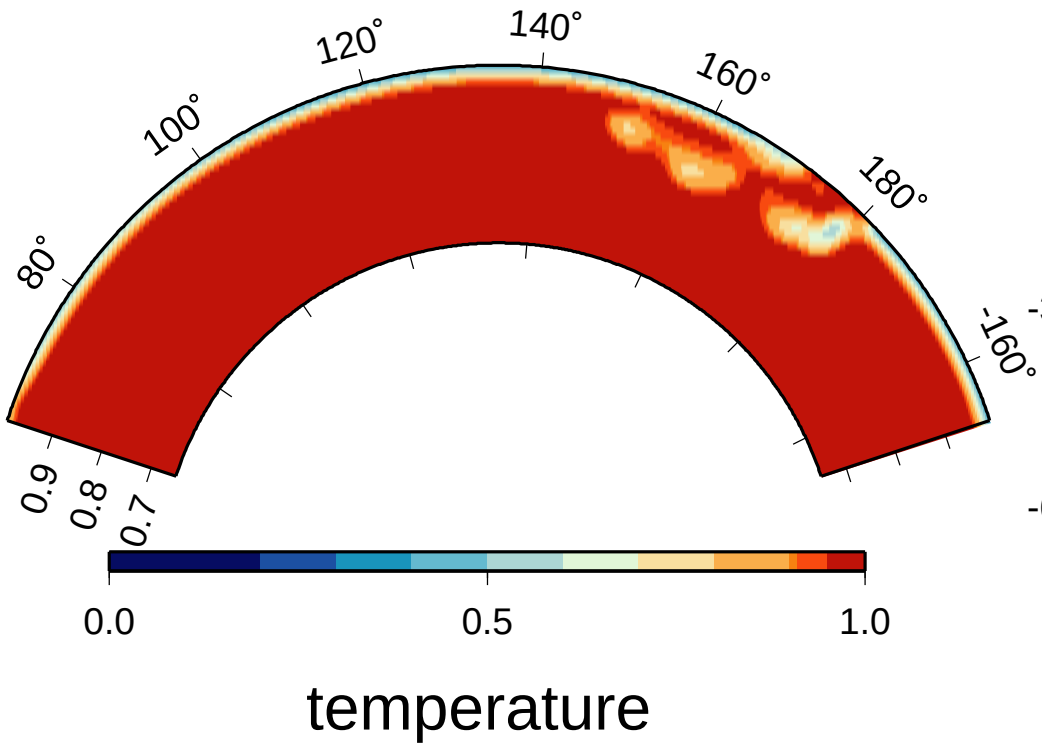


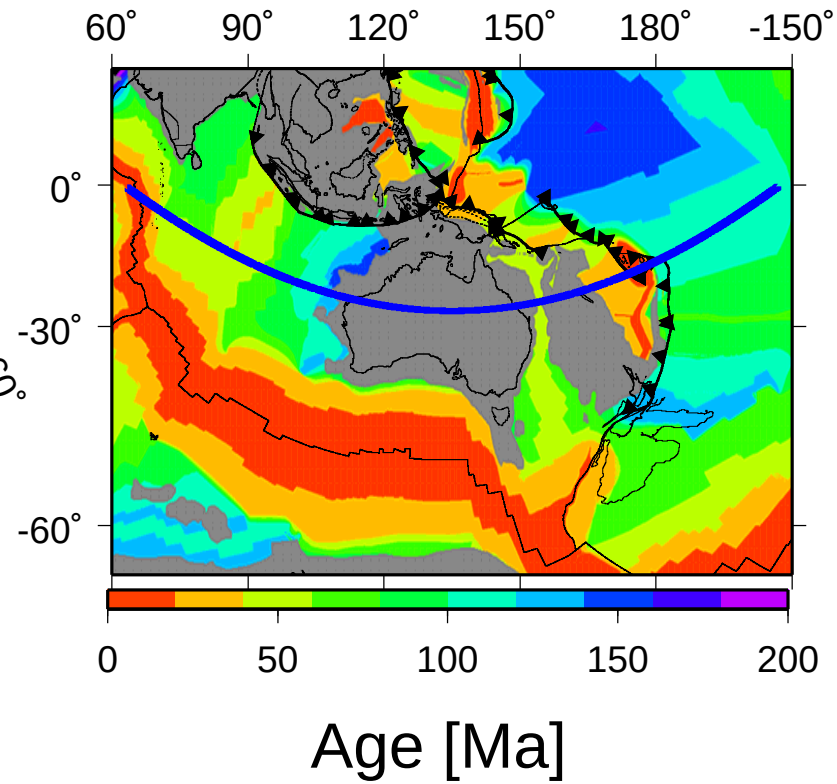
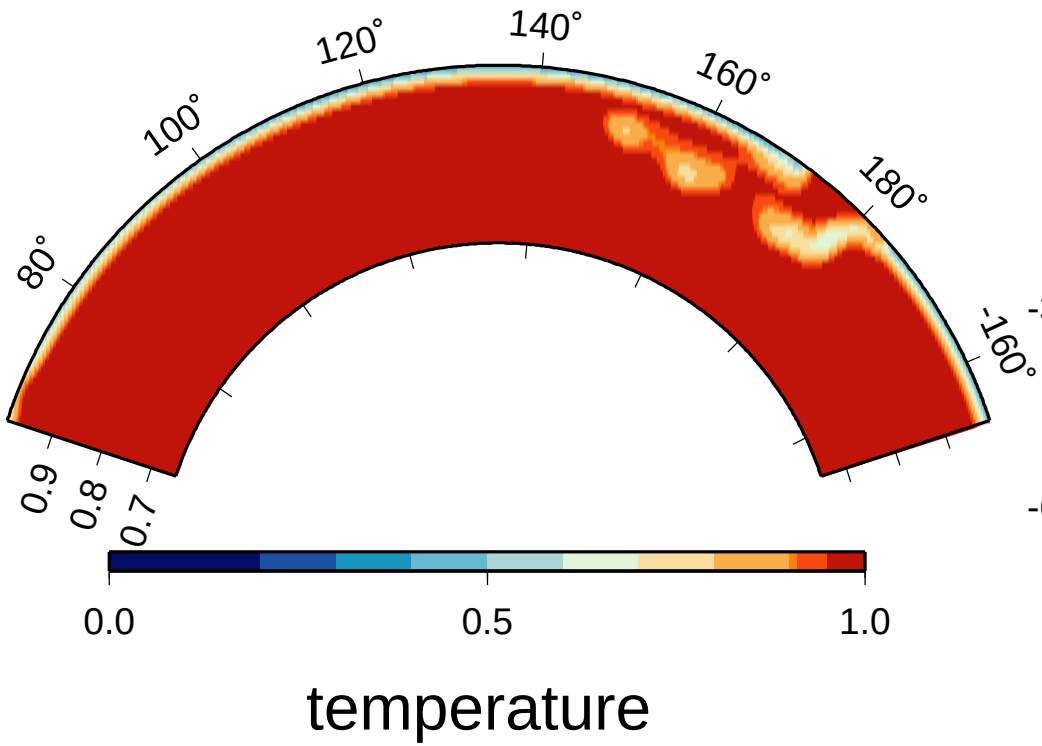
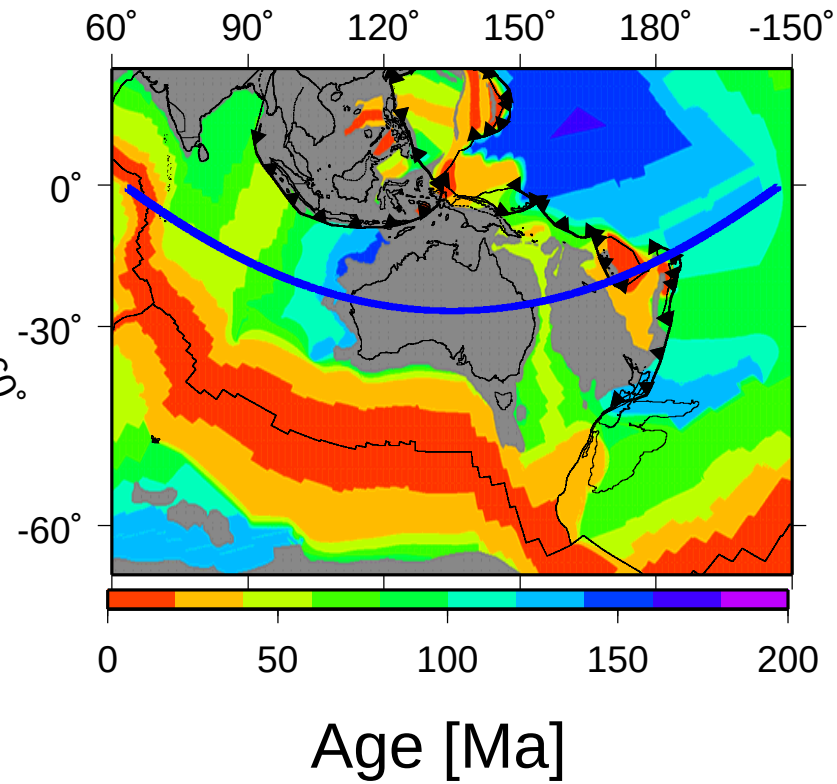
Temperature slice at 10 Ma





Temperature slice at 7 Ma





Temperature slice at 2 Ma