Modelling Thermal Maturity

in an accretionary wedge

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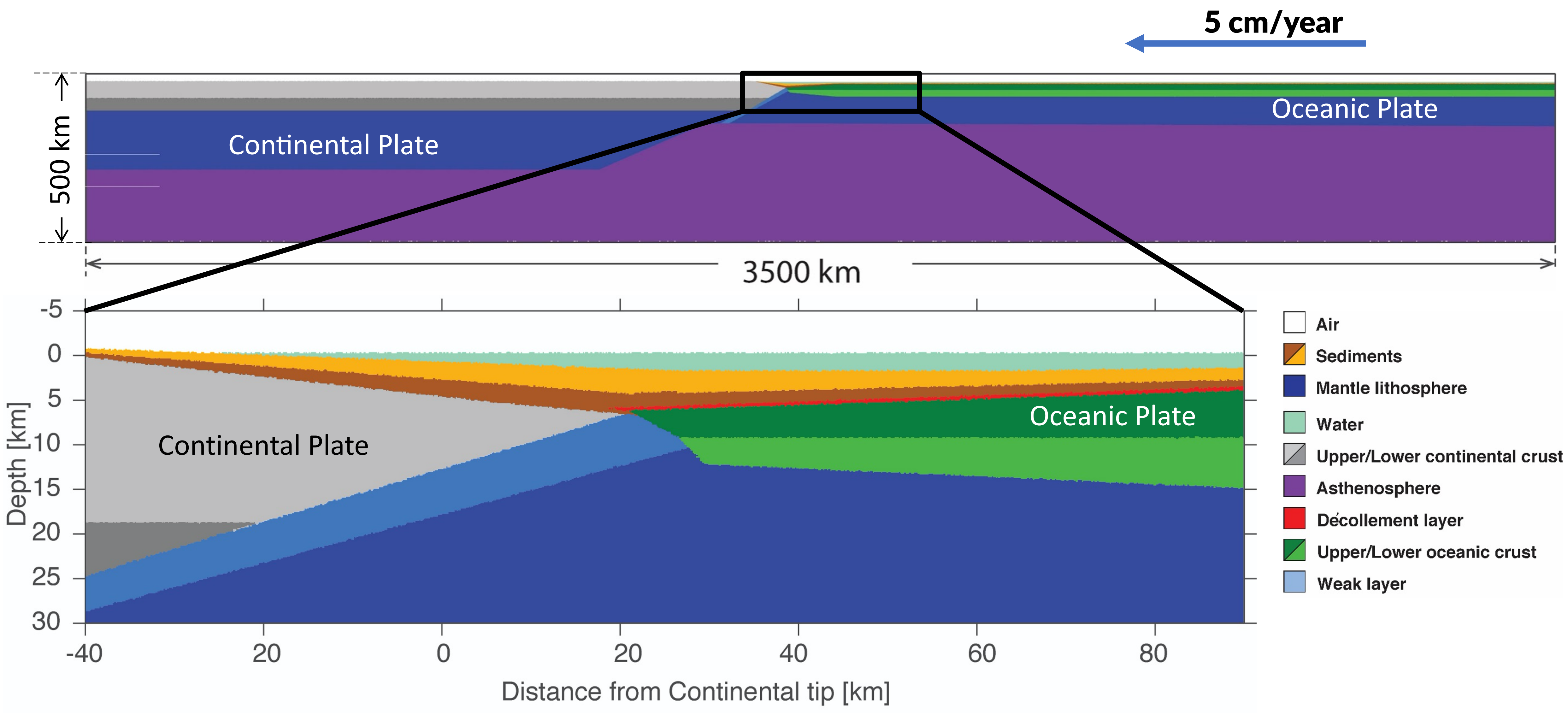
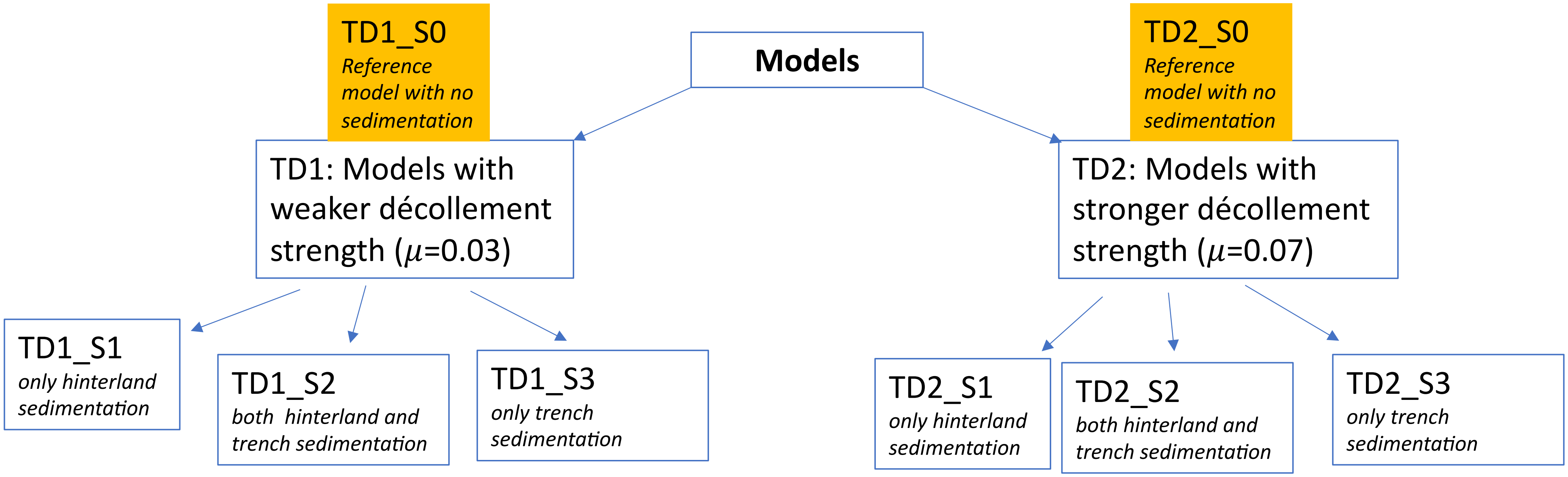


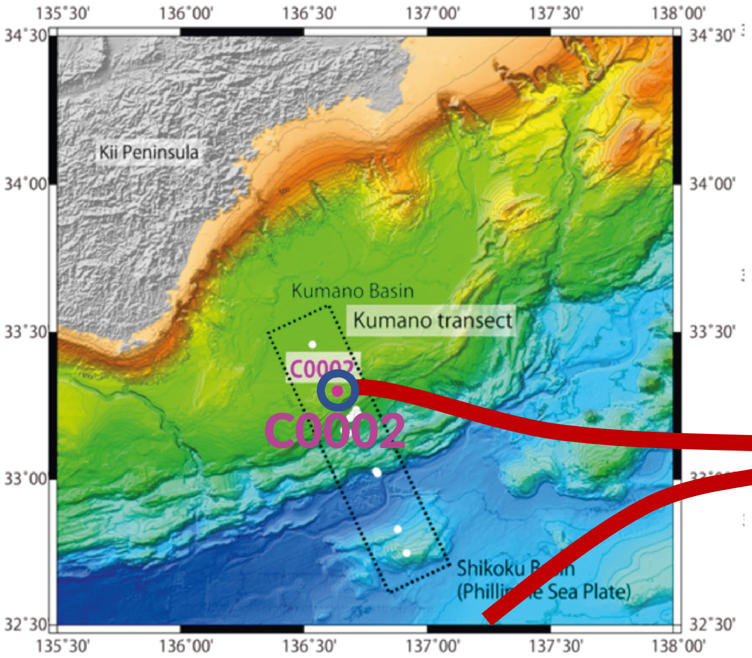
Initial Model Setup



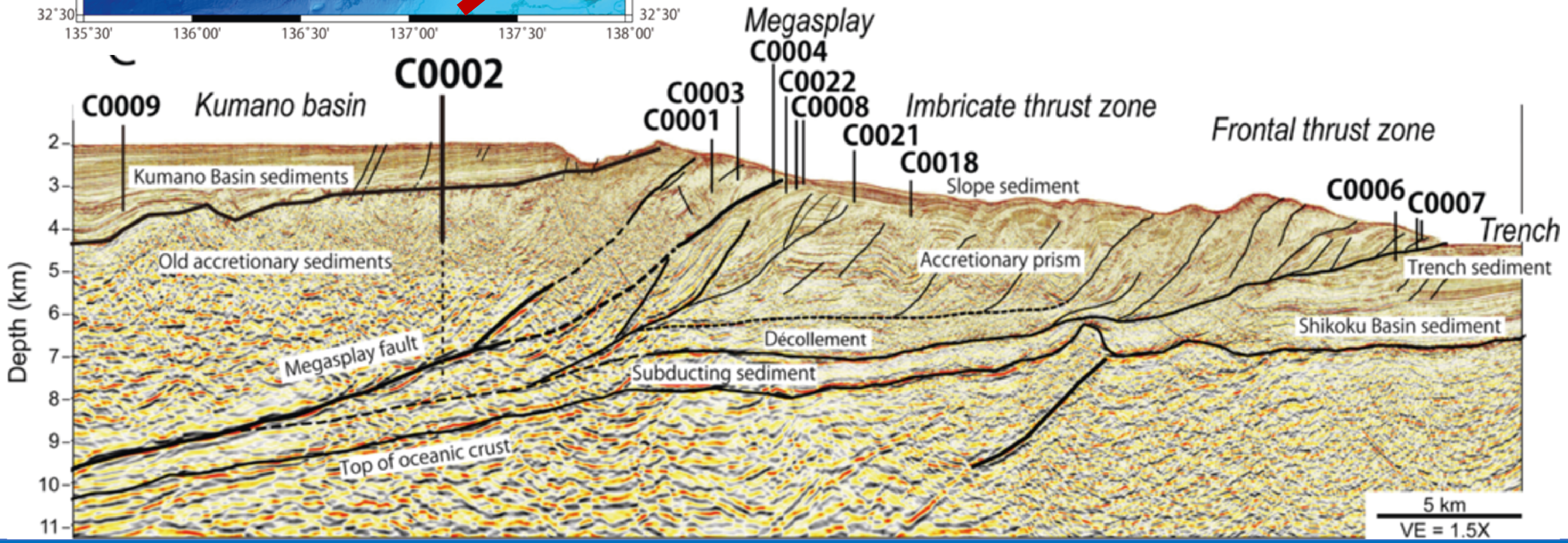
Experimental Strategy: Model runs

Models	Incorporated Thermal Conductivity	Décollement Strength (Coefficient of friction)	Sedimentation
SD1_S0	×	0.03	None
TD1_S0	✓	0.03	None
TD1_S1	✓	0.03	Hinterland(15km^3/Myr)
TD1_S2	✓	0.03	Hinterland(7.5km^3/Myr); Trench(7.5km^3/Myr)
TD1_S2	✓	0.03	Trench(15km^3/Myr)
TD2_S0	✓	0.07	None
TD2_S1	✓	0.07	Hinterland(15km^3/Myr)
TD2_S2	✓	0.07	Hinterland(7.5km^3/Myr); Trench(7.5km^3/Myr)
TD2_S2	✓	0.07	Trench(15km^3/Myr)

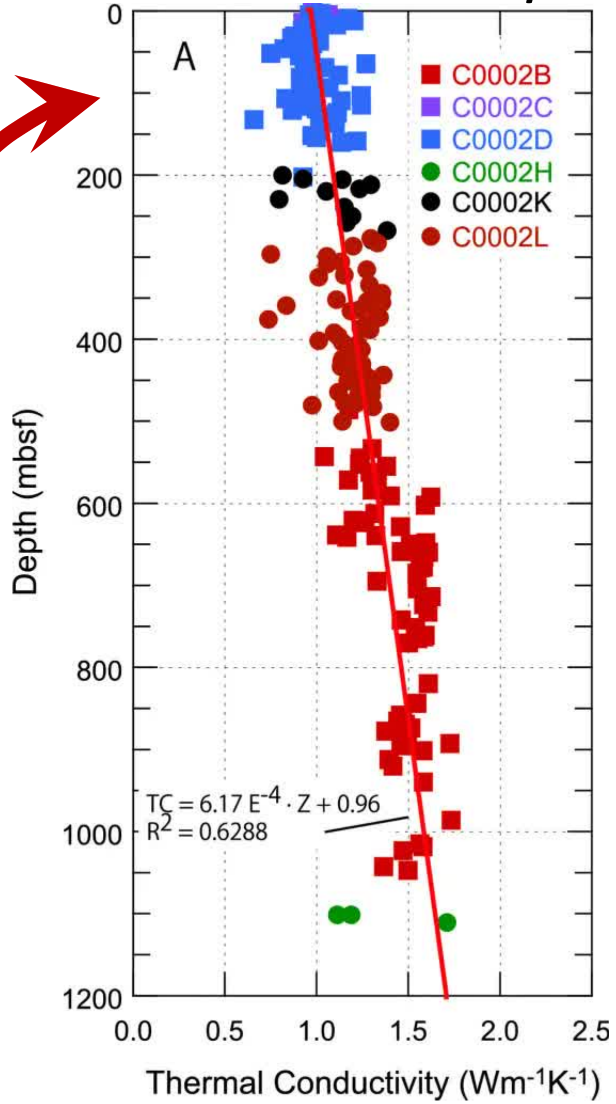
Experimental Strategy: All Model runs



Thermal Conductivity values for borehole C0002

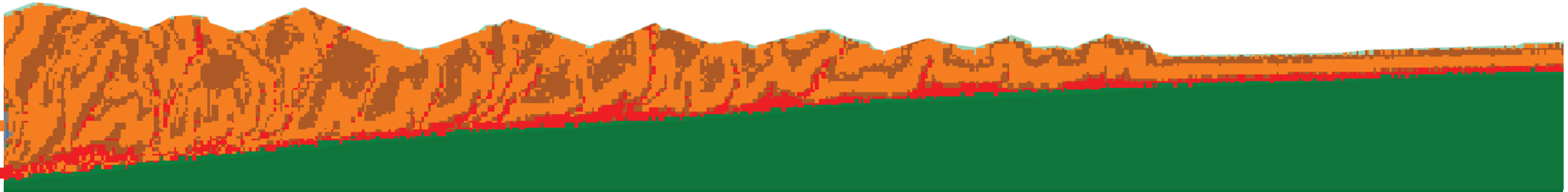


In situ thermal conductivity measured on core samples.



Thermal Conductivity in Nankai Accretionary Wedge

Figure modified from Sugihara et. al [2014]



Shallow thermal conductivity regime in Nankai accretionary wedge is

$$TC = 6.17 * 10^{-4} * Z + 0.96,$$

Where, Z is depth from the seabed.

To incorporate thermal conductivity we use a modified thal conductivity for sediments [●/●] in our models as

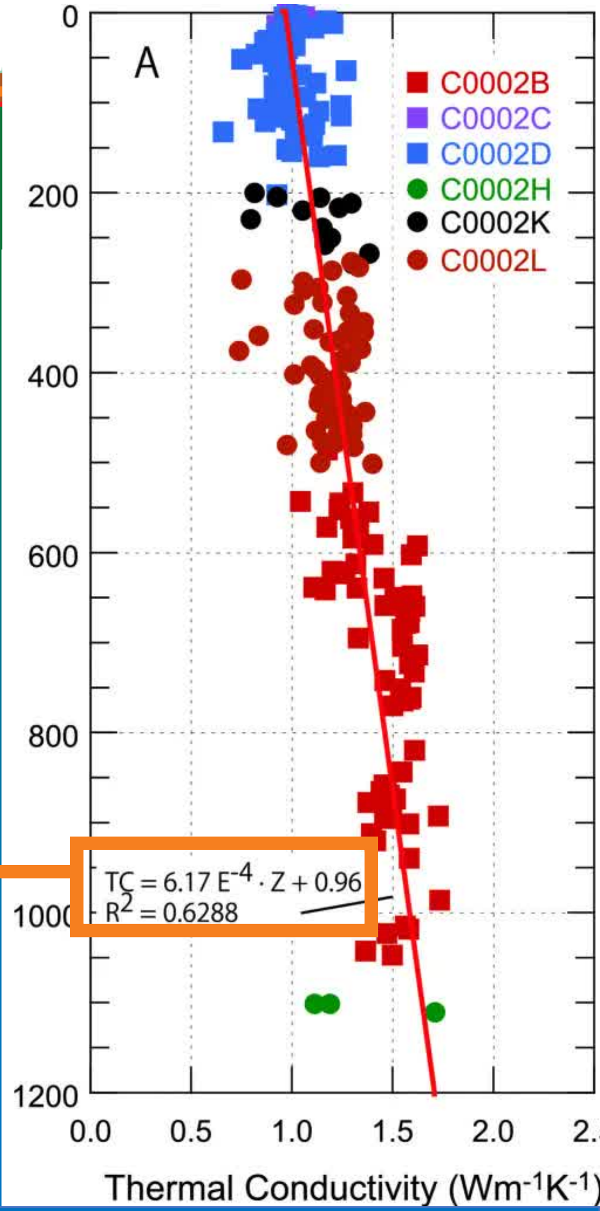
$$TC = 0.96 + (0.64 + 807(T + 77.0)) * exp(KP*P) * (1 - exp(-Z^2/1e7))$$

Where, T is Temperature; KP is specific heat; P is pressure and Z is depth from the seabed.

For Décollement [●] (to incorporate heat transfer by fluid advection)

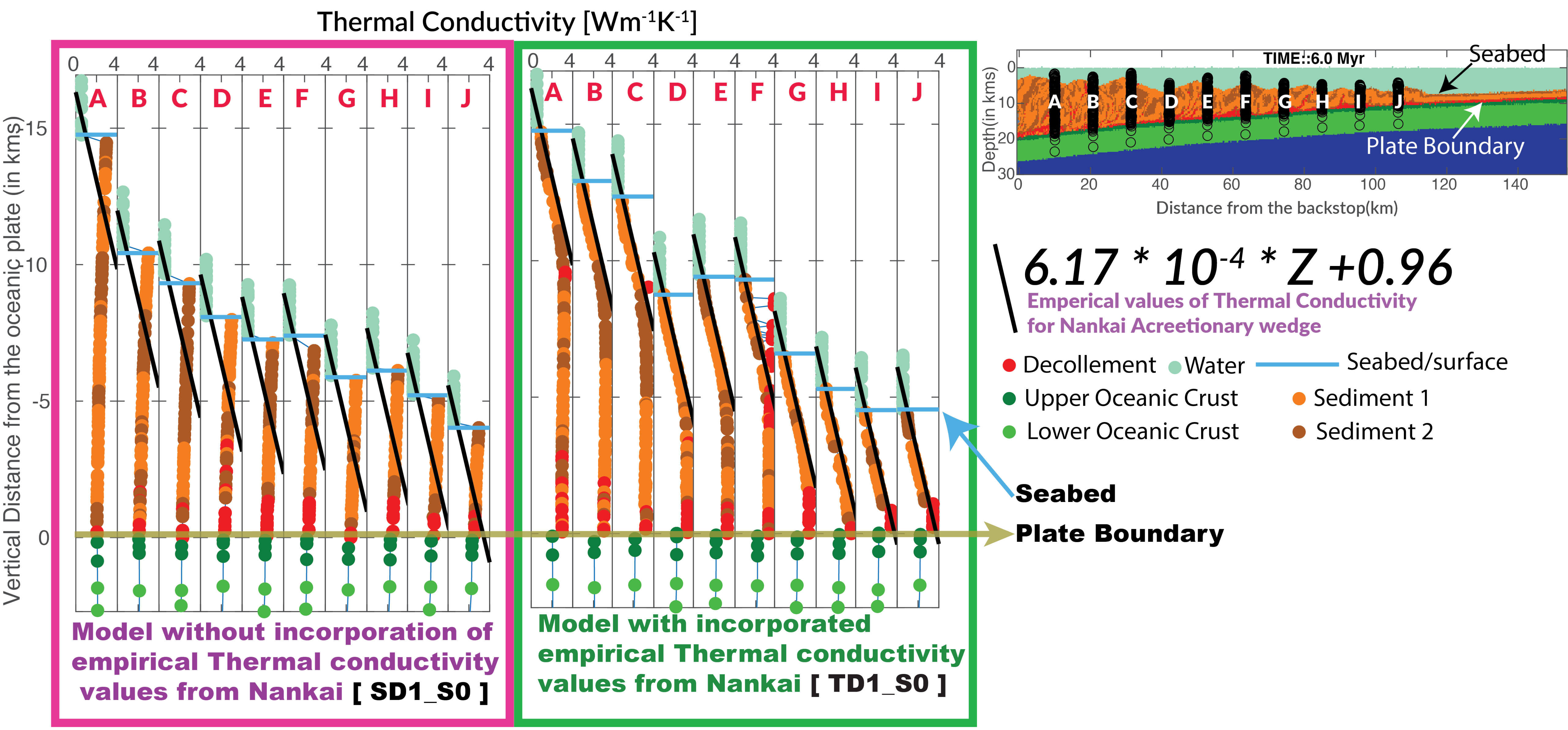
$$TC = 0.96 + (0.64 + 807(T + 77.0)) * exp(KP*P) * (1 - exp(-Z^2/1e4))$$

Where, T is Temperature; KP is specific heat; P is pressure and Z is depth from the seabed.

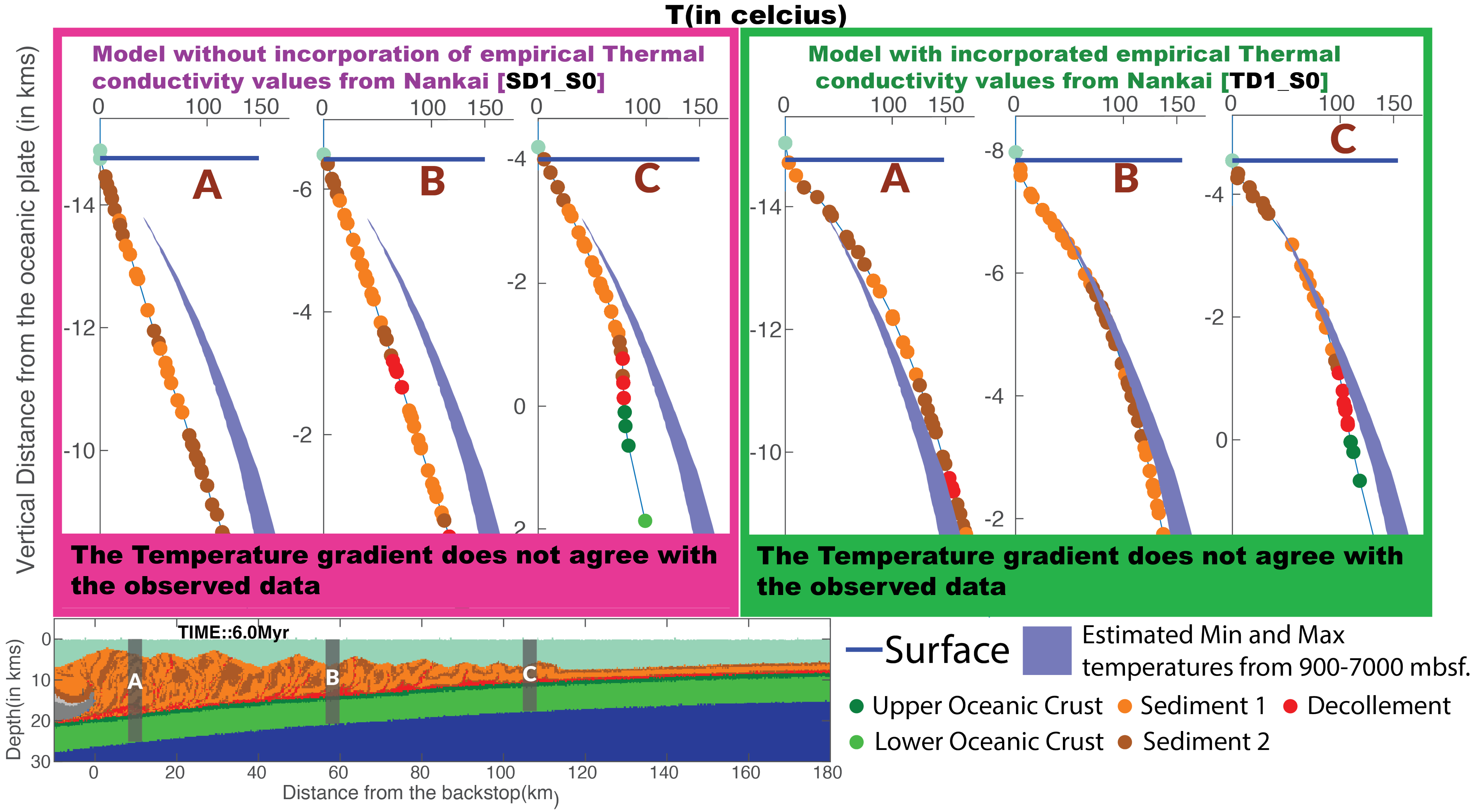


Incorporating Empirical Thermal Conductivity Values from Nankai

Figure modified from Sugihara et. al [2014]

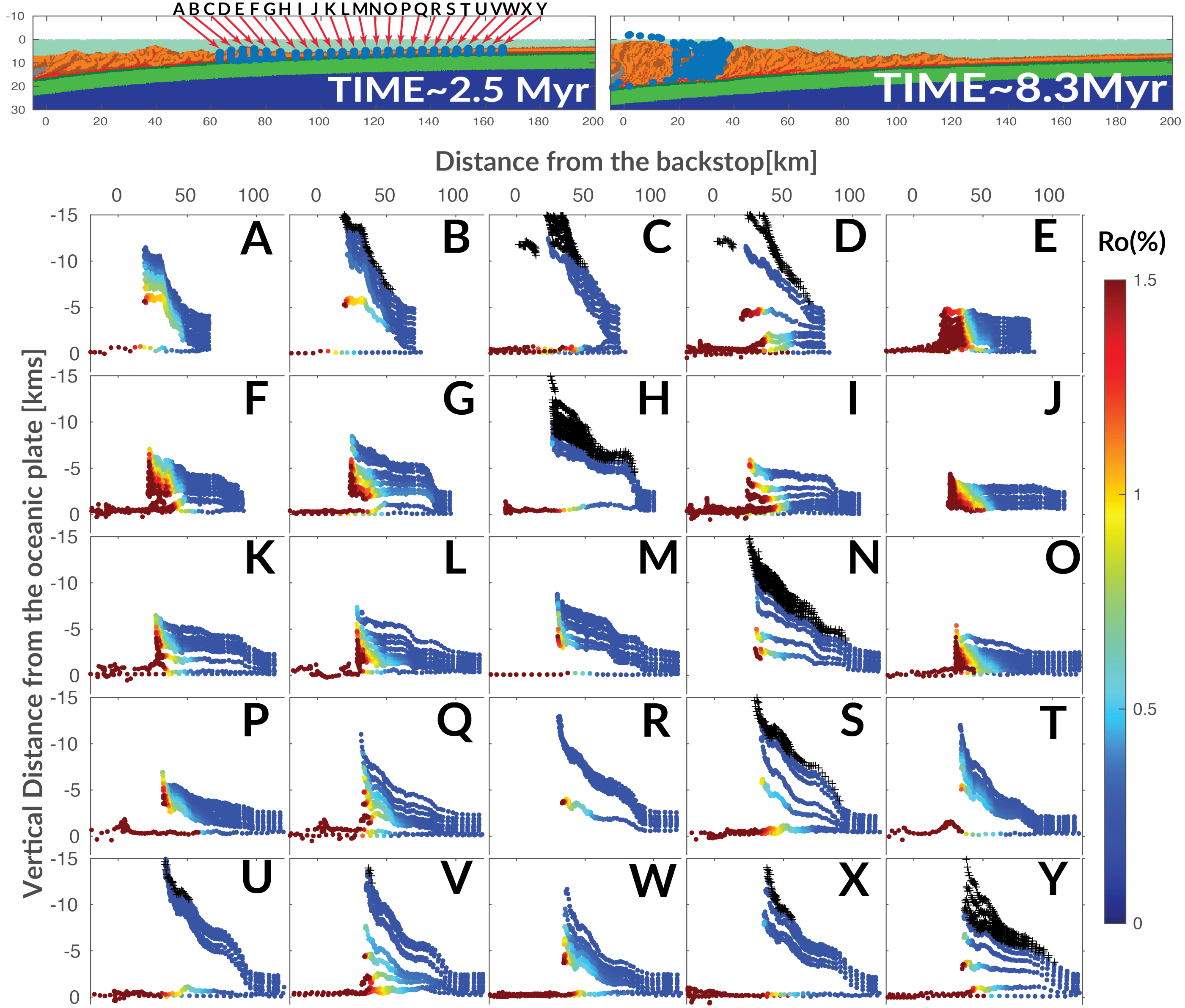


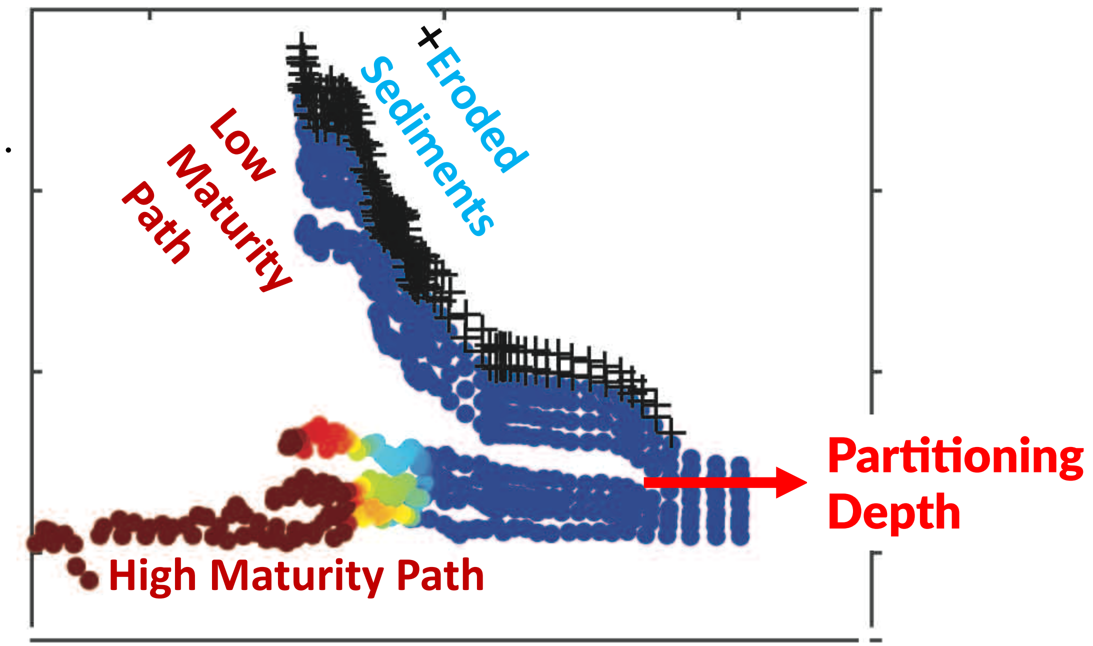
Incorporating Empirical Thermal Conductivity Values from Nankai



Incorporating Empirical Thermal Conductivity Values from Nankai

Figure modified from Sugihara et. al [2014]

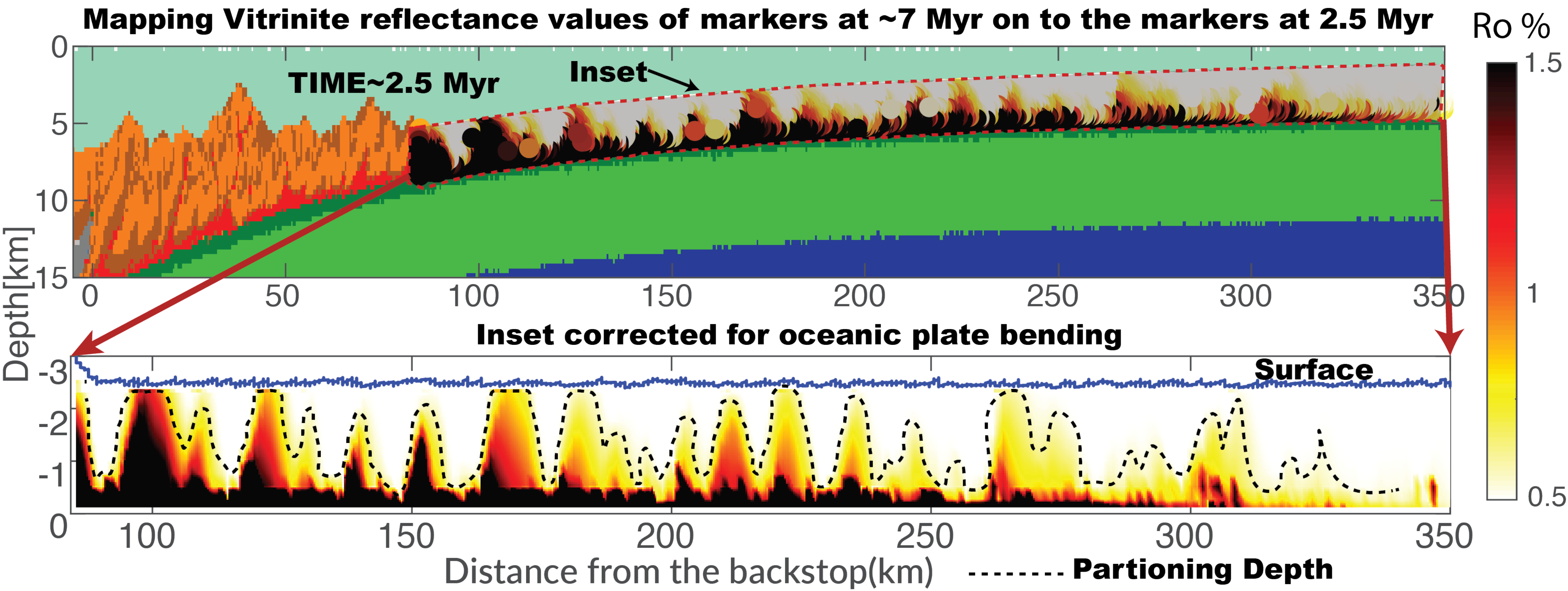




Partitioning Depth:

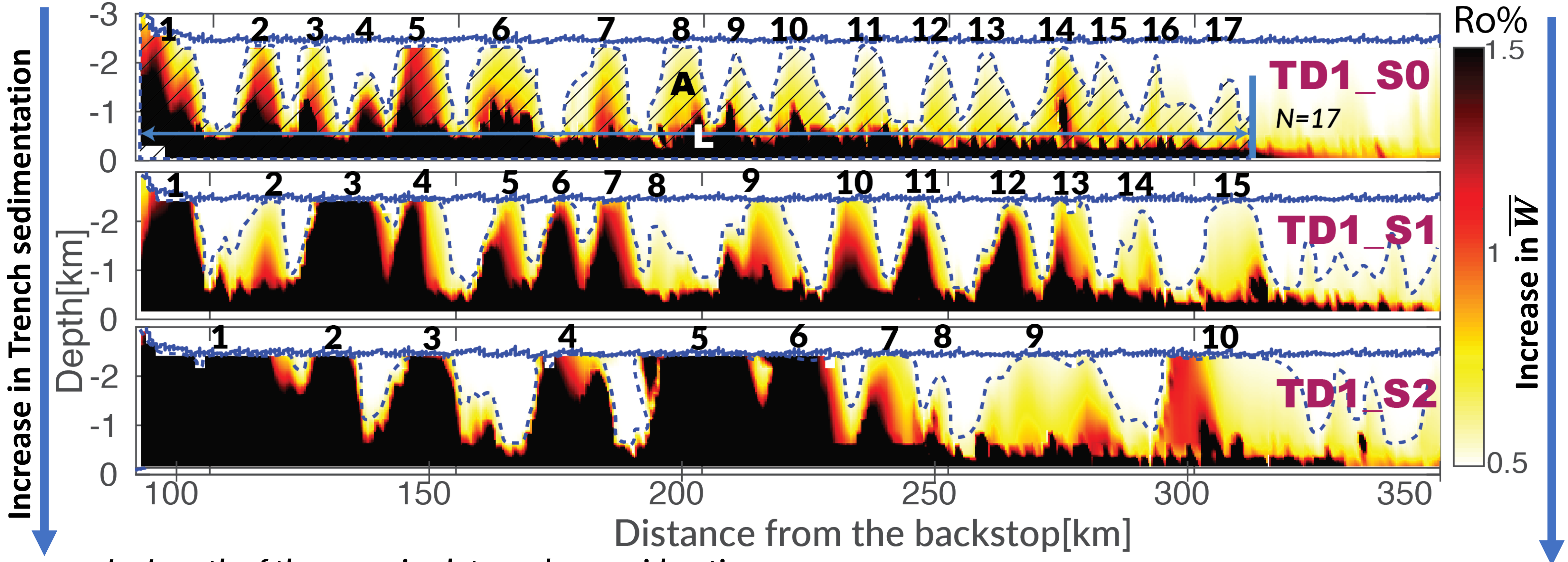
Depth above which most sediment either get eroded or follow a Low-thermal Maturity and below which most sediment follow a High-thermal Maturity

Particle paths for model TD1_S0 [No Sedimentation]



The Partitioning depth between high and low maturity path fluctuates, and correlates with the frequency and spacing of frontal thrust nucleation.

Periodic perturbation of Partitioning depth



L= Length of the oceanic plate under consideration

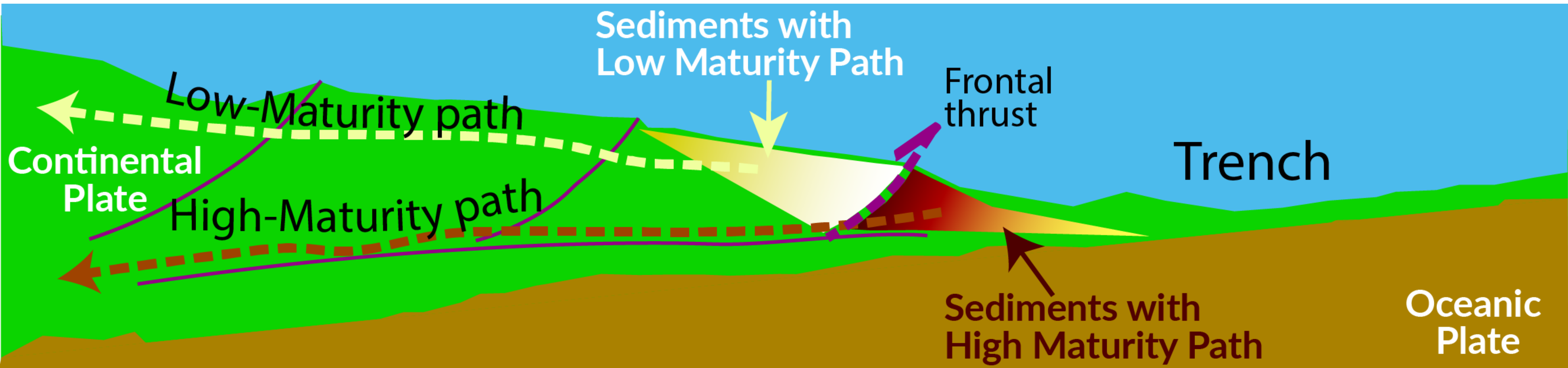
A=Area of the sediments transitioning to high thermal maturity

N=Number of faults≡ Number of crest in high thermal maturity region

$\overline{W}$*=Average width of high-maturity zone defined as* $\overline{W} = \frac{A}{L*N}$

Increase in trench sedimentation leads to wider zones of HIGH MATURITY, so does the width of thrust sheets

Comparing Perturbation of Partitioning depth with increase in trench sedimentation



The syn-accretion location of sediment in the wedge sets its trajectory, and therefore its thermal maturity.

- Sediment underlying the active frontal thrust translates inland closer to the decollement along a high maturity path.
- Sediment overlying the active frontal thrust translates inland closer to the surface along a low maturity path

Thermal maturity is thus controlled by the spacing and timing of of thrust growth

Conclusion

Thanks You

References:

Sugihara, T., Kinoshita, M., Araki, E., Kimura, T., Kyo, M., Namba, Y., ... & Thu, M. K. (2014). Re-evaluation of temperature at the updip limit of locked portion of Nankai megasplay inferred from IODP Site C0002 temperature observatory. Earth, Planets and Space, 66(1), 107.