Heat Flow and Thermal Regime in the Guaymas Basin, Gulf of California: Estimates of Conductive and Advective Heat Transport

EGU General Assembly 2022

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25.05.2022

IODP EXPEDITION 385
San Diego, CA to San Diego, CA
16 Sept 2019 - 16 Nov 2019
Guaymas Basin Tectonics and Biosphere

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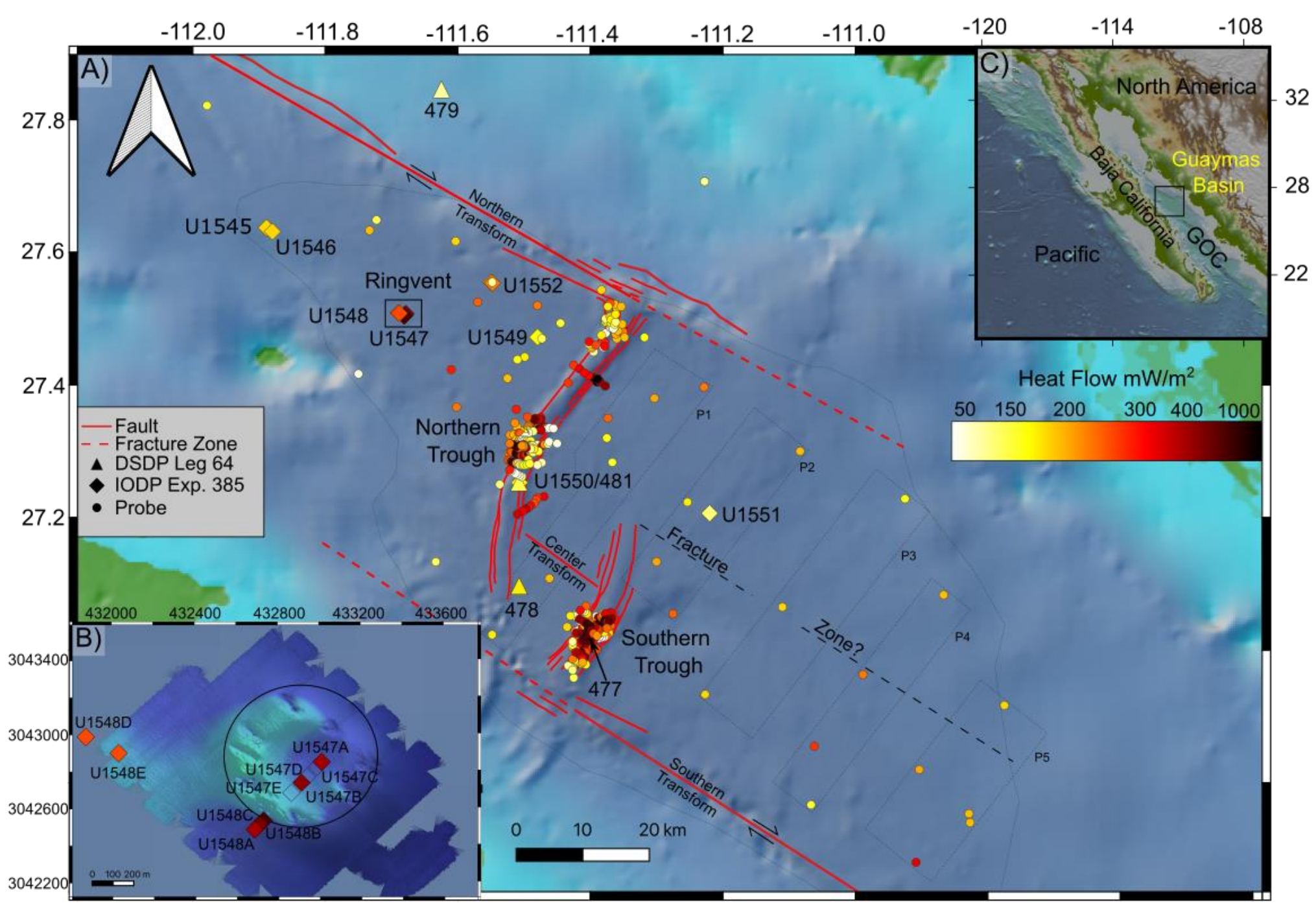


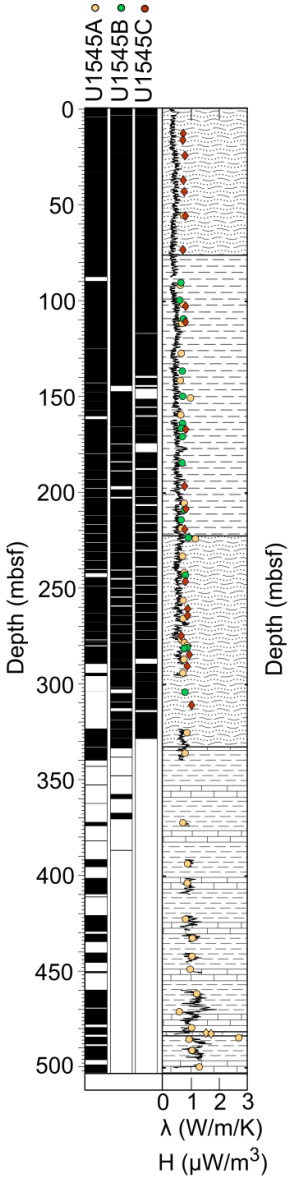
8 Sites
26 Holes
~ 5km Penetration
~ 4km Recoverd

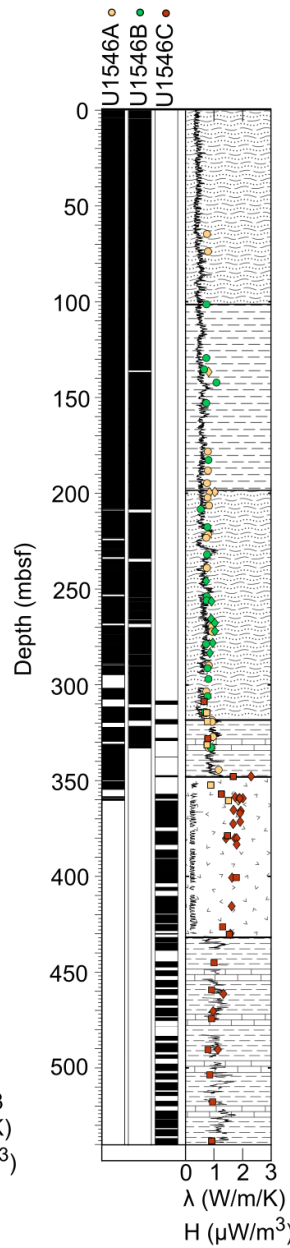
391 Thermal Conductivity
371 Shipboard
20 Lab

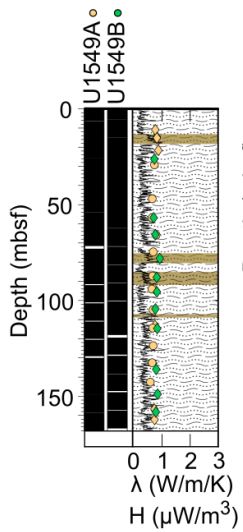
93 Temperature measurements
68 ACPT-3
25 SET-2

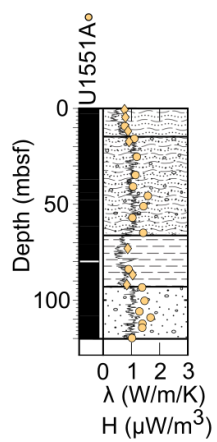
~85000 Radiogenic Heat Generation
Core NGR
Downhole NGR – FMS-TP

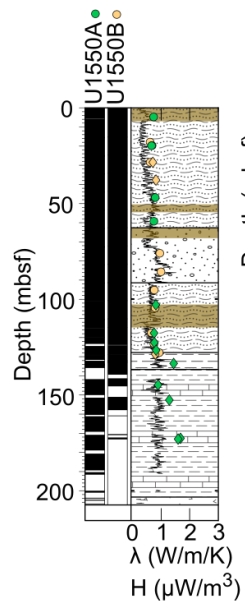
461 HF Values
442 Probe
4 DSDP Leg 64
15 IODP EXP 385

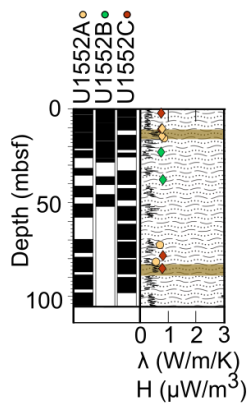


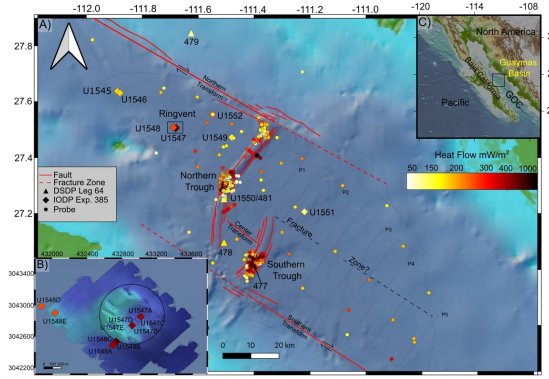












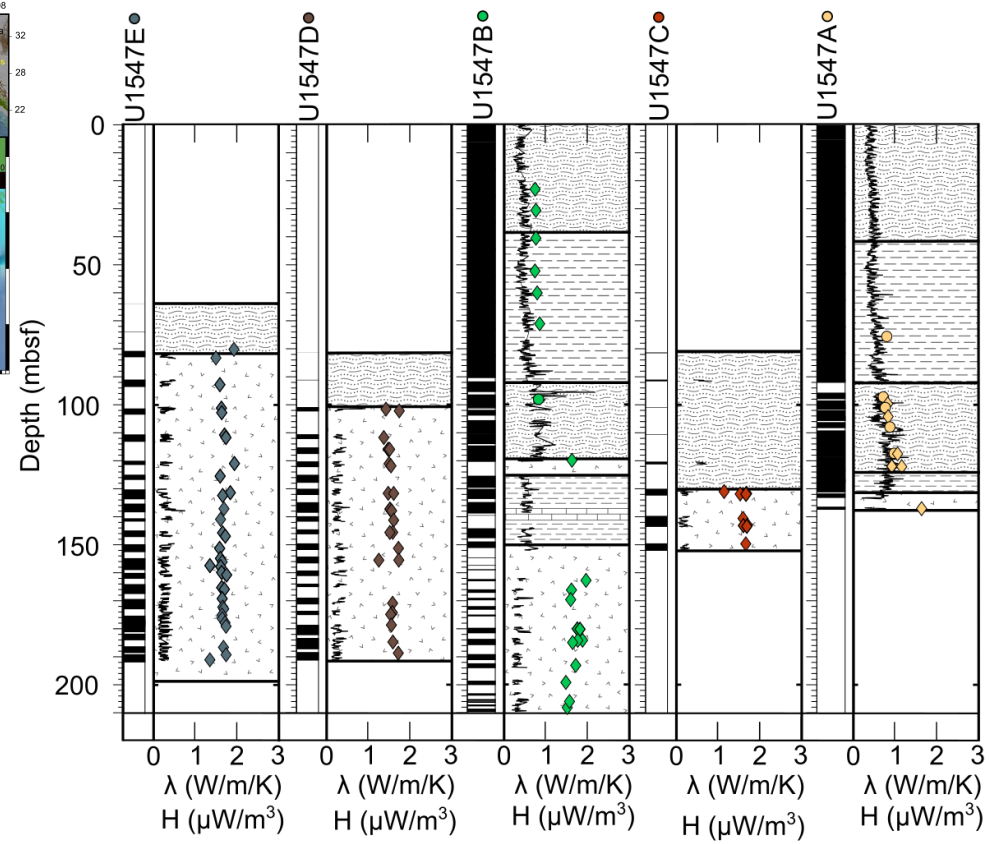
Diatom ooze / clay / micrite
0.81 ± 0.14 W/m/K

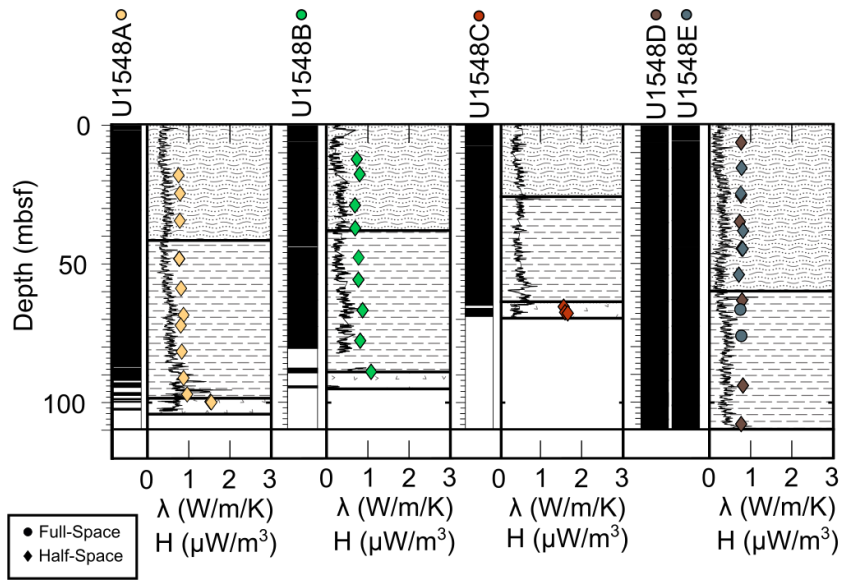
Silicious Claystone
1.11 ± 0.42 W/m/K

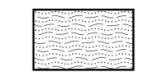
Silt / Sand
1.25 ± 0.22 W/m/K

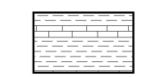
Intrusions
1.72 ± 0.21 W/m/K

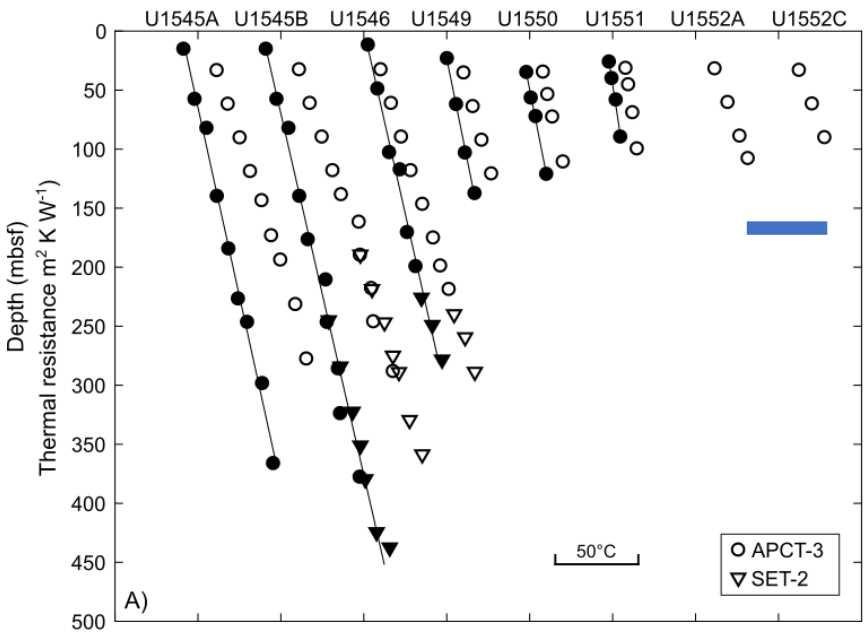
Heat Production:
1-4 mW/m² ~4km
negligible

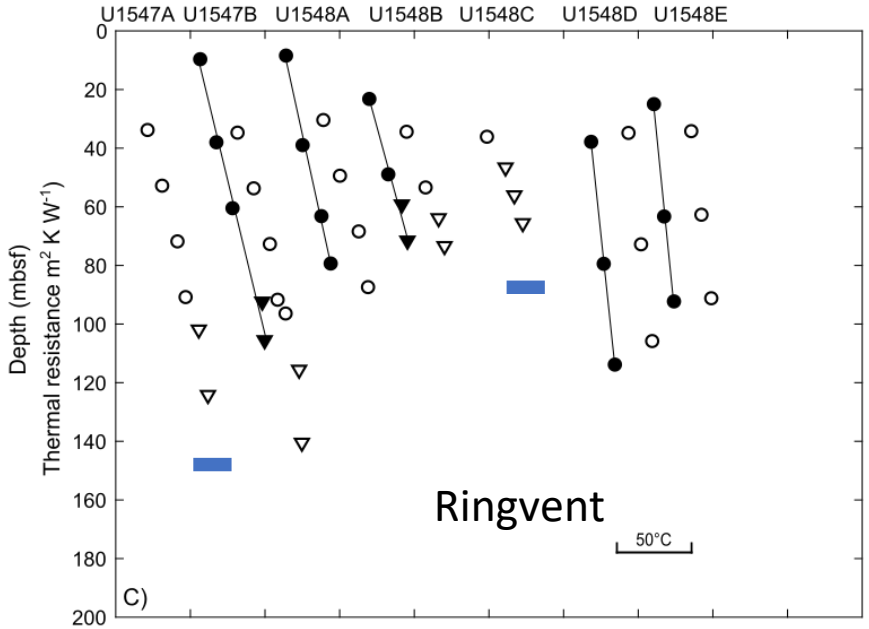




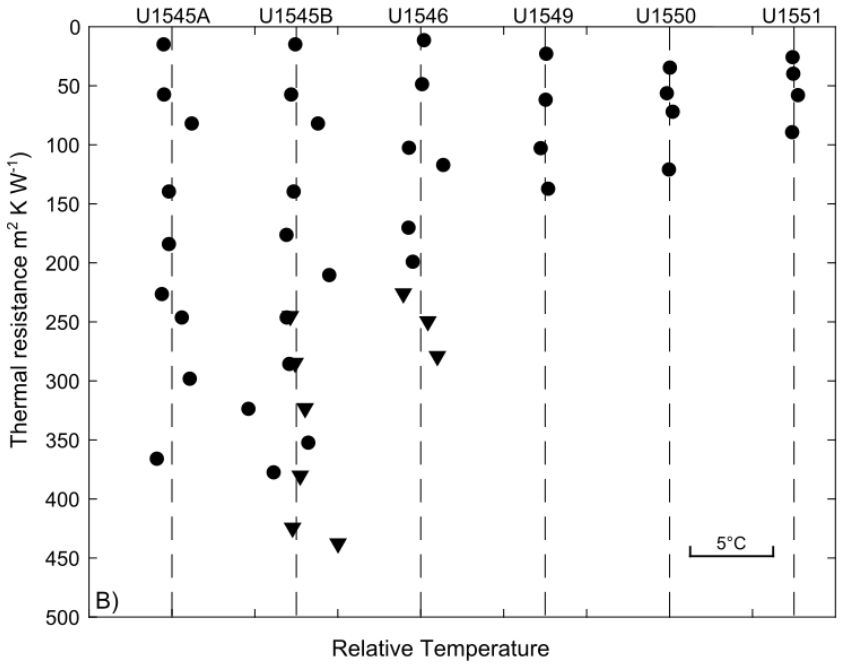


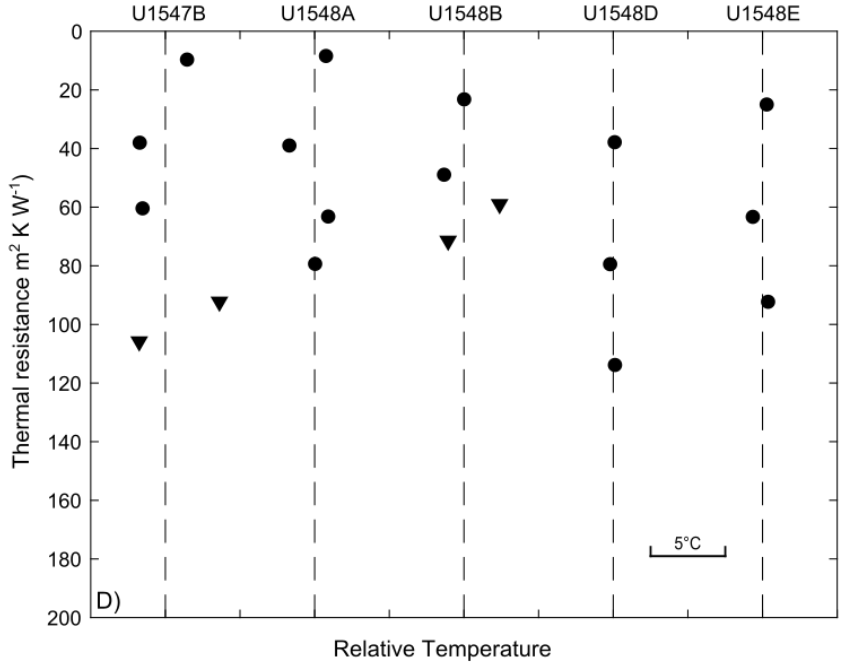




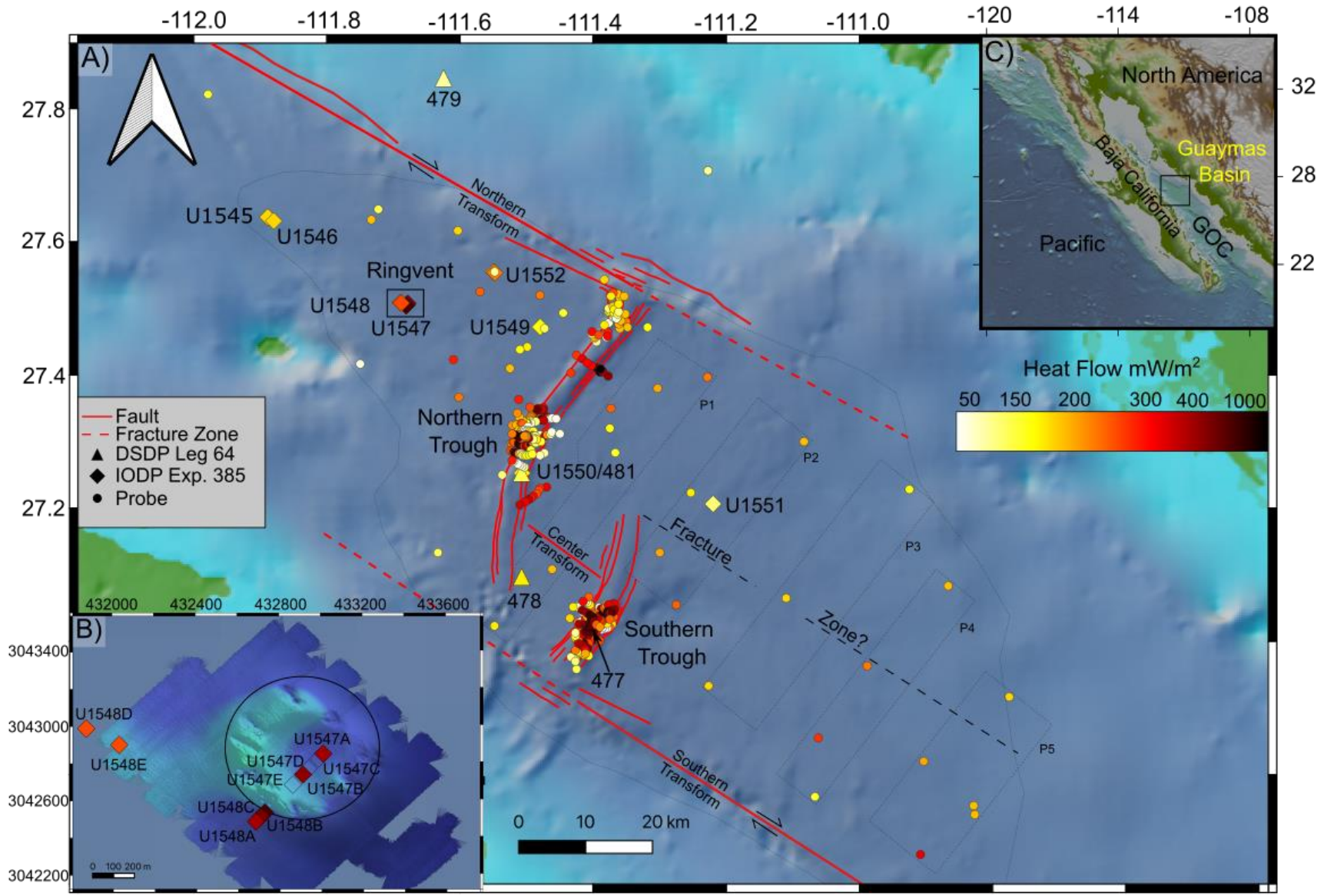


$$T(z) = T_0 + q_0 \sum_{i=1}^{N} \frac{z_i}{\lambda(z)_i}$$





$$q_0 = \lambda \frac{\mathrm{d}T}{\mathrm{d}z}$$



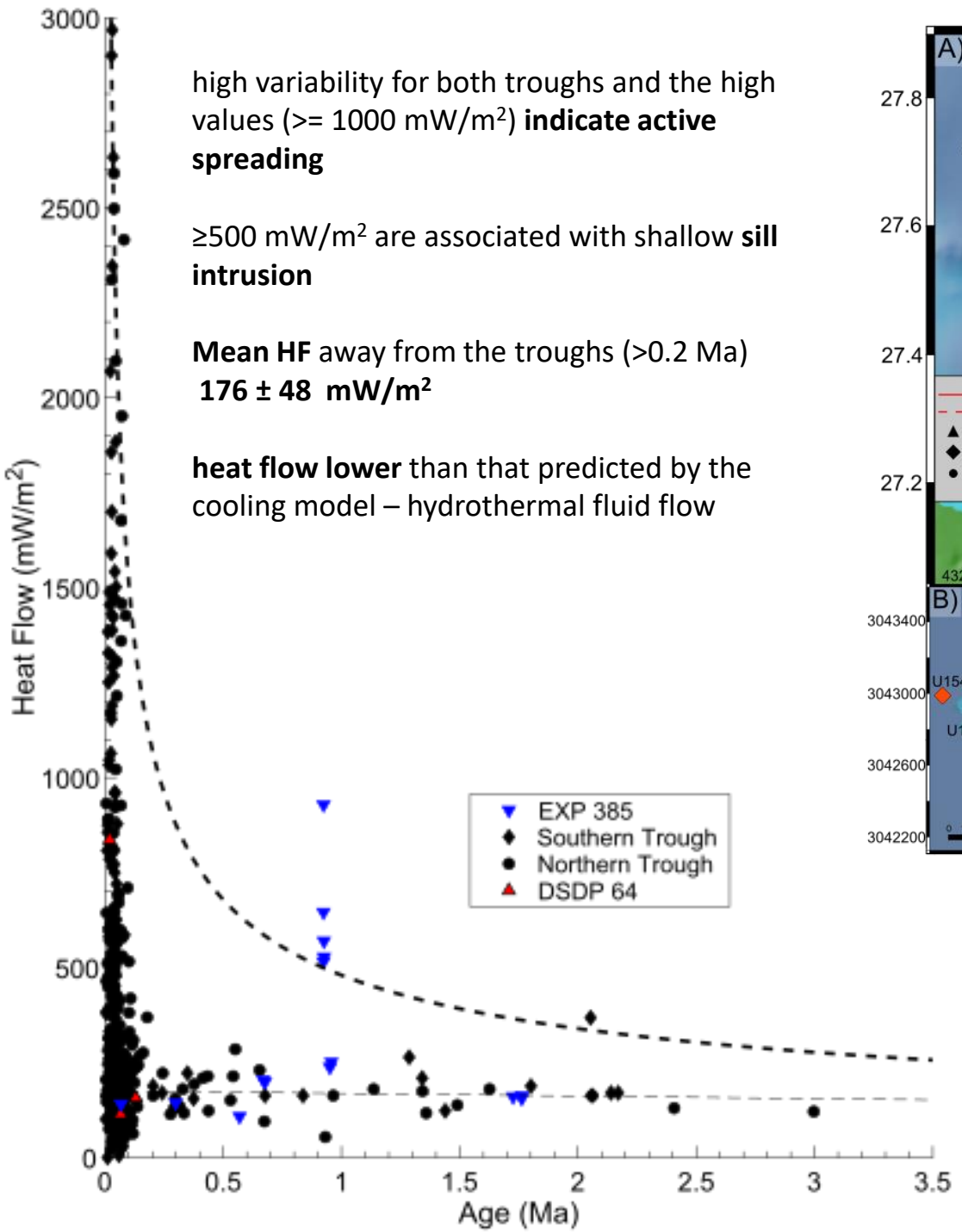
SITE	Heat Flow	Sedimentation Correction
U1545 A	156 ± 9	+17
U1545 B	163 ± 9	+18
U1546	160 ± 13	+20
U1549	144 ± 16	+16
U1550	141 ± 17	+16
U1551	108 ± 24	+10
U1552 A	199 ± 18	+8
U1552 C	205 ± 26	+8
U1547 A	528 ± 155	+12
U1547 B	570 ± 84	+12
U1548 A	516 ± 80	+8
U1548 B	646 ± 168	+8
U1548 C	929 ± 475	+8
U1548 D	251 ± 30	+8
U1548 E	238 ± 106	+8

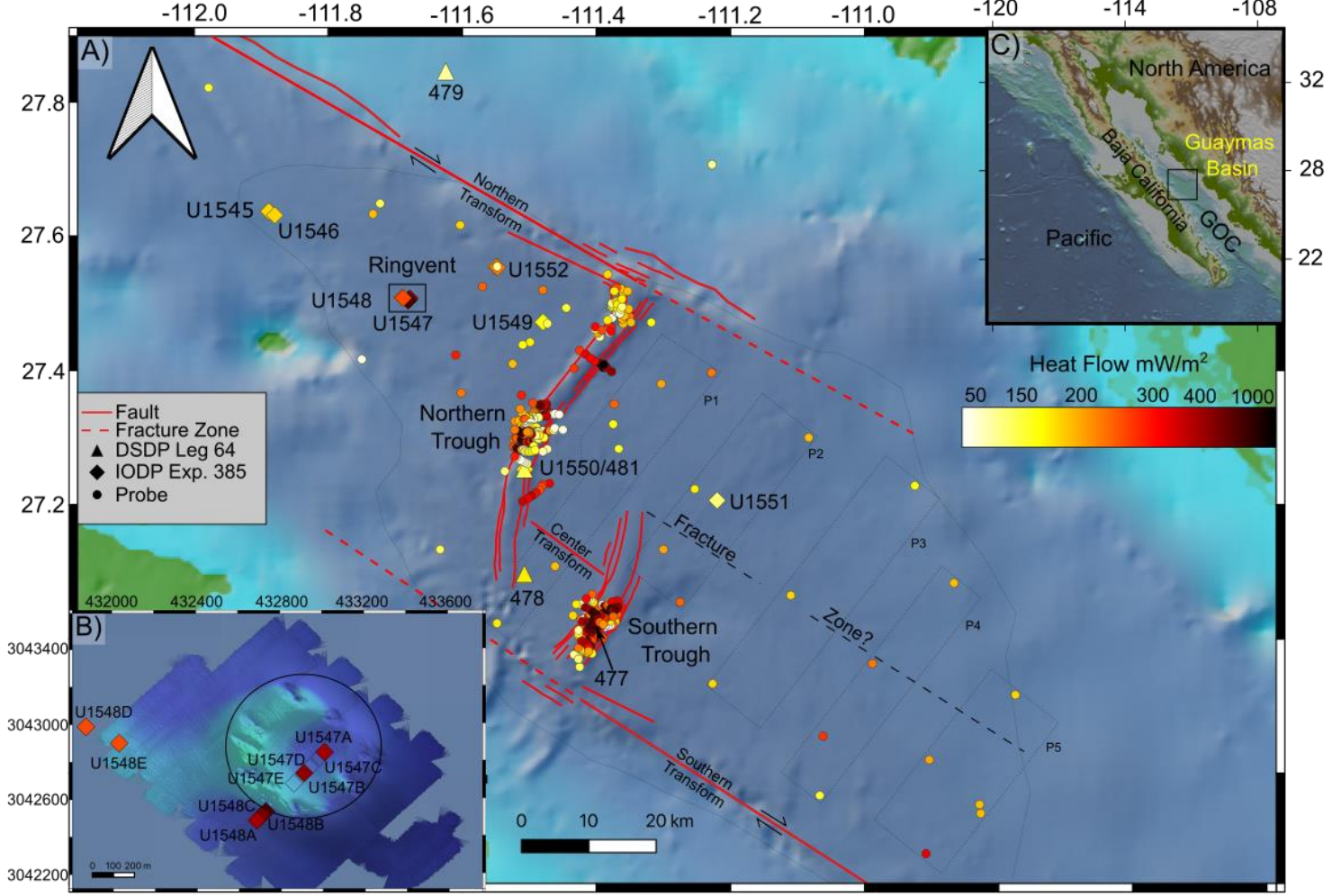
high variability for both troughs and the high values (>= 1000 mW/m^2) **indicate active spreading**

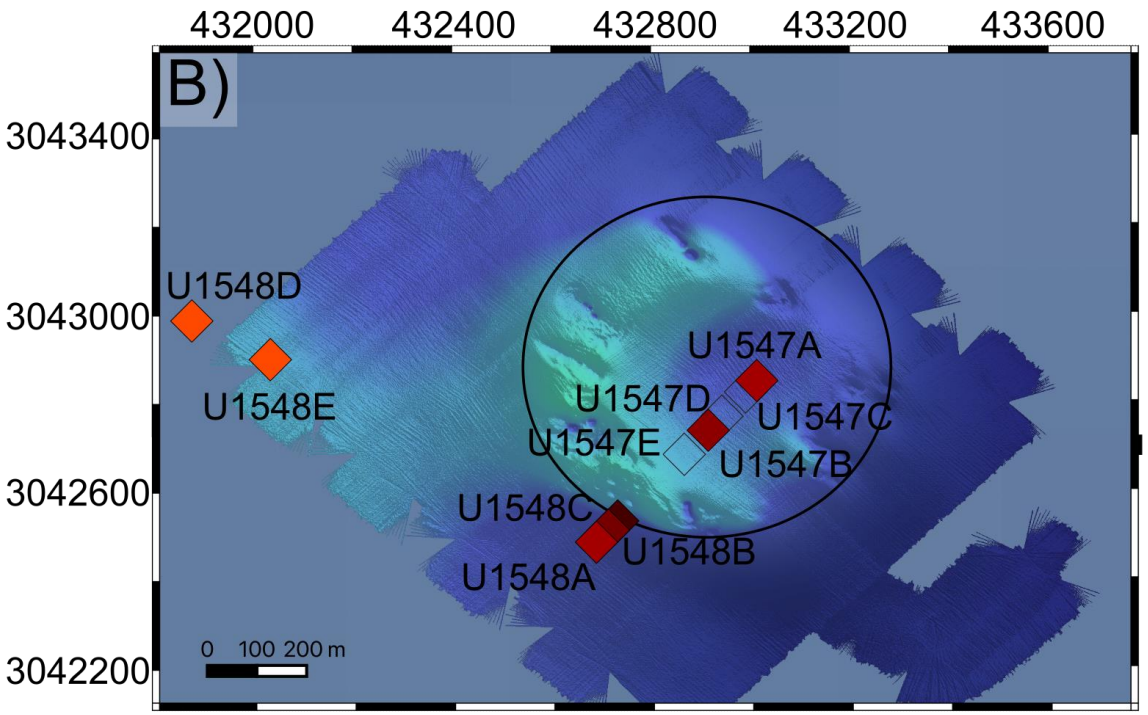
≥500 mW/m^2 are associated with shallow **sill intrusion**

Mean HF away from the troughs (>0.2 Ma)
176 ± 48 mW/m^2

heat flow lower than that predicted by the cooling model – hydrothermal fluid flow







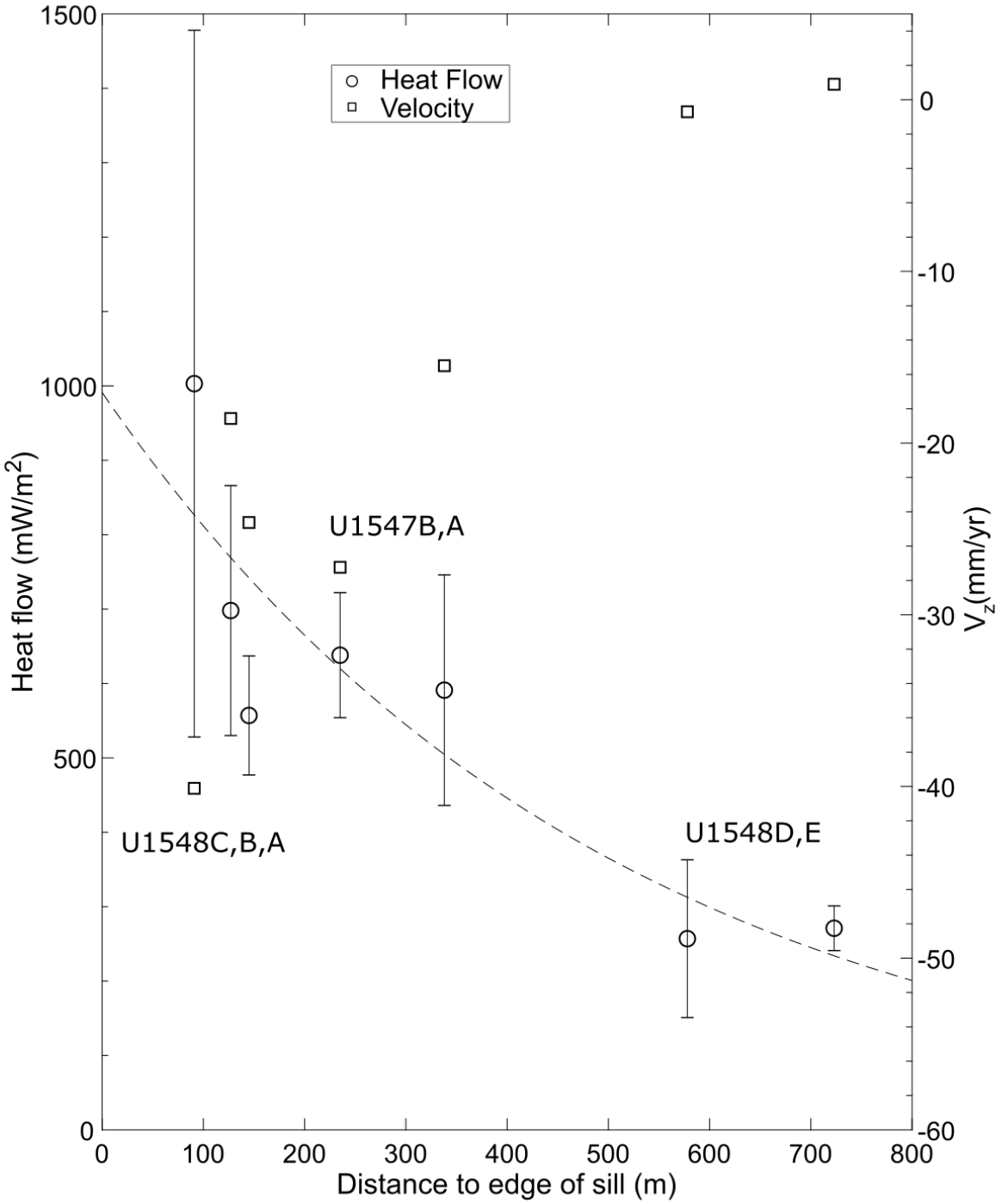
Heat flow values of up to 930 mW/m^2

Curvature of the temperature-depth profiles

Estimation of Darcy's flow **discharge velocities**

Exponential decay away from the intrusion

Active hydrothermal circulation



Summary

1. Heat flow values show **variability in the order of ~100 mW/m^2**. Correction due to bathymetry is negligible and for the effects of **sedimentation** with a maximum of **20%.**
2. Heat flow values **decay rapidly** with age for crustal ages less than 0.2 Ma. For ages > 0.2 Ma a **mean of 176±48mW/m^2** indicates **conductive heat transfer.**
3. Heat flow **anomalies** are concentrated in **the troughs** as a result of active **spreading and hydrothermal circulation** in the young crust.
4. **Off-axis** heat flow **anomalies**, such as Ringvent correspond to **shallow sill intrusions** with evidence of **hydrothermal activity**.