APPENDIX TABLE DR1: MODEL PARAMETERS

Variable	Value	Units
Crustal thickness	6×10^{3}	m
Half-width of intrusion zone	1×10^{3}	m
Depth of melt lens	1×10^{3}	m
Half spreading rate	55×10^{-3}	cm $y.^{-1}$
Mantle density[1]	3.30×10^{3}	kg m^{-3}
Crustal density[1]	2.90×10^{3}	kg m^{-3}
Melt density[1]	2.72×10^{3}	kg m^{-3}
Water density[1]	1.00×10^{3}	kg m^{-3}
Thermal expansion coefficient	3×10^{-5}	$°C^{-1}$
Thermal diffusion coefficient	8×10^{-7}	m^2 s^{-1}
Specific heat capacity	1.085×10^{3}	J kg^{-1} $°C^{-1}$
Latent heat capacity	5.06×10^{5}	J kg^{-1}
Olivine radius for Ca models[2]	1×10^{-3}	m

[1]Reference densities at STP
[2]The same olivine radius was used in forward and inverse parts of the calculation. Changing the model olivine radius to 0.1 mm, that of the smallest in the Coogan et al. (2002) study results in a 10% increase in the cooling rate estimate.

Details of distribution of hydrothermal cooling

Hydrothermal heat removal is treated in different fashions for on-axis and off-axis cooling. The on-axis hydrothermal cooling is specified as described by Maclennan et al. (2004). Heat removal in the axial region occurs over a temperature interval of 300–600°C, which is consistent with observed black smoker temperatures and thermodynamic arguments (Jupp and Schultz, 2004). The heat removal over this temperature interval is distributed as a cosine shaped bell, centred at 450°C. In the off-axis region, however, a number of adjustments have been made, in order to provide greater flexibility in the distribution of cooling and to mimic the cooling in the porous flow models of Cherkaoui et al. (2003). The vertically integrated output, as shown in Figures 2a and 2c in the main manuscript, decays exponentially away from the edge of the intrusion zone, as detailed in Appendix A of Maclennan et al. (2004). Using the notation of Maclennan et al. (2004), this vertically integrated heat output is referred to as $\hat{H}(x)$. The main difference is now that once $\hat{H}$ drops below a threshold value, $\hat{H}_t$, at the off axis distance, $x = x_t$, the decay in $\hat{H}$ is linear with off-axis distance rather than exponential so that $\hat{H}$ is equal to 0 at the edge of the model at x=20 km. In the four models considered in the paper $\hat{H}_t$ was set at between 2 and 5 Wm^{-2}, giving x_t of 2-5 km. Following Maclennan et al. (2004), the vertical distribution of off-axis cooling is defined using the weighting function χ, with

$$H(x) = \hat{H}(x)\left[\chi(x,z) \middle/ \int_0^{z_c} \chi(\xi,z)\,d\xi \right]$$

In the present paper, χ is controlled by the temperature and melt fraction in the intrusion zone, and by the vertical and horizontal positions, as shown in the following expressions. The function $\psi(z)$ is defined in order to ensure that heat is removed from parts of the off-axis region that have not been cooled by on-axis hydrothermal circulation, with

$$\psi(z) = 10 \times C_p \times (T_i(z) - 600)$$

where $T_i(z)$ is the temperature in the intrusion zone and C_p is the specific heat and if $\psi(z)$ is negative its value is set to zero. The latent heat, L_h, associated with the melt fraction present in the axial region $F(z)$ is then taken into account using

$$\gamma(z) = 0.8 \times F(z) \times L_h$$

Then, at off-axis positions within 750m of the edge of the melt intrusion zone, the weighting factor is given as,

$$\chi(x,z) = \psi(z) + \gamma(z)$$

At positions more than 750m beyond the edge of the intrusion zone, the weighting is controlled by position, in order to focus cooling towards the base of the crust with increasing distance from the ridge axis, so that

$$\chi(x,z) = z_n \times x_n^2$$

where z_n is the fractional depth to the base of the crust and x_n is the fractional distance between the outside edge of the intrusion zone and the edge of the model.

This distribution of off-axis hydrothermal cooling ensures that heat is removed from the flanks of the intrusion zone. As described in Maclennan et al. (2004), hydrothermal cooling is only permitted at distances of greater than 100 m from the edge of the intrusion zone. This spacing ensures that the bulk of the off-axis hydrothermal cooling takes place at rocks at temperatures of 300-600°C.

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