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Interactive comment

Interactive comment on "SILLi 1.0: A 1D Numerical Tool Quantifying the Thermal Effects of Sill Intrusions" *by* Karthik Iyer et al.

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Dear Reviewer 1,

Thank you for your constructive review which helped us better evaluate the presented model and make suitable changes where required. A point-by-point answer to the review is as follows (line numbering according to revised manuscript):

1. Please further highlight the novelty of SiLLi by comparing it with some other similar simulators such as MagmaHeatNS1D. MagmaHeatNS1D was developed based on almost the same models and written using an object-oriented language. In comparison, the Silli indeed considers some additional geological processes. Iyer et al. needs to introduce the significance of these processes. Wang D., MagmaHeatNS1D:

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One-dimensional visualization numerical simulator for computing thermal evolution in a contact metamorphic aureole, Computers Geosciences, 2013, 54(4): 21-27.

- We have added the reference to Wang, 2013 in the introduction (Line 67) and also further highlighted the uniqueness of SILLi and the motivation behind the model (Lines 84-93: “The motivation behind the model and manuscript is to make a standardized numerical toolkit openly available that can be widely used by scientists with varying backgrounds to test the effect of magmatic bodies in a wide variety of settings using readily available data such as standard well logs and field measurements. The model incorporates relevant processes associated with heat transfer from magmatic intrusions such as latent heat effects, decarbonation reactions and organic matter maturation and also accounts for background maturation and erosion by systematically reconstructing the entire present-day sedimentary column from the input data. Lastly, the model results can be easily compared to the two most widely used aureole proxies in sedimentary rocks, vitrinite reflectance (VR) and total organic carbon (TOC) data”).

2. Line 153: modeling results are highly sensitive to boundary conditions. What kind of boundary condition is assumed for the upper and lower boundaries by SiLLi? Besides, how to prove that “5 times the thickness of the bottommost sill” is reasonable? Such assumption needs to be made based on either special sensitivity analysis or the results of some similar researches.

- The implementation of temperature boundary conditions for the upper and lower boundaries are already mentioned in Lines 179 to 181 (“The thermal solver computes the temperature within the deposited sedimentary column by applying fixed temperatures at the top and bottom at every step which are calculated from the prescribed geotherm”). We have added the reason and reference to justify that aureole processes are usually limited to less than 400

3. Section 3.6: Iyer et al. consider some potential heat sink/source but ignored water boiling and vaporization. Why? For the one-dimensional thermal models, Jeager

(1959), Barker et al. (1998, international journal of coal geology) Wang et al. (2007, GRL) and Wang (2011, international journal of coal geology) pointed out its effects on thermal evolution of host rocks. This may be explained in this section.

- A full two-phase flow model would be required to fully capture the effect of pore water boing and subsequent condensation away from the heat source (e.g. Coumou et al., 2008. Phase separation, brine formation, and salinity variation at Black Smoker hydrothermal systems, JGR-Solid Earth). Moreover, previous studies have shown that model effects of the uncertainty of pre water volatilization is as large as the effects of variation in material properties such as heat capacity (Wang 2012. Comparable study on the effect of errors and uncertainties of heat transfer models on quantitative evaluation of thermal alteration in contact metamorphic aureoles: Thermophysical parameters, intrusion mechanism, pore-water volatilization and mathematical equations). Therefore, we have not implemented pore water volatilization in SILLi as it only adds to further uncertainty in an unconstrained variable.

4. Section 3.6: although most organic-rich rocks are less permeable, Jaeger (1959), Galushkin (1997), Wang and Manga (2015) indeed showed the possible heat convection mechanism in shallowly buried shale host rocks. These work need to cited in this section.

- The authors acknowledge that in some cases the effect of hydrothermal activity may indeed need to be considered in order to match field data as mentioned by the references above. The use of the Nusselt number approach (enhanced thermal conductivity) for such cases has been outlined in the manuscript (Lines 270 to 276: “Nevertheless, in some cases the effects of hydrothermal activity may be visible where the thermal aureole is larger above than below the sill and is recorded by vitrinite reflectance data (Galushkin, 1997; Wang and Manga, 2015). In such cases, the user may use an enhanced thermal conductivity (up to 5 times the usual rock conductivity) in the layer above the sill following the Nusselt number approach to account for hydrothermal activity and match field data. Note that care should be taken to check if the same effect can also be attributed to changes in other material properties or geological processes.”).

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