PARAMETERIZED THERMAL EVOLUTION OF THE EARTH WITH CONTINENTAL GROWTH. J. M. Menard[1] and C. M. Cooper[2], [1]Washington State University (Scholl of the Environment, PO Box 642812, Pullman, WA 99164-2812; julie.menard@email.wsu.edu), [2]Washington State University (cmcooper@wsu.edu).

Introduction: Continental growth on a terrestrial planet acts as an insulator of the mantle heat flow, but it also favors heat loss, as the heat producing elements (40K, 238U, 232Th) are depleted from the mantle, and concentrated in continental crust. As a result, the thermal evolution of the planet strongly depends on the balance between insulation and heat production of the continental lithosphere. What effects will this balance have for the long term thermal history of the planet?

Method: We built a parameterized thermal history model of the Earth, which takes into account the continental insulation on the thermal evolution of the Earth. Though the continental crust is generally thought of as a perfect insulator, this might not be entirely correct. Previous models have shown that mantle heat flux has a non-linear dependence to the continental surface area even though the insulating effect of continents can increase the average mantle temperature.

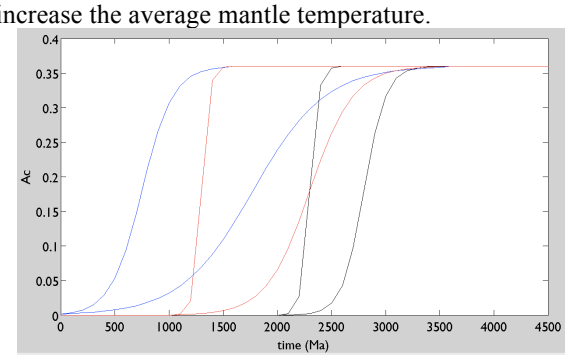

Figure 1: Continental Surface Area *Ac* (%) with time (Ma), after Grigné and Labrosse (2001) [1] .

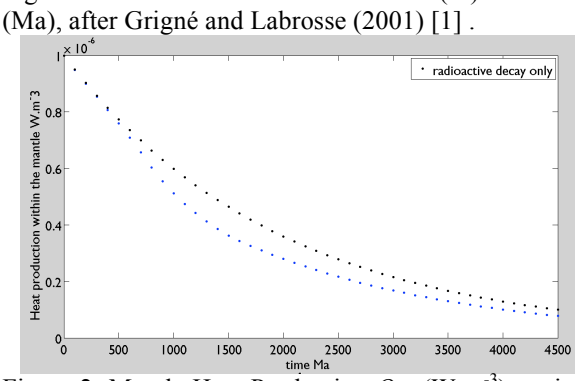

Figure 2: Mantle Heat Production *Qm* ($W.m^{-3}$) vs time (Ma) with the onset of continental growth at 0Ma and its offset at 1500Ma.

Results: Our parameterization includes the continental growth as maintaining the feedback between continental insulation and mantle heat flux. We do this with the scaling of heat flux parameters [2] and adding the continental crust heat flux component into an equation of heat flux from Sotin and Labrosse (1999) [3].

This model brings a more thorough understanding of the thermal evolution of the Earth by taking into account both the continental insulation and the mantle heat flux feedbacks from continental growth.

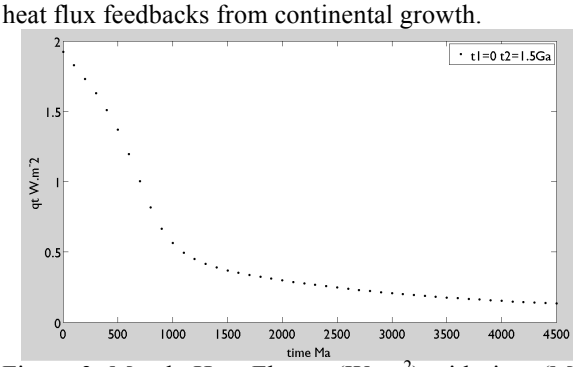

Figure 3: Mantle Heat Flux q_t ($W.m^{-2}$) with time (Ma) with the onset of continental growth at 0Ma, and its offset at 1500Ma.

This study will help us understand the thermal history of a terrestrial planet with continents. It will also help us understand the characteristics of heat loss of a terrestrial planet with the onset of continental crust formation.

References:

[1] Grigné C. and S. Labrosse (2001) *Geoph. Res. Lett., Vol 28, 14,* 2707–2710. [2] Lenardic A. et al. (2005) *EPSL, 234,* 317–333. [3] Sotin C. and S. Labrosse (1999) *PEPI, 112,* 171–190.