**CONSTRAINING HEAT PRODUCTION AND POSSIBLE SEAFLOOR ACTIVITY ON EUROPA.** A. M. Sessa[1] and B. E. Schmidt[1], [1]School of Earth & Environmental Sciences, Georgia Institute of Technology (311 Ferst Drive, Atlanta, GA, 30332, asessa3@gatech.edu).

**Introduction:** At some point in their thermal histories, most of the terrestrial planetary bodies within our Solar System have been volcanically active. Volcanism is a geophysical consequence of the primary mode of heat transport within a planetary body, and depends upon the amount of heat generated within the body over its thermal history. Extreme habitable environments found here on Earth that are powered by volcanic activity, such as hydrothermal systems near mid-ocean ridge boundaries, are good analogs to consider in order to constrain the possibility of a habitable near-seafloor environment at the rock-water interface on a geologically active Europa.

**Motivation:** By utilizing the thermal histories of terrestrial bodies within our Solar System as end member cases of volcanic activity, we seek to link the effects of varying degrees of internal heating (i.e., by accretion, the decay of radioactive nuclides, and tidal dissipation) that these bodies have experienced and equate that to the degree of geologic activity expressed by their surfaces in order to apply that same rationale to the interior of Europa. Since the thermal state and heat flux of a planetary body determines the type and frequency of volcanism and the composition of the material extruded, this is also useful in determining the energy and chemical constituents available for potentially habitable environments. By examining the heating history of Europa since its formation, we can place bounds upon the activity that Europa's interior may have undergone during discrete times in its history, which correlate with different modes of heating and heat transfer, that occurred at each point in its history. The heat production within the silicate interior of Europa has been modeled by Hussmann and Spohn (2004), in which they modeled the two possible end member equilibrium states of the Europan interior (e.g., low- and high-temperature), however intermediary states are possible but always revert back to one of the end members in these models. The corresponding heat fluxes for these states, evaluated for at the rock-water interface, are $10^{11}$ W and $10^{13}$ W respectively and relate to whether the interior is inactive or active geologically, thereby allowing us to determine if volcanic and/or hydrothermal processes are possibly on-going at the Europan seafloor. The primary mode of heating for the model associated with the high heat flux, which is associated with ~1/10$^{th}$ of Io's current volcanic activity, is by tidal dissipation, while the other model assumes most of the heat is produced by radiative decay. However, work remains to characterize the details of the transition between these states, which would in turn affect the assumption of which state Europa would assume as a function of time.

**Approach:** In order to better constrain what processes have occurred, and could still be occurring at the seafloor of Europa, we will refine current estimates of heat sources available throughout Europa's history. We start by updating the initial relative abundances of short-lived radioactive nuclides, including $^{26}$Al and $^{60}$Fe, and long-lived radioactive nuclides, (e.g., $^{40}$K, $^{232}$Th, and $^{238}$U) within the Europan interior. Following Moore and Hussmann (2009), we then include heat produced via tidal dissipation at different points in the orbital history of Europa. Importantly, we will consider how the efficiency of melt production and the evolution of crustal materials affect the assumed transition between modes of activity. Another heating source within the interior of Europa, which is not widely considered in current models is the heat produced through serpentinization of the silicate interior that comes into contact with the Europan ocean. We also calculate the flux of hydrothermal fluid (and/or melt) through the porous outer portion of the Europan interior by utilizing Darcy's Law, similar to Lowell and DuBose (2005), considering updated values from the literature for the variables in the Darcy equation to better constrain the mass flux from proposed hydrothermal systems and their impact on seafloor heating. We include the gravity at the depth of the Europan seafloor, the temperature gradient between the interior and at the seafloor, and the permeability of the upper portion of Europa's interior in this treatment.

In this presentation, we will describe our updated model for the heat production at the Europan interior by considering these better-constrained values for the heat produced via the processes mentioned above. We will then discuss implications for the history of sea floor activity on Europa and its impact on Europa's putative habitability.

**References:** [1] Hussmann, H. and Spohn, T. (2004) *Icarus*, *171*, 391-410. [2] Lowell, R. P. and DuBose, M. (2005) *Geophysical Research Letters*, *32*, 1-4. [3] Moore, W. and Hussmann, H. (2009) *Europa*, 369-380. [4] Vance, S. and Goodman, J. (2009) *Europa*, 459-482. [5] Vance, S. et al. (2007) *Astrobiology*, *7*, 987-1005.