Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24240

Elevated mantle heat flow after lithospheric foundering causes differentiation and metamorphism during orogenesis

JONAS KAARE-RASMUSSEN[1], FORREST HORTON[2], ROBERT M HOLDER[3], ANDREW KYLANDER-CLARK[4], DR. ANNE-SOPHIE BOUVIER[5], OTHMAR MÜNTENER[5] AND AMOS FETY MICHEL RAKOTONDRAZAFY[6]

[1]MIT-WHOI Joint Program
[2]Woods Hole Oceanographic Institution
[3]University of Michigan
[4]UC Santa Barbara
[5]University of Lausanne
[6]Universite d Antananarivo

Presenting Author: jkaaras@mit.edu

Partial melting in the crust is important for the evolution and long-term stability of continental crust [1]. For example, melting in the lower crust can remobilize water [2] and radiogenic heat producing elements [3]. Ultimately, this strengthens the residual crust. The Anosyen domain in southeastern Madagascar is a well preserved ultrahigh-temperature metamorphic (UHTM) terrane that formed during the amalgamation of Gondwana [4]. Like many UHTM terranes, the heat sources required to reach UHTM in the Anosyen domain are a matter of debate [5, 6]. Based on new zircon $\delta^{18}O$, $\varepsilon_{Hf}(t)$ compositions, and U–Pb dates in plutonic rocks from the Anosyen domain, we infer that the foundering of the lithospheric mantle amplified mantle heat conduction into the crust. Plutons, formed from magmas originating in the lower crust, predate peak metamorphism by ~20–40 million years. This is consistent with foundering-induced basal heating that swiftly led to partial melting in the lower crust. Only tens of millions of years later did the thermal pulse associated with foundering reach the middle crust, where it culminated with UHTM and anatexis. Here and elsewhere, crustal differentiation via partial melting may occur on the lengthscales and timescales of mantle heat diffusion.

[1] Sawyer et al., (2011) Elements 7, 229–234. [2] Capitanio et al., (2020) Nature, 89–94. [3] Saniford et al., (2002) J. Metamorph. Geol. 20, 87–98. [4] Jöns and Schenk, (2011) Eur. J. Mineral. 23, 127– 156. [5] Holder et al., (2018) J. Metamorph. Geol. 7, 855–880. [6] Horton et al., (2022) J. Metamorph. Geol. 40, 287–30.