Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.22874

Significant continental crustal loss during the India-Asia collision and its climatic response

ZIYI ZHU[1], IAN H. CAMPBELL[2], PETER A CAWOOD[1] AND OLIVER NEBEL[1]

[1]Monash University

[2]Australian National University

Presenting Author: ziyi.zhu@monash.edu

The buoyancy of continental crust could prevent its recycling into the mantle, leading to the hypothesis that most crustal mass is preserved in collisional zones. However, the density of lower continental crust can be greater than the mantle, which allows it to be subducted or foundered [1]. Understanding the loss of continental crust into the mantle during continental collisions is crucial for unravelling the complex web of Earth's geological processes, because it will impact both the mantle geochemistry and mountain topography. In this study, we present a quantitative evaluation of the crustal loss by comparing the volume of shortened crust since the onset of collision with present-day preserved volume of crust through thickening, extrusion and erosion. Our analysis of the India-Asia collisional system shows that about 30-40% of the shortened crustal volume was lost into the mantle. This loss was likely driven by the increased density of eclogites that formed at the base of the mountain roots. Removal of these roots would have triggered the upwelling of asthenosphere, giving rise to the adakitic and high-potassic magmatism between ca. 25 and 10 Ma in the Lhasa terrane [2]. It is also expected to lead to rapid isostatic uplift, which is consistent with the change from subsidence to uplift at ca. 25-22 Ma in the Himalaya-Tibet paleo-elevation record [3]. Furthermore, this rapid uplift marks the onset of the intensified monsoonal rainfall at ca. 22 Ma, suggesting that the sudden topographic rise may have dramatically changed the atmospheric flow patterns. Our study thus highlights a connection between deep crustal processes with surficial climatic change during the building the mountain belts by continent-continent collision.

References:

[1] Capitanio, F., Morra, G., Goes, S., Weinberg, R. & Moresi, L. (2010), Nature Geoscience 3, 136-139.

[2] Chung, S.-L. et al. (2003), Geology 31, 1021-1024.

[3] Ding, L. et al. (2022), Nature Reviews Earth & Environment 3, 652-667.