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Chemical mohometry: assessing crustal thickness of ancient orogens using geochemical and isotopic data

Mihai Ducea[1,2], *Peter Luffi*[3,4]

[1] *Faculty of Geology and Geophysics, University of Bucharest, Bucharest 010041, Romania*
[2] *Department of Geosciences, University of Arizona, Tucson, AZ 85721, USA; e-mail: ducea@arizona.edu*
[3] *Sabba Stefanescu Institute of Geodynamics, Bucharest 020032, Romania*
[4] *Geological Institute of Romania, Bucharest 012271, Romania; e-mail: peter.luffi@gmail.com*

Convergent plate boundaries are key sites for continental crustal formation and recycling. Quantifying the evolution of crustal thickness and paleo-elevation along ancient convergent margins represents a major goal in orogenic system analysis. Chemical and in some cases isotopic compositions of igneous rocks formed in modern supra-subduction arcs and collisional belts are sensitive to Moho depths at the location of magmatism, implying that igneous suites from fossil orogens carry information about crustal thickness from the time they formed. Several whole-rock chemical parameters correlate with crustal thickness, some of which were calibrated to serve as "mohometers", *i.e.*, quantitative proxies of paleo-Moho depths. Based on mineral-melt partition coefficients, this concept has been extended to detrital zircons, such that combined chemical and geochronological information extracted from these minerals allows us to reconstruct crustal thickness evolution using the detrital archive. We discuss here the mohometric potential of a variety of chemical and isotopic parameters and show that their combined usage improves paleocrustal thickness estimates. Using a Matlab® app developed for the underlying computations, we present examples from the modern and the deeper time geologic record to illustrate the promises and pitfalls of the technique. Since arcs are in isostatic equilibrium, mohometers are useful in reconstructing orogenic paleoelevation as well. Our analysis suggests that many global-scale correlations between magma composition and crustal thickness used in mohometry originate in the sub-arc mantle; additional effects resulting from intracrustal igneous differentiation depend on the compatible or incompatible behavior of the involved parameters.