Insights into the nature of Earth's emerged lands through time from the chemistry of terrigenous sediments

NICOLAS DAUPHAS[1], MATOUS PTÁCEK[1], NICOLAS GREBER[2]

[1]Origins Laboratory, Department of the Geophysical Sciences and Enrico Fermi Institute, The University of Chicago, Chicago IL 60637, USA (dauphas@uchicago.edu)

[2] Département des sciences de la Terre, Université de Genève, 1205, Genève, Switzerland

The nature of the continents through time (mafic *vs*. felsic) holds clues on the onset of plate tectonics, weathering feedbacks, the supply of bionutrients to the oceans, and the continental geotherm. This is a non-trivial question to tackle because erosion and crustal reworking have largely obliterated the geologic record in deep time, so direct examination of the nature of igneous rocks could provide a biased perspective on the nature of the continents through time. A less biased record is provided by terrigenous sediments that average the composition of rocks exposed to weathering on emerged lands [*e.g.*, 1-4]. Interpreting the composition of detrital sediments is complicated by the fact that the igneous rocks also changed: komatiites are mostly confined to the Archean, mafic rocks were produced by higher degrees of partial melting when mantle potential temperatures were higher, and felsic rocks switched from TTGs to granites. Terrigenous sediments have also been subjected to weathering and mineral fractionation during riverine/marine transport. There is thus considerable disagreement in the literature on the nature of the continents through time, with some advocating for a predominantly mafic crust until ~3-2.5 Ga or later [2,3] and others arguing for felsic continents since at least 3.5 Ga [4].

We have developed an algorithmic approach to tackle the question of the nature of the continents through time that relies on numerically intensive statistical techniques to (*i*) identify sediments whose compositions were unaffected by weathering/mineral fractionation, (*ii*) find the most diagnostic proxy ratios to reconstruct the composition of the crust, (*iii*) track the changing compositions of the sediments and igneous end-members through time. This analysis shows that the continents were predominantly felsic since ~3.5 Ga.

[1] Taylor S.R., McLennan S.M. (1991) The Continental Crust: Its Composition and Evolution, Blackwell, 312pp. [2] Tang M. et al. (2016) Science 351, 372. [3] Smit M.A., Mezger K. (2017) Nature Geoscience 10, 788. [4] Greber N.D. et al. (2017) Science 357, 1271.