# Molybdenum isotope evidence for extensive crustal extraction and recycling in Earth's first billion years

ALEX J. MCCOY-WEST[1, 2], PRIYADARSHI CHOWDHURY[1], KEVIN W. BURTON[2], PAOLO SOSSI[3], J. GODFREY FITTON[4], PETER A. CAWOOD[1] & HELEN M. WILLIAMS[2,5]

[1] School of Earth, Atmosphere and Environment, Monash University, Australia (alex.mccoywest@monash.edu)
[2] Department of Earth Sciences, Durham University, UK
[3] Institute of Geochemistry and Petrology, ETH Zürich, SUI
[4] School of GeoSciences, University of Edinburgh, UK
[5] Department of Earth Sciences, University of Cambridge, UK

Estimates of the volume of the earliest continental crust based on zircons and radiogenic isotopes remain equivocal. Given that the crustal rock record from the early Earth is extremly meagre, interpreting the effect of formation vs. preservation bias remains complex. The complementarity of the crustal and mantle reservoirs for long-lived radiogenic isotopes (Sr-Nd-Hf) has long been established, with time-dependent models requiring that only ~30-50% of the mantle's mass underwent melt extraction to balance the present-day compositions of the depleted mantle and continental crust [1-2]. An alterantive approach is to use time-invariant stable isotope systems, such as molybdenum (Mo) to trace differentiation processes. However, this rely on the mantle complementing the known super-chondritic continental crust [3]

We present new Mo isotope data for Archean komatiites [4] and Phanerozoic picrites [5] and demonstrate that: 1) the Mo isotope composition of the accessible mantle is unambiguously sub-chondritic; 2) the formation of this reservoir occurred before ~3.5 Ga; and 3) no resolvable temporal variations are observed with Archean komatiites ranging in age from 3.5−2.7 Ga having identical $\delta^{98}$Mo to Phanerozoic samples. Partial melting modelling demostrates that komatiites will accurately reflect their mantle sources and it is possible to genreate isotopically heavier crust through partial melting processes. Mass balance modelling shows that this early mantle depletion requires the extraction of a 2.5-3.8 times the volume of crust that is preserved today, implying rapid crustal growth and destruction of the crust in the first billion years of Earth's history.

[1] DePaolo (1980) *GCA* 44, 1185; [2] Jacobsen (1988) *GCA* 52, 1341; [3] Yang et al. (2017) *GCA* 205, 168; [4] Sossi et al. (2016) *JPet* 57, 147; [5] McCoy-West et al. (2018) *GCA* 238, 534.