Chromium isotopes in carbonates constrain Mesoproterozoic atmospheric pO_2 levels

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For decades, the Ediacaran-Cambrian radiation of animals has been linked to Neoproterozoic growth in biospheric oxygen. However, given the low levels of O_2 (<1% PAL) required to support simple/primitive animal life, it has been argued that increasing pO_2 is more relevant to the evolution of carnivores and other highly motile animals than it is to the origin of animals per se (*1*). By contrast, recent analysis of chromium (Cr) isotopic fractionation in Mesoproterozoic and Neoproterozoic rocks has provided support for the hypothesis that even the earliest stages of animal evolution may have been constrained by oxygen availability (*2*). Here we present new Cr-isotope data from a suite of well-preserved marine carbonates that demonstrate active terrestrial weathering of Cr in the late Mesoproterozoic (~1.1 Ga), as well as potential modification of local Cr-isotope signals by marine redox cycling. Our sample set includes carbonates from the Turukhansk Uplift succession (Siberia), the El Mreiti Group (Mauritania), the Vazante Group (Brazil), and the Society Cliffs Formation (Canada), providing a global perspective on Cr-cycling in the late Mesoproterozoic. Our results suggest that levels of oxygen sufficient to support early animals were attained long before metazoans actually diverged, but also that the transition from transient, regional oxygen enrichment to permanent and global state change may be a Neoproterozoic phenomenon.

[1] E.A. Sperling *et al*. (2013) *Proceedings of the National Academy of Sciences, USA* **110**, 13446-13451. [2] N.J. Planavsky *et al*. (2014) *Science* **346**, 635-638.