Long-term climate change due to the paleogeographic distribution of LIPs and ophiolite-bearing sutures

FRANCIS A. MACDONALD[1], NICHOLAS SWANSON-HYSELL[2], YUEM PARK[2], OLIVER JAGOUTZ[1]

[1]Harvard, EPS, 20 Oxford St. Cambridge, MA 02138, fmacdon@fas.harvard.edu

[2]University of California, Berkeley, CA 94720, swanson-hysell@berkeley.edu

[3]MIT, EAPS, Cambridge, MA 02139, jagoutz@mit.edu

Climate change on timescales >1 Myr is due predominantly to changes in the geological sources and sinks of carbon that are modulated by the silicate weathering feedback. The relative contribution of modern CO_2 sources from ridges, plumes, and and arcs via CO_2 released from the subducted slab, the mantle wedge, metamorphism of the upper plate, and diffuse outgassing in the backarc is poorly constrained. Estimating changes in CO_2 sources in the past with geological data is further complicated by difficulties in measuring oceanic arc and ridge length and spreading rates where ocean crust has been destroyed. CO_2 sinks, however, are the product of variables such as lithology, paleolatitude, and uplift rates, which can be constrained with geological data. Given that mafic and ultramafic rocks are highly soluble in the warm and wet tropics, emplacement of large igneous provinces (LIPs) and arc-continent collisions at low latitude should increase planetary weatherability.

It has previously been proposed that LIPs or arc-continent collisions in the tropics have significantly contributed to specific episodes of climate change in Earth History, such as Neoproterozoic, Ordovician, and Cretaceous to Oligocene cooling. However, the uniqueness of LIP emplacement and arc-continent collisions in the tropics in association with climate change has not been systematically assessed. How often are major low-latitude LIPs and arc-continent collisions not associated with global cooling and in what context? To this end, we constructed a database of Phanerozoic ophiolite-bearing sutures and LIPs that can be reconstructed with paleogeographic models utilizing GPlates. These reconstructions provide a framework for analyzing the relationships between the latitudinal distribution of highly weatherable mafic and ultramafic lithogies and Phanerozoic climate change.