Focussed degassing of stored continental deep carbon

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Carbon (C) recycling from the Earth's surface to its interior depends on the rates of carbon subduction, carbon outgassing and deep carbon storage. New compilations of CO_2 outgassing from volcanic arcs indicate a lower CO_2 flux [1, 2] than the amount that is subducted, consistent with the idea of potentially significant C storage below the arc crust [4]. Estimates of the overall release of crustal C, however, range from minor [5] to significant [6]. Over geologic times, stored C can accumulate in the cratonic lithosphere below continents [7] and at cratonic edges in the East African Rift massive amounts of CO_2 are released into the atmosphere [8]. New gas data were collected from springs and diffuse discharges along the orogenic-cratonic transition in the Lake Manyara to Gendabi basin in Tanzania in 2018. Compared to the Natron-Magadi rifted region to the north, these new data reveal much weaker mantle-derived CO_2 emission, purely crustal helium isotope values, biogenic C isotopes, and low C/N-C/He ratios. These results support the concept of focussed and variable C release along craton edges. Magmas generated by small degrees of partial melting at the cratonic edges are consequently strongly enriched in C, as illustrated by the current locations of carbonate-rich magmatism around the Tanzanian Craton, including Oldoinyo Lengai, the world's only active carbonatite volcano, and Nyiragongo and Nyamuragira, the world's highest volcanic CO_2 emitters. When advancing our knowledge of the Earth's C budget, long-term storage below continents needs to be taken into consideration and quantified.

[1] Werner et al., (in press) *Deep Carbon, Past to Present Cambridge Univ. Press;* [2] Fischer et al., (in rev) Sci. Rep.; [4] Kelemen and Manning (2015) PNAS 112, E3997-E4006; [5] Aiuppa et al., (2017) Earth Sci. Rev. 168, 24-47; [6] Mason, E., M. et al., (2017), Science, 357, 290-294. [7] Foley and Fischer (2017) Nature Geosci. 10, 897-902; [8] Lee et al., (2016) Nature Geosci. 9, 145-149.