U-Pb geochronology and Lu-Hf isotope data from meta-carbonatites in the southern Canadian Cordillera

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Of the 14 carbonatites in British Columbia [1] only 7 have been dated yielding a wide range of dates interpreted as intrusion ages, which cannot be explained within a coherent tectonic setting. The scope of this study is to provide reliable age data for several undated and/or previously unknown carbonatites.

U-Pb and Th-Pb ages of zircons and accessory phases from meta-carbonatites, obtained by LA-SF-ICP-MS techniques, of the southern Canadian Cordillera provide evidence for two episodes of carbonatitic magmatism during the Cambrian at around 500 Ma and the Late Devonian to Early Carboniferous at ~360-340 Ma. Furthermore, episodes of regional metamorphism are recorded by Pb-loss of the zircons and/or new zircon growth at ~170 Ma, 70-65 Ma and ~50 Ma. Lu-Hf isotope data from these zircons show a complex pattern of homogenous to strongly varying values between and within samples, indicating isotopic differences in the magmatic sources or different degrees of isotopic disturbance during metamorphism. In addition, U-Pb age dating of the accessory phases allanite, apatite, baddeleyite, monazite, pyrochlore, titanite and zirconolite will be conducted in order to determine the intrusion ages and the timing of high-grade metamorphism as well as its effect on the different minerals.

In this study 10 carbonatite, 2 mafic and 4 syenite samples are currently being processed and the results will provide new constraints on the geodynamic evolution of the Canadian Cordillera with regard to carbonatitic-alkaline magmatism. This in turn will help to elucidate why some of the investigated carbonatite-alkaline complexes are of economic interest with regard to the Rare Earth Elements (REE) and Ta and Nb.

[1] Woolley & Kjarsgaard (2008) *Carbonatite occurences of the world, Map & Database*. Geological Survey of Canada, Open File 5796.

Long period oscillations in the Neoproterozoic carbon cycle

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The proposed Neoproterozoic snowball Earth events imply a super-greenhouse period following deglaciation, in which the high CO_2 concentration required to initiate glacial retreat coupled with the decrease in planetary albedo causes greatly elevated surface temperature [1]. In this situation, increased reaction kinetics would drive greater silicate weathering fluxes, which draw down CO_2 until a steady state is achieved [2].

However, the speed at which the system returns to steady state is highly dependent on the global erosion rate. When temperature and runoff are very high, the supply of cations to the weathering zone becomes a limiting factor for silicate weathering [3]. Using estimates for post-snowball CO_2 concentration [1, 4] and the Phanerozoic average erosion rate [5] yields a stabilisation time of $>10^7$ years in the COPSE biogeochemical model [6], comparable with the timing of Neoproterozoic glaciations.

Extended periods of high temperature and nuteirnt abundance following a snowball glaciation may help to explain the biological advances made over the Neoproterozoic, as well as the geochemical features such as long positive excursions in $\delta^{13}C$ and massive deposition of phosphorus. Conversely, evidence that CO_2 concentration quickly returned to low levels might help constrain our views on snowball Earth.

[1] Hoffman *et al.* (1998) *Science* **281**, p. 1342–1346. [2] Walker *et al.* (1981) *JGR* **86**, p. 9776–9782. [3] West *et al.* (2005) *EPSL* **235**, p. 211–228. [4] Pierrehumbert (2005) *JGR* **110**. [5] Wilkinson & McElroy (2007) *GSA Bulletin* **119**, p. 140–156. [6] Bergman *et al.* (2004) *Am.J.Sci.* **304**, p. 397–437.