



## **New high precision zircon and baddeleyite U-Pb TIMS ages of the Karoo Large Igneous Province**

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The African part of the Karoo Large Igneous Province (K-LIP) comprises a range of basaltic lava flows, sills, dyke swarms and evolved volcanic rocks that were emplaced approximately in the time interval between 185 to 175 Ma [1]. Currently, rocks associated with K-LIP are found between the Karoo Basin that is located in South Africa and Swaziland [2] and further north, in Zimbabwe, Mozambique, Botswana, Zambia and Namibia [1]. Available Ar-Ar ages document an apparent south-to-north migration of the magmatic activity [1]. Furthermore, the density distribution of Ar-Ar ages from K-LIP rocks suggests 2 to 3 peaks in the magmatic activity at  $\sim 183$  Ma,  $\sim 180$  Ma and  $\sim 176$  Ma respectively (e.g., [3]). The onset of the magmatic activity in the Karoo Basin at  $\sim 183$  Ma is of global importance due to the probable connection with the climatic and biotic crisis during the Toarcian oceanic anoxic event (T-OAE). The second question of importance is verifying the duration of the K-LIP, or, in other words, corroborating the apparently protracted K-LIP activity until 176 Ma by accurate zircon and baddeleyite U-Pb ages.

With the goal of reducing the uncertainty between both the correlation with the T-OAE and the total duration of the K-LIP, we dated zircon and baddeleyite from a series of samples across a S-to-N transect of the K-LIP: three dykes from the Karoo Basin, one rhyolite north of Swaziland and a syenite from Zimbabwe. Only considering the small dataset we report here together with the ages published in Sell et al. [4] confirms (i) the south-to-north migration of the magmatic activity over around 6 My from 183.0 to 176.7 Ma, and (ii) that the dyke emplacement in the Karoo Basin occurred over a restricted time interval between  $183.01 \pm 0.06$  Ma and  $182.68 \pm 0.14$  Ma. This latter result is in perfect agreement with the range of dyke U-Pb ages from Svensen et al. [2] and Corfu et al. [5] ranging from  $183.4 \pm 0.5$  to  $182.7 \pm 0.6$  Ma, corroborating our excellent interlaboratory reproducibility. These data support the hypothesis that a ca. 300 ky long pulse of basalt dyke injection into the sediments of the Karoo Basin, and associated release of magmatic and thermogenic volatiles into the atmosphere caused the environmental and biotic changes known as Toarcian oceanic anoxic event.

Our new U-Pb data set together with the Sell et al. [4] data are as well in line with the hypothetic peaks of younger magmatic activity at  $\sim 180$  and  $\sim 176$ -177 Ma. Ongoing work will study the significance of these pulses as well as temporal change of melt sources over the lifetime of the K-LIP.

[1] Jourdan, F. et al. (2005) *Geology*, 33(9), 745. [2] Svensen, H., et al., (2012) *EPSL*, 325-326(C), 1–9. [3] Ware, B., et al. (2018) *EPSL*, 503, 181–193. [4] Sell, B. et al. (2014) *EPSL*, 408(C), 48–56. [5] Corfu, F., et al., (2016) *EPSL*, 434(C), 349–352.