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The Karoo Large igneous province and the Pliensbachian - Toarcian boundary

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Geochronology is a tool of choice when one tries to understand the relationships between biotic crises and climate change. In particular, absolute (isotopic) geochronology which allows testing synchronicity between two events or measuring their respective duration. Increasing isotopic age data over the past few years and a better understanding of the isotopic systems (e.g. decay constant bias; statistics; alteration effects) drastically improved the knowledge we have on the geodynamic history of large igneous provinces (LIPs). It now provides us with the opportunity to correlate LIPs to the stratigraphic timescale with an unprecedented accuracy and precision.

The statistically filtered and standardized age database of the $>3x10^6$ km^2 Karoo province (southern Africa) is now sufficiently large (n>70; [1]) to allow correlating the Karoo CFB emplacement with the Pliensbachian-Toarcian second order biotic extinction and associated global warming (and anoxia condition). We apply a 1% decay constant bias correction to the $^{40}Ar/^{39}Ar$ ages of the database to compare them with the U/Pb age of the Pliensbachian-Toarcian (183.0 $\pm$ 1.5 Ma; [2]). The mass extinction and the isotopic excursions recorded at the base of the Toarcian appear to be synchronous with both an increase of magmatic production rate of the Karoo province and the emplacement of a huge sill complex that intrudes carbon-rich sedimentary layers of the southern Africa Karoo basins. Greenhouse gases from both the Karoo LIP and the coal-layers might be the main culprits of the global warming and oceanic anoxic conditions recorded at this time [3]. Additionally, we propose that the relatively low eruption rate of the Karoo province (main peak duration of 4 ± 1 Ma; [4] is one of the main reasons explaining why its impact on the biosphere is relatively low contrary to e.g. the CAMP (Triassic-Jurassic) and Siberia (Permo-Triassic) provinces.

[1] Jourdan et al., Lithos 98 (2007), 195-209.

[2] Gradstein et al., ICS (2004). www.stratigraphy.org

[3] Beerling & Brentnall, Geology 35 (2007), 247-250.

[4] Jourdan et al., G-cubed 8, Q02002, 1-20