

EGU2020-4145

<https://doi.org/10.5194/egusphere-egu2020-4145>

EGU General Assembly 2020

© Author(s) 2020. This work is distributed under the Creative Commons Attribution 4.0 License.



Sills Sautéing Shales: Did Karoo Intrusions into the Eccca Formation cause the Toarcian Ocean Anoxic Event?

Sean P. Gaynor¹, Urs Schaltegger¹, and Henrik Svensen²

¹University of Geneva, Sciences de la Terre et de l'Environnement, Department of Earth Sciences, Geneva, Switzerland

²Physics of Geological Processes, University of Oslo, Oslo, Norway

Eruptions of Large Igneous Provinces (LIP) are commonly correlated with global climate change, and environmental, as well as biological, crises. However, establishing a causative link via chemical and physical proxies for global change is more complicated and often ambiguous. As technical improvements have allowed for increasingly higher precision dates especially in U/Pb dating, it is possible to better assess hypotheses connecting LIP's and environmental impact via their contemporaneity. Here, we focus on the early Jurassic period, which includes a period of global change known as the Toarcian oceanic anoxic event (TOAE), as well as emplacement of the Karoo Large Igneous Province (K-LIP). Previous work has tied these two events together due to overlapping chronology and observed metamorphism and degassing (e.g., Svensen et al., 2012; Sell et al., 2014), and excellent exposure allows for extensive sampling of both the intrusive and extrusive components of the K-LIP. Therefore it is possible to directly study the influence of intrusive LIP magmatism on potential climate forcing.

The K-LIP is comprised of a suite of basaltic lava flows, sills, dike swarms, centered in southern Africa. Approximately 340,000 km³ of sills are interlaid within the Karoo Basin, and therefore served as significant heat source to the basin upon emplacement. While much of the sedimentary rocks of the basin are siliciclastic, the Eccca Group contains organic-rich facies and hosts 160,000 km³ of basaltic sills (Svensen et al., 2012). This unit is therefore uniquely capable of generating large volumes of thermogenic gas through thermal metamorphism of the organic matter of the shale. Previous mass balance calculations indicate that between 7,000 and 27,000 Gt of CO₂ equivalents was released through metamorphic reactions in contact aureoles within the Eccca Group (Svensen et al. 2007). If intrusive magmatism was short lived within this formation, causing rapid volatilization and degassing from the shales, than this event could represent a mechanism to drive a short pulse of global climate change. Previous studies have shown that intrusions are coeval with the TOAE (Svensen et al., 2012; Corfu et al. 2016), however higher-precision geochronology data from the sills is necessary to determine if the flux and timing of thermogenic gases from the basin was sufficiently high to destabilize Earth's climate. In order to test the hypothesis, we present single crystal U-Pb zircon dates from sills across the Eccca Group. These data will be used (i) to quantify the duration and flux rate of carbon gas during the intrusive event, and (ii) to better understand how and to what extent K-LIP intrusive activity and associated thermogenic gas release of Eccca wall rocks were able to drive global climate change.

Corfu, F., et al., (2016) EPSL, 434, 349-352.

Sell, B., et al., (2014) EPSL, 408, 48-56.

Svensen, H., et al., (2007) EPSL, 3-4, 554-566.

Svensen, H., et al., (2012) EPSL, 325-326, 1-9.