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# 40Ar-39Ar geochronology of the Karoo flood basalts: tracking disturbance in the isotopic system.

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High precision dating of Large Igneous Provinces (LIP) is not only useful to understand their link to environmental changes and mass extinctions (Courtillot and Renne, 2003), but they also provide insights into the geodynamic setting in which they form (Encarnación et al., 1996). The Drakensberg continental flood basalts of South Africa and Lesotho are part of the Karoo LIP, which is presumably responsible for a phase of global climate change and disturbance of the oceanic ecosystems (the so-called Toarcian oceanic anoxic event T-OAE; Pálfy and Smith (2000)). However, the paucity of zircon or baddeleyite in most continental flood basalts renders is difficult to match the sub-permil age precision and accuracy that is typical for high-precision U/Pb CA-ID-TIMS age determination. Previous attempts to date the Karoo lavas using the $^{40}$Ar-$^{39}$Ar method failed to yield sufficient precision and accuracy for resolving the sequential stacking of the different basalt units. For example, $^{40}$Ar-$^{39}$Ar analyses of carefully selected plagioclase separates yielded dates that are inverted relative to their stratigraphic position, with uncertainties that encompass the entire duration of volcanism in the area (Jourdan et al., 2007; Moulin et al., 2017). Here we test the hypothesis that previous, inconsistent $^{40}$Ar-$^{39}$Ar dates of plagioclase were a consequence of degassing of primary, metasomatic and alteration phases (mainly zeolites with subordinate sericite and carbonate) within single or multiple crystals. The lavas are mainly tholeiitic basalts that display two distinct sizes of plagioclase, which can be dated separately. Petrological characterization of these two size fractions shows that the larger plagioclase crystals (100-400 µm) are more altered and fractured than the smaller grains and are therefore more likely affected by post-crystallization disturbance of the Ar isotopic system. We present preliminary $^{40}$Ar-$^{39}$Ar data from i) untreated plagioclase that hosts visible alteration phases, ii) untreated plagioclase that is devoid of visible alteration phases (2 grain size aliquots), and iii) leached plagioclase that is devoid of visible alteration phases (2 grain size aliquots). The results of this study may enhance the effectiveness of the $^{40}$Ar-$^{39}$Ar dating technique to accurately constrain the crystallisation ages of altered mafic lavas, which form the majority of the exposed Karoo LIP flood basalts. Ar isotope data were collected using a multi-collector Argus VI mass spectrometer, and irradiated in an un-shielded reactor position to optimize the formation of $^{38}$Ar from Cl to permit identification of different gas reservoirs in the sample through isochemical dating, based on Ca, K and Cl in-situ concentration (EPMA) and Ar isotopic ratios.