Geophysical Research Abstracts, Vol. 8, 09495, 2006
SRef-ID: 1607-7962/gra/EGU06-A-09495

From flood basalts to the onset of oceanisation: example from the $^{40}Ar/^{39}Ar$ high-resolution picture of the Karoo Large igneous province

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The Karoo large igneous province (177-185 Ma; [1,2]) consists of vast quantities of basaltic lava-flows, giant radiating dyke swarms and poorly studied silicic magmatism. The Karoo magmatism occurred over more than 3 millions km^2 and was associated with the opening of the Indian Ocean. We present new $^{40}Ar/^{39}Ar$ geochronological data concerning the easternmost part (i.e. the Mwenezi and Lebombo areas) of the Karoo province, close to the future rifted margin. These data allow documenting the final history of the Province and the period between the end of magmatism and the initial phase of oceanisation. This important type of information is poorly documented for most of the Large Igneous Provinces. Eighteen plagioclase separates yielded 15 plateau and " mini-plateau " ages obtained on 4 basaltic dykes (178.1 $\pm$ 1.1 to 177.2 $\pm$ 2.4 Ma; 2 sigma), 3 gabbroic (178.2 $\pm$ 1.7 to 176.8 $\pm$ 0.7 Ma) and 2 silicic (175.8 $\pm$ 0.7 to 174.4 $\pm$ 0.7 Ma) plutons and 1 rhyolite lava-flow (177.8 $\pm$ 0.7 Ma). We also obtained three concordant plateau and mini-plateau ages ranging from 173.9 $\pm$ 0.7 Ma to 172.1 $\pm$ 2.3 Ma on the atypical E-MORB-like N-S striking Rooi Rand dyke swarm. One dyke from the Save-Limpopo N70°-oriented giant dyke swarm provides a mini-plateau age of 177.7 $\pm$ 0.8 Ma in agreement with the dates previously determined on this branch and possibly assessing a similar age and duration ($<$ 2 Myr) as the 179 Ma Okavango dyke swarm.

When we put together new and previous selected age data obtained on the Karoo province, we observe that the magmatism was active over more than 10 Myr from 185 to 174 Ma. The main basaltic phase occurs mostly over the first $\sim$8 Myr and is progressively followed by a more differentiated magmatism over the last 4 Myr. The

easternmost Lebombo-Mwenezi long lasting magmatism is interpreted as being triggered by the progressive lithospheric extension preceding the continental disruption. The transition from rifting to oceanisation is probably illustrated by the E-MORB-like Rooi Rand dykes which are likely to be emplaced during or shortly after the final stage of the Karoo magmatism. A geodynamic evolution of the province is proposed.
Geological, geochronological and tectonic relationships between major Phanerozoic CFBs and their associated continental breakup suggest that most of the CFBs were emplaced in areas already in extension since tens millions of years and that the onset of oceanisation slightly follows (1-2 Myr) or is coeval with the flood basalts activity.

[1] Jourdan et al (2005), Geology 33, 745-748.
[2] Duncan et al (1997), JGR 102, 18127-18138.