

# A low- $\delta^{18}\text{O}$ hydrothermal breccia from the Koegel Fontein Complex, South Africa

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The 134 Ma Koegel Fontein Complex is situated 350 km north of Cape Town and is the only large igneous complex south of Namibia related to the break-up of southern Africa and South America. Rocks from the complex are notable for having low- $\delta^{18}\text{O}$  values. The rocks with the lowest  $\delta^{18}\text{O}$  values are highly brecciated with a fine-grained black matrix. This breccia rock is compositionally variable ( $\text{SiO}_2$  43-61wt.%) and has  $\delta^{18}\text{O}$  values that range from 1.6‰ to -5.2‰ (mean = -2.6‰; n=16). The variation in major element composition of these rocks is consistent with the existence of at least three distinct components, two of which are suggested to be igneous in origin (trachyte and basalt), and one metamorphic (xenoliths of gneissic country rock). The presence of epidote in these rocks indicates that any interaction with fluid was between 300-400°C. However, the overall water content in the breccia rocks is low (<1.1 wt.%  $\text{H}_2\text{O}$ ), which is consistent with final equilibration with fluid at relatively high-temperature.

Field mapping indicates that the breccia started off as a plug-like intrusion, which extended along plane(s) of weakness for up to 2 km on either side of the plug, and eventually formed a dyke-like intrusion with a bulge in its centre. The estimated  $\delta^{18}\text{O}$  value of the alteration fluid (-10 ‰) seems too low for the latitude and climate expected at 134 Ma. It is, therefore, proposed that the breccia rock is of hydrothermal origin and formed during initial dehydration melting of low- $\delta^{18}\text{O}$  metamorphic basement rocks (lowest xenolith  $\delta^{18}\text{O}$  value of

-5.6 ‰; mean = -2.1‰, n=7). The original lowering of  $\delta^{18}\text{O}$  values in the country rock most likely pre-dates the formation of the complex and may have occurred during the Pan-African orogeny, a time of global glaciation. The low  $\delta^{18}\text{O}$  values in the breccia could result from a combination of the incorporation of country rock and the interaction with low- $\delta^{18}\text{O}$  metamorphic fluids derived from the gneiss. These fluids presumably collected within the crust before rapid, possibly explosive release along pre-existing crustal weaknesses occupied by basalt and trachyte dykes. We suggest that the hydrothermal breccia marks the initial stage of crustal melting, which culminated in the intrusion of the 25 km in diameter Rietpoort Granite.