Constraining the origin of CO_2 upwelling beneath southern South Africa using noble gases

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The Lesotho-KwaZulu-Natal region of south-eastern Africa displays numerous enigmatic geological phenomena given its location on a long-lived continent. These include active seismicity, anomalously high topography, recent small-scale volcanic activity, thermal springs, a high geothermal gradient and active CO_2 seeps.

Here we will uniquely show an unambiguous mantle origin for the CO_2 being released along the Ntlakwe-Bongwan fault in southern KwaZulu-Natal using new noble gas isotope data. Helium, neon and argon isotope systematics confirm that the degassing CO_2 is sourced from a moderately undegassed mantle source rather than the convecting depleted upper mantle.

This potetnially provides the first geochemical evidence of the previously hypothesised Quathlamba mantle plume, providing an explanation for the regions enigmatic geological phenomena, the chain of volcanic seamounts in the Natal Valley and the anomalous bathymetry and seamounts of the Mozambique Basin.

Hence, we belieive that the region provides a unique insight into ongoing early stage effects of mantle hotspot interaction with the stable continental crust. Our work shows that even modest mantle upwelling can cause significant tectonic effects and has obvious implications for future volcanic and tectonic activity in the region and beyond.