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Fracture Controlled CO_2 gas migration at the Bongwana Natural CO_2 Release Site, South Africa.

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Understanding the role of faults and fractures as fast pathways for CO_2 through overburden strata is critical for ensuring carbon capture and storage (CCS) site integrity. For example, the veracity of the In Salah CO_2 CCS site is questioned due to the role of fractures in creating a conductive network through which CO_2 can migrate. Here we present data from a natural CO_2 release in South Africa that supports the hypothesis that faults and fractures can act as significant migration pathways for CO_2 in the sub-surface, and to the surface, and are a crucial consideration for CCS projects.

Natural CO_2 releases are identified at several sites along the Bongwan-Ntlakwe fault in southern KwaZulu-Natal, South Africa. These release sites were first described in the early 20th century as dry gas exhalations (98% CO2) along a 150 m line cutting through farmland near the Bongwana rail siding. Since then little work has been reported, however other gas seeps and the formation of travertines have been noted. It is thought that natural CO_2 is being released along the length of an ~80 km fault that cuts through Dwyka Group tillite caprock above a potential carbonate hosted CO_2 reservoir. A team of Scottish and South African researchers performed initial fieldwork and reconnaissance in September 2015. In the field, sampling was undertaken for: stable isotope and noble gas analysis of water and gases, travertines for dating and stable isotope analysis; as well as soil gas chemistry and flux measurements. Structural geological mapping and sampling of the fault zone was also undertaken and forms the main set of data presented here.

Three main localities at the northern end of the fault were visited, where CO_2 springs and gas bubbles in rivers had been reported. Structural characterisation of the sites documents the change in nature of both the CO_2 seeps and structural characteristics of the fault along strike. The fault is generally defined by a broad fracture zone. Fractures predominantly trend North-South and have dip-slip slickensides, but the fractures are locally re-oriented NE-SW in an area where the fault trace bends. At this bend the fault is heavily kaolinitised, and is recognised by a white, apparently pulverised, rock mass. CO_2 flux measurements demonstrate a clear spatial relationship with the fault/fracture zone. The CO_2 flux, is apparently controlled by fracture flow of the CO_2 to the surface, associated with faulting.