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Natural carbon sequestration process into shallow sill intrusions – numerical modelling, land-based and IODP drilling investigations

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Permanent carbonate mineralisation in basalt is a promising solution for Carbon Capture and Storage of anthropogenic greenhouse gases without the risk of leakage. While this process is known to occur at relatively low temperatures below 100°C, new research on Large Igneous Provinces (LIPs) and young rift basins suggests that much of the thermogenic gases mobilised during contact metamorphism can remain trapped and mineralised in the sills that mobilised them. This discovery is the result of two distinct drilling investigations on land (KARIN) and at sea (IODP Exp 385). It shows that basalts may not only trigger the sudden release of thermogenic gas, but also represent an important carbon sink. The two examples of carbonate trapping in sills presented here are from the Karoo and Guaymas basins. Results indicate that a large fraction of epimagmatic fluids charged with thermogenic gas systematically penetrated inside the sills during cooling. Our numerical solutions suggest that in both cases the higher permeability of the sill acquired during cooling and crystallisation compared to that of its host, ultimately dictates the fate of the thermogenic gas that accumulated in the igneous bodies.