Tracking the crustal sinks of mantle-derived CO_2 sampled in South Atlantic Brazilian sedimentary basins

E. T. DE MORAIS[1,3*], V. ROUCHON[2] AND M. MOREIRA[3]

[1]Petrobras R&D Center, Av. Horácio de Macedo, 950. 21941-915, Rio de Janeiro, Brasil, (*correspondence: ericat@petrobras.com.br)
[2]IFP Energies Nouvelles, 1 et 4 avenue de Bois-Préau, 92852 Rueil Malmaison, France (virgile.rouchon@ifpen.fr)
[3]IPGP, 1 Rue Jussieu, 75005 Paris (moreira@ipgp.fr)

Regions of mantle melting, such as mid-oceanic ridges and zones with hyper-extended crust are characterized by a relatively high concentration of mantle-derived gases [1]. The South Atlantic Margin of Brazil is one of these regions where mantle exhumation and multiple magmatic events over its geological development attest to the influence of mantle processes on sedimentary basin formation [2]. New data on noble gases and carbon isotopes in gases from sedimentary basins located on the offshore area of the Brazilian South Atlantic margin (BSAM) have allowed further understanding of the multiple origins of fluids trapped in CO_2-rich oil reservoirs, and on the fate of mantle-derived CO_2 at the crustal scale.

In all studied basins, the $CO_2/^3He$ ratios are well correlated with the $^3He/^4He$ ratios and the CO_2 abundance, regionally indicating an increase from North to South of the mantle volatile influence along the BSAM. The expected $CO_2/^3He$ ratio and $\delta^{13}C_{CO2}$ fractionation resulting from the isotopic equilibrium between gaseous CO_2, CO_2 dissolution and carbonate precipitation were calculated based on reported temperature and salinity dependent fractionation factors. According to calculations, we suggest that the main process of CO_2 removal are carbonate precipitation at temperatures in excess of 250°C, that likely occurred during CO_2 migration through the crust and dissolution into basin formation groundwater. Both processes have suppressed up to 98 % of initial mantle-derived CO_2.

The magnitude of CO_2 removal seems regionally correlated with the distance to main drainage areas of mantle volatiles, represented by major crustal faults. These results can be also useful as natural analogs for studies of CO_2 anthropologic storage.

[1] Kennedy *et al*. (2007) *Science* **318**, 1433-1436. [2] Magnavita *et al*. (2012) *34th Inter. Geological Congress*, 68.