# Fluid pathways in fractured carbonate rocks

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Structural, petrological and geochemical ($\delta^{13}C$, $\delta^{18}O$, $^{87}Sr/^{86}Sr$ and ICP-MS) analyses of calcite veins and carbonate host rocks are used to establish a fluid-flow evolution model for the Achado outcrop in the Irecê Basin (Neoproterozoic Salitre Formation, Una Group, São Francisco Craton), NE Brazil. Combined to structural data, the geochemical data show different fluid migrations over time: during deposition, early contraction and main folding stages. Then, during post-folding stages, conjugate fractures and later strike-slip faults also influenced fluid flow within the basin.

The Achado outcrop exhibits present day karstic features controlled by fractured carbonate layers that are strongly affected by along strike brittle deformation and by millimetre-scale carbonate veins formed parallel to the maximum tectonic stress direction. Our isotopic data show that limestone and dolomite exhibit large variations in $\delta^{13}C$ (-8.7 to +10.3‰) and $\delta^{18}O$ (-4.9 to -2.7‰). The high $\delta^{13}C$ values are primary and relate to highly positive carbon isotope limestones at the upper part of the succession. In contrast, carbonate from veins and hydraulic breccias present lower isotope values than carbonate host rocks. We confirm that the Achado Thrust Fault Damage Zone shows permeability reduction and hence behaved as a barrier to isotopic fluid homogenization.

The Irecê basin and its geological features are considered important for the understanding of processes that can effect the offshore Pre-Salt carbonate reservoirs on the Brazilian eastern continental margin. The expulsion of hydrothermal fluids may cause carbonate dissolution and hypogenic karstification that can create large scale cave systems. These macro permeability anisotropies must be considered during well planning since remnants of cave/karst system at depth can create drilling problems, such as severe mud-loss, due to the potential for high permeability pathway preservation.