Estimation of the partial fluid composition after fluid-rock interaction: from mass balance calculations with an application to natural dolomitization

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Using the example of dolomitization where calcite is replaced by dolomite, estimation of the fluid composition in equilibrium with dolomite for major and trace elements was estimated based on EPMA and LA-ICP-MS data using a mass balance approach. The method consists in an analytical quantification of the mass transfer between the original calcite and the newly formed dolomite giving us which elements are coming in and out of the system. Chemical composition of the aqueous fluid in equilibrium with dolomite can be estimated such as the partition coefficient for each element involved in the reaction. This approach was tested using three existing datasets obtained from natural dolomite and original limestone in both Jurassic limestones of the Layens anticline in the Pyrenees (France), and two from the Middle Devonian Presqu’ile barrier from Pine Point (Canada). These are completed with data acquired in Cretaceous limestones of the Benicassim area of the Maestrat Basin (Spain). Using the result obtained with the mass balance calculation, the amount of fluid required to dolomitized a fixed amount of limestone can be obtained for different fluid source (brine and seawater). Results show that the four dolomitization reactions have similar solid volume variation (-14 to -10 vol.%) and the fluid in equilibrium with the dolomite have also similar concentration in trace element. Estimation of the partition coefficients for all trace elements for the three regions were determined and compared.