



Determination of the stable isotope compositions of different carbonate minerals in CO₂-bearing reservoirs in Hungary: a new approach

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Abstract

Stable isotope systematics of carbonates found in the CO₂-bearing reservoirs can help to better understand the chemical and physical processes, which control the carbonate dissolution and precipitation during CO₂ flooding. In addition, they can be used to trace the origin of the fluids (CO₂ and H₂O), from which different mineral phases are formed. However, the determination of the stable isotope composition of the different carbonates is not simple. These phases are generally fine grained and occur together in the sandstone, where the CO₂ invaded. Therefore, most of the stable isotope studies on CO₂-bearing reservoirs (McCrea, 1950, Baker et al., 1995, Liu et al., 2011) follow the same approach. In this methodology, whole rock samples, containing several different carbonates, are reacted with 100 % orthophosphoric acid at 25 °C for 6, 24 and 48 hours to extract sequentially different carbonate minerals (i.e., calcite, dawsonite, ankerite) and analyze their carbon and oxygen isotopic compositions.

Our work proved that this widely used method is inappropriate to separate properly the carbonate minerals as the CO₂, produced during the acid reaction, represents a mixture, which are originated from the carbonate minerals in different proportions. Thus, in the present study we used pure mineral phases (calcite, dolomite, ankerite, dawsonite, siderite) to react them with 100 % orthophosphoric acid at 25 °C for 1, 6, 24 and 48 hours and determine the amount CO₂, which resulted in by the acid reaction and analyze their carbon and oxygen isotopic composition.

The amount and isotopic composition of CO₂ gas developed during the dissolution of calcite and dawsonite have not been changed significantly after one hour, suggesting that these carbonates cannot be separated by using different reaction time. Majority of the ankerite and dolomite was reacted in the first 24 hours, thus these minerals also cannot be separated from each other only by using distinct reaction times. In addition, the isotopic composition of ankerite and dolomite does not show significant variation after 24 hours. Based on these experiments, it is evident that the described method by Liu et al. (2011) is not suitable for separating carbonate minerals (calcite, dawsonite, ankerite, dolomite) and determine their stable isotopic composition. Instead, we suggest to separate the carbonate minerals from the CO₂-bearing reservoir and to analyze them separately. Following this approach, we have separated different carbonates from a natural CO₂-bearing reservoir, which is located in West Hungary (Mihály-Répcelak) and determined their stable isotope composition. We compared the results to reveal differences in their origin.

Acknowledgement:

This research was financed by the Hungarian Scientific Research Fund (K1159727). The János Bolyai Research Scholarship of the Hungarian Academy of Sciences financially supported György

Czuppon's work. Dóra Cseresznyés's work supported by the ÚNKP-17-2 New National Excellence Program of the Ministry of Human Capacities.

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