

Cyclic Zoning in Authigenic Ankerite-Dolomite Indicates a Complex Relationship Between Fault-Rupturing and the Silicate, Sulfide, and Carbonate Diagenetic Systems

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Abstract

Cyclic chemical zoning in dolomite-ankerite crystals was observed in a reservoir sandstone unit in the northern Bonan Sag, a lacustrine rift basin in the Jiyang Depression of Bohai Bay Basin, China. These dolomite-ankerite cements are found in the vicinity of faults that were active during the deposition and burial of the rocks. The association of the dolomite-ankerite cements with pyrite, organic matter, and the overlying sulphate-rich evaporate sequence, and oxygen isotopes, suggesting that the carbonates and pyrite formed from thermochemical reduction of sulphate at temperatures above 100 °C. The thermodynamic calculation of the dolomite-ankerite solid-solution obtained the maximum Fe aqueous activity fraction for 0.0035 and Mg for 99.9965 when ankerite precipitated. The dolomite-ankerite zones alternate between low and high Fe-content and show evidence of corrosion before each growth stage. This is suggested to be caused by an alternating aqueous Fe-concentration, being controlled by the relative rates of pyrite formation and Fe supply by silicate mineral alterations. The complex relation between the silicate, carbonate, and sulphur/sulfide systems can be explained in terms of open-system diagenesis, where faults rupturing triggers influx of CO₂ and/or H₂S, and sulphate may be supplied by diffusion from the overlying evaporites. The model however relies on the relative kinetics of Fe-supply and

consumption by silicate alteration and pyrite precipitation, respectively, and must be regarded as a working hypothesis for further detailed studies on the silicate-sulphur/sulfide-carbonate system.