Mass-Balance Approach to Clastic Sediment Diagenesis Modeling: Feldspar and Calcite Interaction

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Diagenetic alteration of clastic sediments involves extensive exchange of mass between sandstone and shale. An important feature of moderate to deeply buried sediments of Gulf Coast is the precipitation of calcite as cements in sandstone. It has been previously suggested that significant amount of Ca can be derived from shale, and that pH is an important factor that can induce Ca mobilization. It is also believed that increasing CO(g) decreases pH, and that sufficient acetates in water can buffer pH changes induced by other reactions.

Less understood, but that may have a significant effect on Ca mobilization, are feldspar reactions. Because feldspars and carbonates share Ca and H elements in common it is reasonable to suspect that feldspar reactions can have a significant effect on carbonate minerals. This is especially true considering the abundance of feldspars in both sandstone and shale, even as lab experiments suggest their rates are orders of magnitude slower than those of carbonate minerals.

Extent of this interaction between feldspars and carbonate minerals is therefore tested using Balance diagenesis simulator. A series of simulations were carried out by varying imports of CO_2(g) and acetates to sandstone-shale couples of moderate to deeply buried Gulf Coast sediments. Quartz, feldspars, major clays (excluding chlorite), and calcite were used in the simulations. Resulting behavior diagrams that chart feldspar pH-buffering capacity as a function of other compositional variables are complex, but provide a new insight into feldspar-calcite interaction in clastic sediments.