

# Siliciclastic Diagenesis and Quartz Precipitation Driven by Mixing of Rock-Buffered Fluids of Differing Chlorinity

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Understanding the controls on burial diagenesis lies at the very heart of understanding the timing, pattern, and mechanisms of fluid flow and solute transport in sedimentary basins. One of the more perplexing problems of burial diagenesis has been in explaining the origin of large volumes of quartz cements and overgrowths in sedimentary sequences lacking evidence for stylolization or flow-through of large volumes of fluid. It can be shown, however, that significant volumes of quartz could be precipitated simply as a result of mixing rock-buffered fluids of differing chlorinity.

The major cation composition of saline basinal fluids worldwide can be explained by rock buffering with respect to multi-mineralic suites of silicate and carbonate phases (Hanor, 1994). Chloride is by far the dominant anion in these waters and generally behaves conservatively. That is, in the absence of evaporite dissolution, the concentration of chloride is controlled simply by processes of diffusion and of advection and dispersion of fluids of varying chloride concentration.

While the concentrations of individual buffered cations in saline waters generally increase with increases in salinity, the concentrations are a non-linear function of both chlorinity and salinity as a result of non-ideal effects and the stoichiometry of the various mineral hydrolysis reactions (Hanor, 1996). If mixing of waters having differing concentrations of the conservative component chloride occurs without inducing mineral-

fluid reaction, however, there will be a linear relation between the concentrations of these cations and chloride, and waters of intermediate chlorinity thus will be out of equilibrium with the ambient mineral assemblage.

Theoretical mass balance calculations have been performed to simulate the effects of mineral-fluid re-equilibration induced by advective-dispersive mixing of fluids of differing chlorinity in the presence of the metastable mineral assemblage: quartz, kaolinite, illite, Na-smectite, chlorite, albite, K-feldspar, calcite, and dolomite. Illite, chlorite, and calcite are favored to precipitate under such conditions, and Na-smectite, kaolinite, albite and K-feldspar, and dolomite are favored to dissolve. Most significant, however, are the large quantities of quartz that could be precipitated under isothermal-isobaric conditions without large volumes of fluids being involved as the relative proportions of the other mineral phases adjust to the changes in fluid composition resulting from mixing. Such a process may explain, for example, the occurrence of quartz cements at the transition between hydrostatically-pressured and overpressured sediments in the U.S. Gulf Coast, where episodic mixing of waters of differing salinity is known to occur.

Hanor JS, *Geological Society Special Publication*, **78**, 151-174, (1996).

Hanor JS, *SEPM Special Publication*, **55**, 3-12, (1996).