

Calcium variation in formation waters from petroleum reservoirs

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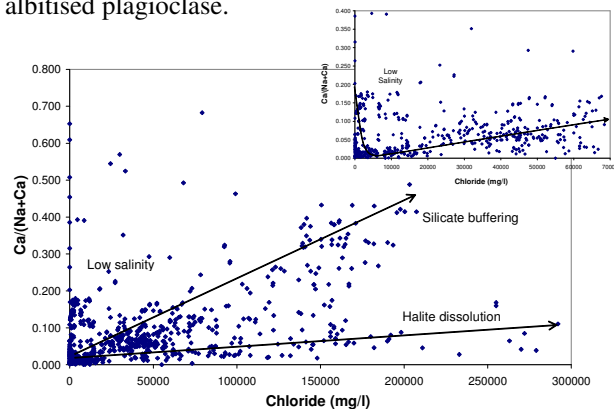
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Formation water compositions are highly variable with respect to both salinity and concentrations of calcium and other potential scale components.

We have compiled a dataset of water analyses from sedimentary basins worldwide. Yardley (2005) showed that concentrations of transition metals such as Fe, Zn and Mn vary systematically with fluid salinity and temperature in crustal fluids, due to rock buffering. Ca, Ba and Sr do not show these trends although the Ca/Na ratio tends to increase with salinity. This is likely the consequence of mineral-fluid exchange buffering $\log \text{mol Ca/Na}^2$, and is demonstrated in Fig 1, from which three main types of behaviour are apparent.

Formation waters of seawater salinity or greater mostly lie along a trend of increasing $\text{Ca}/(\text{Ca}+\text{Na})$ with chlorinity, indicative of buffering. A few datasets show low Ca concentrations even at very high salinity and are associated with the dissolution of halite beds. Very low salinity formation waters however show a marked increase in $\text{Ca}/(\text{Ca}+\text{Na})$ at low chloride levels and are bicarbonate dominated.

The existence of these three trends suggests that anion availability and fluid-mineral interactions are major factors dominating formation water chemistry. However it is also likely that in high porosity formations with concentrated pore fluids, the silicate buffer capacity is readily exhausted, as where calcic brines occur in formations containing only fully albitised plagioclase.



Yardley, B.W.D., 2005, *Economic Geology*, **100**, 613-632



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