

Spectral induced polarization signatures during calcium carbonate-iodate coprecipitation in Hanford formations sediments

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Abstract.

One of the challenges of Hanford site restoration strategies is to mitigate the fate and transport of harmful contaminants emplaced in the vadose and saturated zone. A promising remediation methodology is the immobilization of contaminants by means of their incorporation to the crystal structure of calcium carbonate mineral (calcite) during coprecipitation processes. In this study, we investigated the capabilities of the spectral induced polarization (SIP) method to sense the calcium carbonate-iodate coprecipitation in different Hanford formations sediments at column scale. Sediments were saturated with deionized water (DIW) (Phase I), and gently subjected to $\text{CaCl}_2 + \text{NaIO}_3$ (Phase II) and $\text{CaCl}_2 + \text{NaIO}_3 + \text{NaCO}_3$ (Phase III and IV) flow afterwards while the electrical response was monitored continuously. Calcium carbonate-iodate precipitates occurred in the form of CaIO_3CO_3 during Phase III and IV at two ionic strength regimes, 0.0235 mol/l and 0.05 mol/l, respectively. The SIP response to coprecipitation is characterized by a gradually increase of the quadrature conductivity accompanied by a decrease of the in-phase conductivity. Precipitates appear to start forming attached on the surface of grains at the low ionic strength regime, causing a low-frequency maximum polarization. An increase in the amount of precipitates upon Phase IV reduced the pore space causing clogging, which resulted in an enhanced polarization significantly at high frequencies. Our results show the SIP method is capable to detect the calcium carbonate coprecipitation in Hanford formations sediments, suggesting its suitability for monitoring the efficiency of such remediation technique in saturating conditions.

Key words: Hanford, calcium carbonate, iodate, coprecipitation, spectral induced polarization