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Evidence of self-sealing in wellbore cement under geologic CO2 storage conditions by micro-CT, SEM and Raman observations

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In this study, reaction experiments between CO2-saturated brine and wellbore cement samples cured under different pressures were conducted to study microstructural and mineral composition changes using micro-computed tomography (micro-CT), scanning electron microscopy (SEM) and Raman spectroscopy. The CT images of post-CO2 exposure cement samples showed a dissolution-precipitation-dissolution pattern at the exterior of the samples. The dissolution in the inner hole of the samples, however, was not significant. Instead, only CaCO3 precipitation was observed in the inner hole. CaCO3 precipitation in the inner hole contributes to selfsealing of the cement, which reduces the risk of CO2 leakage through wellbore cement. According to CT and SEM observations, a higher curing pressure caused more precipitation of CaCO3, which favored cement selfsealing when exposed to CO2. The appearance of a C—O peak and the disappearance of a –OH peak after reaction with CO2 were observed by Raman spectroscopy, which was attributed to cement carbonation that converted Ca(OH)2 into CaCO3. This study provides solid evidence of cement self-sealing due to cement carbonation under geologic CO2 storage circumstances.

Participation

In-Person

References

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