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Reaction-induced changes to structure and transmissivity of foamed wellbore cements

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Foamed cement is used in deep well construction for its strength, versatility, and ease of density adjustment by changing the gas fraction during slurry injection. When well cement is fractured it may encounter formation and injected fluids. Understanding potential reaction-induced changes in wellbore cement is crucial to managing well integrity in these situations.
To examine the alteration of a fractured foamed cement in a geologic carbon storage system, six Portland class H foamed cement samples were created with different gas fractions, fractured, and exposed to flowing CO2-acidified water (carbonic acid) over a period of several days. The experiments were conducted at room temperature, under a confining pressure of 8.27 MPa, pore pressure of 5.52 MPa, and were periodically imaged with a Computed Tomography (CT) scanner. The differential pressure across the sample was measured during the experiment to evaluate changes in fracture conductivity. Image analysis of the progressive changes in the matrix shows that foamed cements are a heterogenous material with varying degrees of susceptibility to reactive liquids. The transformation of cement matrix suggests both matrix dissolution and mineralogic alteration play a part as the reaction front migrates through the sample, with principal reacted zones residing in the immediate vicinity of the fracture. We present a discussion of the morphological changes observed in CT data in the cement matrix, coupled with an analysis of simulated fluid flow paths through the altered fracture geometry and transmissivities as the cement matrix reacts with carbonic acid.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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