Fe-saponite as alteration growth on low-carbon and stainless steel in hydrothermal-bentonite experiments

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Hydrothermal experiments on engineered barrier system (EBS) materials were conducted to characterize high temperature interactions of bentonite clay with candidate waste container steels (304SS, 316SS, low-C steel) for deep geological disposition of nuclear spent fuel. Wyoming bentonite was saturated with a 1,900 ppm K-Ca-Na-Cl solution in combination with stainless and low-C steel coupons.

Authigenic Fe-saponite precipitated utilizing steel as a growth substrate with Fe being supplied by steel corrosion. Concurrent with Fe-saponite formation, sulfides precipitated from sulfide-bearing fluids, from pyrite dissolution, near the steel interface. The presence of sulfides suggests highly reduced environments at the steel-clay barrier interface influencing steel corrosion rates and potential passivation mechanisms. This research shows that nuclear waste steel container material may act as a substrate for mineral growth in response to corrosion during hydrothermal interactions with bentonite barriers