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Spatial distribution of geochemical changes about an oil shale retort

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Heating of oil shale converts the kerogen in the rock to extractable hydrocarbons that can be brought to the surface and converted to value-added products. However, during this heating process, there are concomitant changes in the mineralogical makeup of the rock matrix and chemical composition subsurface waters that may ultimately affect the migration of contaminants in the subsurface. We have conducted hydrous pyrolysis experiments that provide insight into the types of geochemical alterations at different temperatures. Experiments were conducted over the temperature range of 25 to 350°C. The mineralogy of the raw and spent oil shale is measured using quantitative powder x-ray diffraction. The chemical composition of the retort water was also measured. The experimental results are combined with heat-flow calculations generated using Comsol Multiphysics software to conceptualize the potential spatial extent of geochemical alterations in the native rock and subsurface waters. Additional calculations using reasonable initial mineralogical compositions not investigated in our hydrous pyrolysis experiments are also presented.