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Role of supercritical water ingeological processes; e.g., salt accumulation, petroleum migration, and volcanism

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Seawater migrating deep into the Earth's crust will pass into its supercritical domain attemperatures above 407°C and pressures above 298 bars. In the oceanic crust, these pressures are attained at depths of 3 km below sea surface, and sufficiently high temperatures occur near intruding magmas with temperatures up to 1200°C.

The physico-chemical behavior of seawater changes dramatically when passing into its supercritical state and the formation of supercritical vapor (ScriW). This water phase has a density of 0.3 g/cc and a strongly reduced dipolar character. The loss of polarity causes the water phase to lose its solubility for common sea salts (chlorides and sulfates). Thus, a spontaneous precipitation of salts takes place in the pore system. Another important effect of the lost polarity of ScriW is its potential to dissolve petroleum and other organic material. The complete miscibility of ScriW and petroleum opens up the potential of migrating petroleum through low-permeable carrier rocks without having to overcome high capillary entrance pressures. When this solution passes into the sub-critical region of water, a phase separation takes place with water attaining a steam phase and a separate petroleum phase. Thus, the ScriW migration may also explain the occurrence of asphalt volcanism observed several places in the World. Furthermore, ScriW may also be the potential starter and driver of the poorly understood mud volcanism, both submarine and terrestrial. ScriW may also initiate serpentinization and other mineral transformations in the deep crust. It also plays an important role in the initiation of volcanism in subduction zones.

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