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Saline water incursion into Icelandic geothermal and groundwater reservoirs

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Abstract

A major challenge of groundwater exploitation on islands is the risk of saline water incursion into groundwater systems due to water production in excess of the natural recharge. As many oceanic islands have groundwater reservoirs where saline groundwater underlies the freshwater, the cause of the saline water intrusion can either be due to mixing of the fresh and saline groundwaters or by inflow of seawater into the groundwater system. This is particularly problematic on small islands and islands in arid and semi-arid regions with a considerable populations, for example the Canary Islands which fall into both groups.

Iceland is neither particularly small nor densely populated and is blessed with abundant precipitation. Nonetheless, several examples of saline water incursion into Icelandic groundwater reservoirs are known. Low-temperature (<150°C) geothermal water systems in Iceland are groundwater systems, in most cases recharged by either local or distant precipitation, where the water has been heated by deep circulation into bedrock where the geothermal gradient is high (>100 °C/km). Therefore, the geothermal systems may also be susceptible to incursion of saline water due to excessive production. As the saline water tends to be colder than the geothermal water there is an added complication of water-rock interaction and possible mineral precipitation when the saline water is heated up to the temperature of the geothermal system. This leads to a three-fold operational risk for the field operators; mineral scaling, corrosion and reservoir cooling.

In this contribution, examples will be given of saline water incursion into Icelandic geothermal and groundwater systems, including a recent example of seawater intrusion into the geothermal system at Hjalteyri in N-Iceland. The system is very permeable and shows little pressure drawdown, but geochemical monitoring of the produced water shows strong signs of seawater mixing.

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