GeoWell: Geochemical assessment of cement durability in the supercritical domain

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Within the H2020 GeoWell project, that aims to develop reliable technologies for high-temperature geothermal wells (>400°C), it is necessary to assess the durability of cements under such thermal stress, especially regarding mineralogical evolution.
For modelling above 300°C, the geochemical database and modelling codes need to be extended. This starts by using the HKF model (1, 2), which computes standard molal thermodynamic properties (heat capacity, volume, Gibbs free energy) for aqueous species at temperature and pressure in the supercritical domain. In some cases, the parameters used in the model were determined by Sverjensky et al (3) correlation.
A tool was built allowing the calculation of a PHREEQC-V2 (4) database between 0 to 600°C along specific P-T profiles. After comparing the resulting calculations with literature data and other geochemical codes, we focussed on the selection of thermodynamic properties for the relevant cement mineral phases. This was done consistently with the IDDP1 (Iceland Deep Drilling Project) well cement samples analyses and the results of lab experiments. The PHREEQC-V2 calculations with the upgraded database allows predicting potential cement evolutions during temperature and pressure changes in term of mineral phase transitions and their effect on volume and water content.

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