Geochemical modeling of high temperatute geothermal systems

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Geochemical numerical models require a comprehensive and coherent thermodynamic database. Although today's geochemical database are quite complete, including the most common reaction and reaction constants, some reactions typical of specific environments are not included yet.

As part of the EU FP7-funded Integrated Methods for Advanced Geothermal Exploration (IMAGE) project, a building up of a thermodynamic database focused on thermal aureole minerals, with Pitzer formalism was carried out.

Therefore, the thermodynamic properties of several minerals have been added to the Thoughreact Pitzer default database (data0.ypf). Input data, in a modified format were also added to the provided Toughreact (Thermok.dat) and Phreeqc (llnl.dat) databases, to be used both in Debye-Hückel [1] and in the Pitzer [2] aqueous model.

The data were taken from available literature on thermodinamical properties of minerals, and in particular from the thermodynamic data collection of Holland and Powell [3] and Holland et al. [4] among many others.

The new data collection allow to carry out two simple models of interest in fossil high-temperature geothermal systems in Elba Island (Italy) and Geitafell (Iceland). These models were computed with Phreeqc. The first involves the formation of tourmaline from biotite which could be also related to tourmaline formation in the Larderello geothermal field. The second model is an hydrothermal alteration of an Icelandic basalts with meteoric water at high temperature, showing the possible alteration minerals.

[1] P. Debye and E. Hückel (1923), *Physikalische Zeitschrift* **24**: 185–206 [2] Pitzer, K.S.; Mayorga, G. (1973), *J. Phys. Chem.* **77**(**19**): 2300–2308 [3] T.J.B.Holland & R. Powell (2011), *Journal of Metamorphic Geology* **29**(**3**) 333–383 [4] T.J.B. Holland, N.F.C.Hudson, R.Powell, B. Harte (2013), *J.of Petrology*, 1-20