

Petrophysic and geochemical study of Valpaços granite pluton (Northern Portugal)

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With this work, we intend to apply a multidisciplinary methodology to a pluton located in the Galiza Média Trás-os-Montes Zone, the granite pluton of Valpaços. The host rocks of this circumscribed pluton are composed by metasedimentary formations from Silurian age and by syn-tectonic granites. The Valpaços pluton consists of a coarse-grained porphyritic two-mica syenogranite, apparently not oriented. Primary minerals are quartz, potassium feldspar megacrysts (microcline and orthoclase), plagioclase, biotite and muscovite. Silimanite, andalusite, apatite, zircon and opaques occur as accessory mineral phases. As secondary minerals are present muscovite, chlorite, leucosene and rutile. According to the classification of Frost [1], the geochemical data indicate that this granite is an alkali-lime magnesian potassic granite with highly peraluminous character with A/CNK average of 1.3. The REE patterns are characterized by high fractionation between LREE and HREE (La/Yb)_N with an average of 22.91 and a moderate negative Eu anomaly (Eu/Eu*_N=0.48). The mineralogical and geochemical data, including the peraluminous character and the REE fractionation values, and despite the lack of isotopic data, are compatible with the characteristics presented by S-type granites [2]. Preliminary studies of Anisotropy of Magnetic Susceptibility (AMS) were carried out in 51 samples in order to characterise the structure of this pluton. The susceptibility is comprised between 65.1 and 47.8 x 10⁻⁶ SI, typical of a paramagnetic behaviour and ilmenite type granites [3]. Magnetic anisotropy (3.0%) can be related to a magma emplacement late-tectonically driven. AMS fabric patterns show subhorizontal NE-SW trending magnetic foliations associated with subhorizontal N120°E trending magnetic lineations which point out the role of the last ductile Variscan deformation phase in the emplacement of this pluton. ASM ellipsoids are predominantly oblate which suggests that magnetic fabric is controlled by the muscovite and biotite.

[1] Frost *et al.* (2001) *J. Petrology* **42**, 11, 2033-2048.
[2] Chappell & White (1992) *Trans. Roy. Soc. Edin. Earth Sciences* **83**, 1-26. [3] Ishihara (1997) *Mining Geology* **27**, 293-305.

A new thermodynamic model for C-S-H solubility valid in the range of P-T conditions encountered around CO₂-injection wells

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Numerical simulation of the well-bore integrity in the context of CO₂ injection and storage requires dealing with the solubility of Portland cement constituents under pressure, temperature and high CO₂ activity. Along with portlandite, Ca(OH)₂, calcium silicate hydrates (C-S-H) are the main components of Portland cements. The solubility behaviour of C-S-H involves different solid-solution components. Kulik & Kersten [1] proposed a C-S-H solubility model based on two binary ideal solid-solutions depending on the Ca/Si ratio; for lower Ca/Si ratios amorphous silica and a tobermorite-like C-S-H are the end-members whereas for higher ratios, a jennite-like C-S-H and portlandite are the two end-members. Recently, Sugiyama & Fujita [2] modelled C-S-H as a single binary non-ideal solid-solution between amorphous silica and portlandite. These two models are based on abundant C-S-H solubility data at 25°C available in the literature.

Following [2], we designed a C-S-H solubility model, assuming a binary non-ideal solid-solution between amorphous silica and portlandite, but which applies to higher temperatures. The end-members activity fitting procedure exposed by [2] has been modified using simplified Boltzmann functions. The fits are based on the existing C-S-H solubility experimental datasets at 25°C and also at 90°C [3,4,5]. Furthermore, an interpolation of the modelled solubility at an intermediate temperature of 50°C is also proposed.

A comparison between this new model and the two existing ones will be discussed as well as its ability to predict the formation of C-S-H. This C-S-H dissolution model is now being implemented in a reaction-transport code and applied to the interaction between CO₂-rich fluids and Portland cement under pressure and temperature.

[1] Kulik & Kersten (2001) *J. Am. Ceram. Soc.* **84**, 3017-3026. [2] Sugiyama & Fujita (2006) *Cem. Concr. Res.* **36**, 227-237. [3] Atkinson *et al.* (1989) *J. Chem. Soc. Dalton Trans.* **12**, 2371-2379. [4] Barbarulo (2002) *PhD Thesis ENS Cachan, France / Université de Laval, Québec*. [5] Courault (2000) *PhD Thesis Université de Bourgogne, France*.