

Iron in the CaO-SiO₂-H₂O system

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Calcium Silicate Hydrates (C-S-H) are both a common product of low temperature geochemical no-carbonated system, and the main constituent of the cement pastes. Understanding their structure and

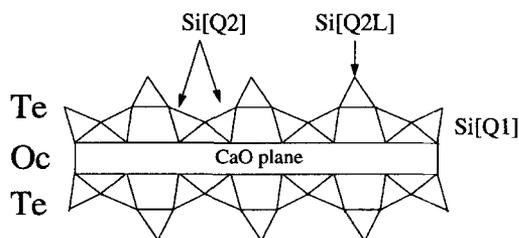


FIG. 1. Silicate tetrahedra chains in the C-S-H. Their length depends on the calcium content (Faucon *et al.* 1996).

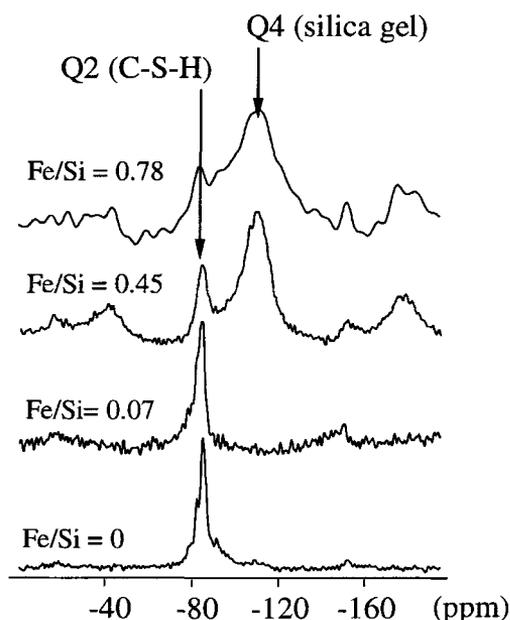


FIG. 2. ²⁹Si MAS NMR spectra of the serie A.

properties constitutes a major challenge of cement chemistry. Their characterization is difficult because of their variable stoichiometry and their low crystallinity make difficult. In this work, we focused on the effect of Fe³⁺ incorporation on the tobermorite-like structure of low Ca/Si ratio (initial value 0.8: Fig. 1) by using the following complementary techniques ²⁹Si MAS NMR, ⁵⁷Fe Mössbauer spectroscopy and Transmission Electronic Microscopy (TEM). Fe³⁺ was introduced as a nitrate either initially with CaO, SiO₂ and H₂O (series A samples) or after precipitation of the C-S-H (series B samples).

For low Fe/Si ratios, Fe³⁺ substitutes Ca²⁺ in the CaO sheets and in the interlayer space of the Te-Oc-Te structure of the C-S-H. Because of the charge compensation needed in such a mechanism, the maximum Fe/Si ratio is of about 0.3

At Fe/Si higher than 0.33, no more Fe³⁺ atoms can be incorporated into the C-S-H structure and different neoformed iron hydrates precipitate according to the two reaction routes.

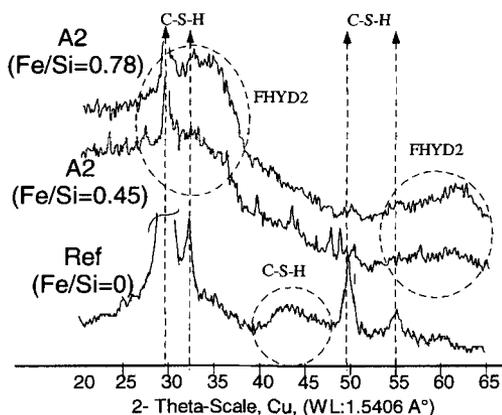


FIG. 3. X-ray diffraction pattern of the samples A: Zoom on the broaden lines.

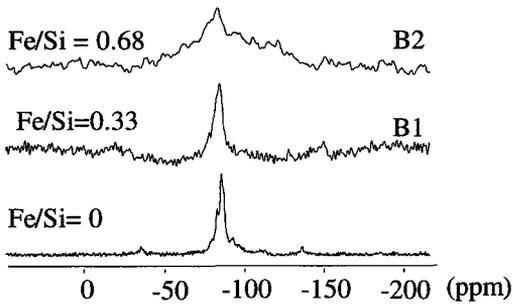


FIG. 4. ^{29}Si MAS NMR spectra of the samples B.

^{29}Si MAS NMR results (Fig. 2) and X-ray diffraction results (Fig. 3) reveal in series A that 2 line ferrihydrite and silica gel (with few iron in its structure) precipitate. On the contrary the precipitation of two-line ferrihydrite and silica gel is prevented and the stable hydrate is a silico-ferric coprecipitate (Figs. 4 and 5).

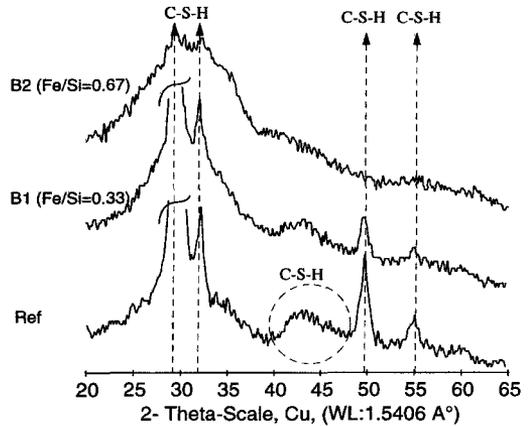


FIG. 5. X-ray diffraction pattern of the samples B: Zoom on the broaden lines.

References

- Faucon, P., Delaye, J.M. and Virlet, J. (1996) *J. Sol. Stat. Chem.*, **127**, 92-7.