Nucleation of Ca, Mg and Fe carbonate minerals monitored by time-resolved Raman spectroscopy

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The nucleation-growth processes of Ca, Mg and Fe carbonate minerals (including solid solutions such as Mg-calcite, dolomite and ankerite) were monitored in real-time by Raman spectroscopy from surface ambient conditions to hydrothermal conditions. These original studies have direct implications in the understanding of natural systems as well as on the synthesis of nanostructured carbonate minerals (e.g. mesocrystals) with a given economical interest (retarding flame agents, excipients, additives in foods, paper, paints, etc.). Herein, the presence of organic/inorganic impurities (ions or soluble organic molecules) and additives (solvents and surfactants) were also assessed in order to understand idealized organic-mineral systems or to improve the textural utilization properties in the precipitating particles. For these fundamental experiments, a multiphasic gas-liquid-solid batch reactor coupled to Raman and pH probes are being used/developed at the ISTerre lab. Raman spectroscopy has allowed a realistic assessment of nature of first nucleating particles in homogenous and heterogeneous systems and the so-called lifetime (or persistence time) of amorphous phases was also measured [1], which are not accessible, to our knowledge, by other lab-based analytical techniques under the conditions of our experiments (up to 300°C and 200 bar).

[1] G. Montes-Hernandez, F. Renard. Time-resolved in situ Raman spectroscopy of the nucleation and growth of siderite, magnesite and calcite and their precursors. *Crystal Growth & Design 16* (**2016**) 7218-7230.

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