



## **Role of epitactic relationships in the replacement of anhydrite (CaSO<sub>4</sub>) by celestite (SrSO<sub>4</sub>)**

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Mineral replacement reactions are ubiquitous phenomena in geological settings where the presence of a fluid phase facilitates the development of interface-coupled dissolution-crystallization reactions. The kinetics of these reactions is largely faster than that of reactions that exclusively involve solid state mechanisms and is often promoted by the generation of porosity during their development. Many factors play a key role in controlling the kinetics of interface-coupled dissolution-crystallization reactions. Among them, the existence of crystallographic similarities between the phases involved is a most important one, and its role in each system needs to be specifically addressed. Commonly, the existence of epitactic relationships between primary and secondary phases effectively hinders the development of mineral replacement reactions (1,2). However, there are also numerous examples of systems where the progress of interface-coupled dissolution-crystallization reaction is hardly affected. Here, we focus on the dissolution-crystallization reaction that takes place when Sr-bearing aqueous solutions interact with anhydrite (CaSO<sub>4</sub>). This reaction leads to the formation of celestite (SrSO<sub>4</sub>), which is the most relevant ore of strontium. Furthermore, most authors agree that the interaction between relatively diluted Sr-bearing solutions and calcium sulfate minerals is the main process responsible for the formation of the large celestite deposits found in sedimentary basins (3). In this work we study the progress of the interaction of Sr-bearing solutions with the three main anhydrite cleavage surfaces, (100), (010) and (001) by conducting batch-experiments. Our aim is (i) evaluating to what degree the kinetics of the replacement reaction is affected by the existence of anhydrite-celestite epitactic relationships in each face and (ii) understanding the influence that the chemical evolution of the system as the reaction progresses has in celestite crystal habit and the textural characteristics of the replaced layer.

SEM observations on anhydrite crystal surfaces confirm that the interaction of the former with Sr-bearing aqueous solutions results in the concomitant dissolution of anhydrite surfaces and the crystallization of oriented celestite crystals. The progress of celestite epitactic growth, which leads to the formation of a continuous layer carpeting anhydrite cleavage surfaces, does not preclude the progress of anhydrite dissolution. Most striking is the morphological evolution undergone by celestite crystals, which start as platy rhombus shaped single crystals at the initial stages to evolve as the interaction proceeds towards progressively more complex aggregates that consist of numerous fan-like arranged platy individuals. The limited influence of the existence of epitactic relationships between celestite and anhydrite in the kinetics of the interface-coupled dissolution-crystallization reaction is discussed taking into consideration (i) the goodness of the epitactic match, (ii) the described morphological evolution of celestite crystals and (iii) the chemical evolution of the aqueous phase.

### **References:**

- 1) Ruiz-Agudo, E.; Putnis, C.V.; Putnis, A. *Chem. Geol.* 2014, 383, 132–146.
- 2) Prieto, M.; Astilleros J.M.; Fernández-Díaz, L. *Elements* 2013, 9, 195-201.
- 3) Hanor, J.S. *J. Sediment. Res.* 2004, 74, 168-175.