Interactions between reactive $CaCO_3$ surfaces in aqueous solutions - Surface Forces Apparatus measurements.

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Mineral – fluid interfaces existent in pore spaces and fractures are critical regions, in which adhesion, repulsion, crystal growth and dissolution govern the overall mechanical strength of the rocks and mineral-based materials. The properties of nanoconfined water films present in these extremely narrow spaces are expected to differ from that of the bulk, and to locally modify the reactivity, mass transport and interfacial interactions. In such unstable regions material failure may be triggered, thus raising much interest in a range of factors contributing to these phenomena, including pore fluid chemistry and solid mineralogy. We present a Surface Forces Apparatus (SFA) study of calcium carbonate surfaces confining dilute salt solutions, showing how the reactivity of the surfaces influences the nanometer-range attractive and repulsive interactions between the surfaces. The SFA is a force measuring technique that, unlike the more well-known Atomic Force Microscope (AFM), can provide *in situ* observations of surface alteration processes via an interferometric technique. It also uses much bigger contact areas (50-150 µm contact diameter) than the standard AFM measurements. At this scale, the surface roughness becomes a major contribution to the forces acting between the surfaces, which now involve elastic interactions between contacting asperities. In our experiments with reactive $CaCO_3$ surfaces, we show how crystal growth, dissolution, and the resulting changes in surface roughness influence the measured magnitude and range of forces. We also investigate the conditions necessary for the adhesive interaction between the surfaces, and follow the recrystallization-induced alteration of surfaces brought into close contact over time. Our goal with this study is to understand under what conditions growing crystals may cause cementing growth and attraction between the surfaces or, conversely, a strong repulsion that can lead to the damaging force of crystallization.