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MINERAL DISSOLUTION AND PRECIPITATION - IMPLICATIONS

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1 ABSTRACT

Mineral dissolution and precipitation are common geological phenomena that contribute to sediment formation (e.g., clay minerals), rock evolution (i.e., metamorphism), changes in porosity (compaction or loosening), stress changes and even shear failures in contraction. Furthermore, there is increasing evidence that dissolution and precipitation can have a profound effect on the performance of engineered systems (e.g., fly ash and mine tailing ponds), and in energy geo-engineering (e.g., nuclear waste repositories, CO2 geostorage and methane hydrate).

Yet, the literature is "patchy", in part due to inherent complexity in coupled hydro-thermo-bio-chemo-mechanical processes responsible for dissolution and precipitation. For example, the formation of stylolites in carbonates remains unclear almost three centuries after they were first reported, and studies of the evolution of the internal state of stress in uncemented sediments during dissolution are just emerging in the literature even though many regionally extensive fracture networks in sedimentary basins have long been identified and are often misconstrued as the consequences of tectonism.

Dissolution and precipitation have played a defining role in carbonate formation and petroleum accumulation. On the other hand, further use of fossil fuels demands long-term geological storage of CO2 (say 30,000 years), however, the acidification of subsurface water will trigger mineral dissolution and the potential development of leakage paths; in the absence of clear understanding of dissolution and precipitation todays' efforts to inject CO2 in the subsurface emerge as a Faustian bargain. Dissolution and precipitation are also relevant to energy storage for prominent renewable sources such as solar and wind, for example in the form of compressed air energy storage in dissolution caverns (i.e., engineered dissolution) and ensuing leak control (i.e., engineered precipitation).

Consequently, the enhanced understanding of dissolution and precipitation and the ensuing "geo-plumbing" will define our ability to improve resource recovery, CO2 geological storage, and energy storage.