Chemical reactions between a porous medium (such as rock formation) and the fluid flowing through it can lead both to the transformation of rock strata and the formation of complex micro-scale structures (see Figure 1). These reactions may gradually alter the composition and structure of the solid matrix, either creating or destroying permeable paths for fluid flow. A complex, dynamic feedback thus arises where, on the one hand, the fluid flow affects the characteristics of the solid medium, and on the other hand the changing medium influences the fluid flow. Such feedbacks between flow of fluids and the media in which they flow are important for understanding the slow processes, which – over geological timescales – may transform the rock masses.

Understanding these processes is also important for their potential applications. A good example here is mineral carbonation, the fixation of carbon dioxide in mineral materials, which is a promising method of CO2 storage, thus reducing the carbon content in the atmosphere and oceans to mitigate global warming effects. Mineral carbonation process proceeds in two stages - first, silicate minerals are dissolved by water saturated with carbon dioxide, then CO_2 reacts with the cations released by the dissolution reaction to form a secondary carbonate mineral deposit. Unfortunately, this reaction often spontaneously halts when the main flow paths become clogged by precipitate. The task of this project is to determine how to deal with such situations. Is it possible to direct the reaction so that new flow paths continue to form and the product is evenly distributed throughout the medium? What types of structures will spontaneously form in dissolution-deposition reactions in the presence of flow, and what controls their shapes and lifetimes? These are just some of the questions we will try to answer in this project.

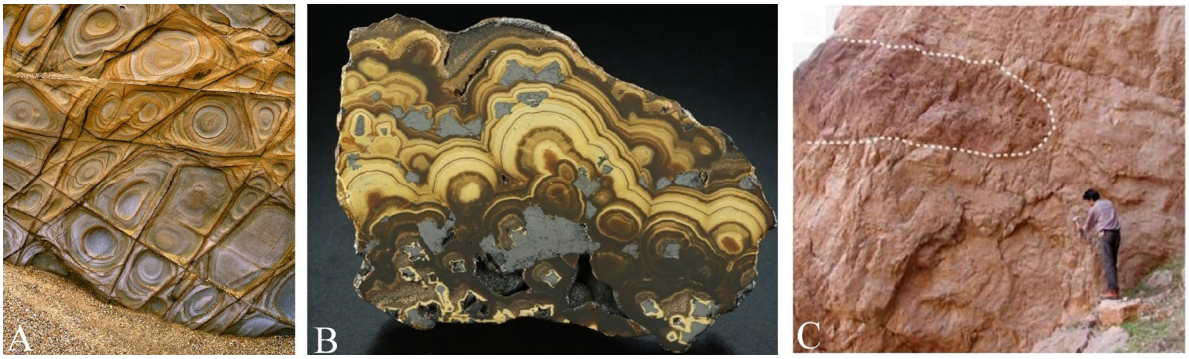

Fig.1 Structures formed by dissolution/precipitation processes in nature: (A) Liesegang rings in sandstones (Bay Bude, England), (B: Zinc blende sphalerite, wurtzite, galena, marcasite; Pomorzany mine, Poland) (C) Dolomite finger, Zagros mountains, Iran.