Project “Viscous EffeCTs On Raman-based elasto-thermobarometry (VECTOR): a field, mechanical and diffusion study of mineral inclusions entrapped under a wide range of metamorphic conditions.”

Many geological processes in the interior of the Earth undergo at a slow rate and high pressures and temperatures. Experimental work carried out for almost 100 years on metamorphic rocks (i.e. rocks that bear a record of high pressure and temperature conditions) significantly contributes to our knowledge of parameters controlling physical, chemical and mechanical properties of rocks and minerals. Despite this, understanding the complexity of geological processes that take place in the Earth over millions of years remains challenging. This is due to the slow rate as well as the high pressure and temperature at which these processes occur, making it difficult to reproduce in a laboratory. However, instead of simulating such conditions in the laboratory, it is also possible to describe the processes taking place in the Earth by studying metamorphic rocks.

Despite the difficulties that arise when studying the processes taking place in the interior of the Earth, the application of the principles of thermodynamics makes it possible to describe and interpret the record of pressure and temperature changes preserved in metamorphic rocks. In recent years, a method of estimating the pressure and temperature conditions experienced by rocks during their history has also been developed on the basis of measurements made using the Raman spectroscope. The described method (called the elasto-thermobarometry) uses the so-called residual pressure, which can be preserved in mineral inclusions entrapped in minerals behaving in an elastic manner (such as garnet). Therefore, it is possible to estimate the conditions under which the described inclusions were closed in the host mineral, i.e. the conditions of metamorphism. However, recent studies have shown that minerals which usually behave in an elastic manner may be affected by processes leading to weakening of their elastic properties and making them unable to maintain the residual pressure of inclusions. These processes, collectively termed as viscous creep, hinder the deciphering of the pressure and temperature conditions of the metamorphism. The aim of our project is to develop an unconventional method that will enable to quantify the impact of the viscous creep on the ability to maintain residual pressures in mineral inclusions and to reproduce the pressure and temperature conditions at which they were formed.

The influence of viscous creep on the ability to maintain the residual pressure by mineral inclusions entrapped in the host mineral has been recognized relatively recently. Therefore, there are no systematic studies describing this phenomenon in the available literature. In the course of the project we are going to create a coherent database including field observations, analytical measurements and numerical modelling. The integration of these data will make it possible to describe quantitatively the effects caused by viscous creep to determine the pressure and temperature of a metamorphism using Raman thermobarometry.