Geochemical gap in seismites research – new criteria for seismically-induced sediment liquefaction

Earthquakes are one of the most dangerous natural phenomena, not only because of the scale of damage they can cause, but also because of the difficulty of predicting them. Recognition of traces of past earthquakes is also a difficulty. Earthquakes occurring in areas covered with unconsolidated sediments can be "recorded" in the form of internally deformed layers called seismites. Seismites formation is related to the sediment liquefaction process, which occurs as a result of a temporary increase in the fluid pressure in the spaces between the grains, as a result of which the water-saturated sediment is transformed into a viscous, plastic mass. This condition deforme the sediment, causing the formation of the so-called soft-sediment deformation structures such as load casts and pseudonodules, pillow and ball structures, escape structures and sand volcanoes. Despite many years of research, the knowledge about the liquefaction process, deformation structures or seismites themselves is still insufficiently recognized. Missing, among others results of research on geochemical conditions during seismites formation, as well as the soft-sediment deformation structures themselves. In addition, little is known about the chemical composition of water in intergrain spaces, as well as about the co-occurring soil-forming processes.

The planned project will address the problem of the formation and development of seismites and soft-sediment deformation structures from study sites located in Germany, Latvia, Spain and Italy. These study sites differ in the conditions of sediment deposition, climatic conditions, the degree of seismic activity at that time, as well as the time of formation of the seismites themselves. **The main goal of the research is the geochemical and mineralogical analysis of liquefied sediments forming both deformation structures and seismites. For the first time, sedimentological records of earthquakes will be subjected to a comprehensive geochemical analysis, including the determination of individual elements, chemical compounds, physicochemical parameters, and the identification of minerals and mineral phases.**

The research will be based not only on the identification and characteristics of seismites, but also on determining the share and impact of soil-forming processes on the formation and behavior of deformation structures in unconsolidated sediments. The project involves 1) carrying out field work and sampling; 2) laboratory work including the analysis of elements, chemical compounds and basic parameters of soils, as well as the identification of minerals and microstructures; and 3) small-scale works during which sedimentological, crystallographic and geochemical relationships between the examined sediments will be determined.

The expected results will not only prove the need for seismites analysis in terms of chemical and mineralogical research, but will also show the relationship between earthquakes and chemical compounds on the formation and recording of deformation structures in unconsolidated sediments. In addition, the research will complement the characteristics of the sediments, and will also determine the geochemical conditions occurring at that time after the process of its liquefaction. What's more, study sites can be new, unique forms of nature protection, such as geosites or geoparks, illustrating valuable geological heritage.