DESCRIPTION FOR THE GENERAL PUBLIC

Research planned in the project is aimed at a significant improvement of the accuracy of sediment dating using optically stimulated luminescence (OSL) applied to quartz grains. Absolute dating of sediments has a fundamental importance for determining quaternary chronology and, in consequence, also the history of the Earth's climate changes. The only method used all over the world that enables estimating the time of creation of a sediment layer, i.e. the moment of deposition of mineral grains and covering them by the next layer, is a method exploiting the phenomenon of optically stimulated luminescence. In general, a measurement of the OSL signal relies on registering the luminescence emitted by a material during its illumination (stimulation) after its previous exposition to nuclear radiation. The light that is observed has a shorter wavelength than the stimulating light. OSL can be detected in non-metals, also in quartz commonly found in sediments. The luminescence intensity is proportional to the radiation dose that the investigated sample absorbed before the measurement, therefore OSL is used for measuring the radiation dose in the field of radiation protection wherever nuclear radiation is utilised, e.g. in nuclear medicine. Quartz from sediments shows the so-called natural OSL, which is the result of the exposition of the grains to nuclear radiation from radioisotopes that are commonly present in small amounts in nature. The intensity of the natural OSL is a measure of the total radiation dose absorbed by the quartz grains in the past. The OSL signal can be erased (bleached) by sunlight, therefore in the case when the sediment grains were exposed to sunlight before the grain deposition in a layer, their OSL signal increases from zero at the moment of the sediment layer constitution to a level, which depends on its intrinsic radioactivity and the radioactivity of its surroundings, during the period of the layer being buried. If it can be assumed that during the existence of the sediment layer, the natural radiation dose absorbed by the grains was constant, the age of the layer can be determined simply when the total dose absorbed from the time of its deposition is known. The latter can be obtained from the natural OSL measurements performed for the quartz grains separated from the sediment, whereas the annual radiation dose is estimated by means of standard dosimetric methods. The most crucial issue in the field of luminescence dating is the zeroing problem. It is related to the bleaching of OSL signal by sunlight before the creation of the sediment layer that is mentioned above. It is known from the former investigation of OSL in quartz that its signal is complex, that the individual components of this signal are bleached by sunlight with varying efficiency and their intensities grow with the radiation dose at a different rate. Up to now, in OSL measurements being carried out in order to establish the total radiation dose absorbed from the time of the sediment deposition, the sum of the different OSL components is measured. The result of age estimation is accurate only when the OSL component most effectively bleached by sunlight considerably dominates the total OSL signal. This is never known in advance, so it happens that the age of a sediment is overestimated. Such evident discrepancies are not a problem because in such cases the dating results are rejected. A real issue are results that are not accurate but they cannot be eliminated in an obvious way. The only solution, that allows to improve the reliability of luminescence dating is the application of new stimulation methods in the OSL measurements which enable the selective detection of the individual OSL components and which lead to using exclusively the fast component in the age calculation. Recently, in the Polish dating laboratories, investigations were conducted that resulted in the development of a few new OSL measurement techniques that allow for the selective OSL components detection. In this project, investigations of OSL in quartz will focus on the application of the new methods in order to establish the optimal measurement parameters that lead to the extraction of the individual components of quartz OSL, especially the ones which are most quickly bleached by sunlight. Introducing the newest stimulation techniques into the measurement protocols will be a significant progress in the field of luminescence dating. Establishing the dependency of the intensities of the individual components of OSL in quartz on the value of the absorbed dose allows for improving the dating precision, especially in the case of samples whose age is close to the limit of age range of the method. It is also expected that the works undertaken in the project will lead to finding the origin and features of the OSL signals that have not been fully recognised up to now and that are believed to give the possibility of extending the age range of OSL dating from the presently estimated 300 ka to about 1 million years. Such shift of the age limit in the application of the method would be an important breakthrough in the OSL dating of sediments with the application of quartz.