

What did our world look like millions of years ago? We may imagine it from films or illustrations in magazines and books, but the truth is that we still know very little about it. In order to obtain as much reliable information as possible, scientists from all over the world are turning to the relevant materials that hold information about those times. These include, for example, fossils of animal and plant remains, or reflections of organisms fixed in charcoal, through which we can learn about their appearance.

Unfortunately, very many elements of the environment from millions of years ago were organic and have practically no possibility of being preserved to the present day. After all, the fossils, fixed in the rocks, were subjected to conditions aggressive to organic matter - considerable temperature and pressure - and have often survived to the present day as mineral reflections of those organisms.

There is, after all, only one organic material that has survived to the present day in almost unchanged form. This material is resin. Yes, it has polymerized over the years, from a viscous and dense liquid it has practically become stone (as they are called - 'fossil resins'). And although organic matter has also survived to the present day in the form of, for example, crude oil, it is difficult to speak of even the slightest degree of preservation of the original structure of the organisms from which it originated. Resin in this field is a rarity. The pieces that have survived have not been subjected to conditions that would destroy the organic structure of the resin, and therefore that would destroy the organic matter trapped inside.

Thus, fossil resins, such as the popular amber, have the potential to preserve organic material from over 300 million years ago to our time. No other material has such repository potential. Depending on where they are found in the world, they come from different periods in the history of the earth. Fossil resins were formed when dinosaurs walked the planet, they were formed when an asteroid hit the earth, causing dinosaurs extinction, they were formed when mammals began to take over the planet and they are still being formed today. They are therefore the best 'time capsule' capable of storing information for some 320 million years. They are also the oldest archival material, as the use of similar archival materials: layers of snow, bottom sediments or peat bogs can go back as far as 2.6 million years.

While biologists have long exploited this potential of fossil resins, describing the inclusions of insects, animals, plants or fungi fixed in them, the chemical information trapped in resin remains largely undiscovered. The chemical stability of this material makes it virtually impossible to dissolve, and extracts can damage sensitive analytical equipment. **Therefore, this project brings together prominent Polish analytical chemists from the Gdansk University of Technology and the University of Warsaw, world-renowned geochemists from Japan's Kwansei Gakuin University and fossil resin specialists from the International Amber Association and the University of Gdańsk**, to develop, for the first time, an efficient and organized method for reading chemical information trapped in fossil resins. The developed method will set new standards in the analysis of fossil resins, opening up new opportunities for scientists in many scientific fields.

A methodology for using fossil resins as chemical signature archives will be developed in this project based on the determination of PACs (*polycyclic aromatic compounds*) and TEs (*trace elements*) in this material. At the same time, it will confirm its applicability as these chemicals are used as diagnostics for the state of the environment and the events emitting them. Polycyclic aromatic compounds, their derivatives and some trace elements are emitted from natural sources such as volcanic eruptions or forest fires. Thus, by being able to identify them in fossil resins, it will be possible to link them to specific events affecting the environment and to the state of the environment itself millions of years ago.

State-of-the-art analytical techniques will be applied to a broad and rarely studied population of fossil resin samples: TGA-GC-MS, HPLC-FLD, ICP-MS, LC-ICP-MS, CV-AAS, FTIR, Raman, fluorescence spectroscopy, XRF (+ coupling with appropriate microscopy). Polycyclic aromatic systems and their derivatives, which are responsible for the characteristic fluorescence of fossil resins, will certainly be determined. Trace elements characteristic of natural events emitting them will also be determined. Thanks to modern statistical and chemometric analysis, the determined compounds, together with information on their content in resin samples, will serve to define the state of the environment millions of years ago and allow the identification of significant events emitting these substances.

The history of Gdansk is inextricably linked to amber, so the implementation of this project by the Gdansk University of Technology (in consortium with the University of Warsaw), also has a symbolic meaning. Until now, scientists have encountered a wall when it comes to the chemical analysis of ancient environment, while in this wall there is a huge '**amber window**' onto the ancient world, which, in the spirit of friendship between many communities, will be opened in Gdansk. In the city where the entire modern history of amber began!