In the middle Paleozoic era, numerous global changes occurred in marine and terrestrial ecosystems, which were associated with the dynamic development of higher land plants that had a significant impact on weathering processes, soil formation, and changes in global geochemical cycles. These dynamic changes led to multiple crises and global events expressed by distinct geochemical changes in the marine sedimentary record, primarily with short-term perturbations in the global carbon cycle. Positive carbon anomalies were generally attributed to eutrophication of oceanic waters, as emphasized by the authors of numerous studies. However, new research suggests that carbon cycle changes during the Late Devonian events have a much more complex nature than previously thought. In reality, the influence of diagenesis on carbon isotopes signal appears to be much more limited than previously assumed, and several negative isotopic anomalies have been reinterpreted as a primary signal associated with large-scale thermogenic degassing of light isotopically enriched ^{12}C carbon due to increased volcanic activity.

Until now, researchers worldwide have focused much more attention on the Late Devonian ecological crises. During this time, one of the largest extinctions in the history of our planet occurred, known as the Kellwasser event, marking the end of the Devonian period, followed by the Hangenberg event. However, the beginning of the Carboniferous period is also marked by two significant globally impactful environmental changes. The older one is known as the Middle Tournaisian anoxic event (approximately 355 million years ago), also referred to as the Lower Alum Shale event (LASE), which is associated with the formation of organic-rich black shales in many regions of the world. The younger event is called the Tournaisian Isotopic Carbon Excursion (approximately 352 million years ago; TICE), which is one of the largest disruptions in the carbon cycle characterized by one of the highest positive carbon anomalies $\delta^{13}C_{carb}$ of around 7‰ in the Phanerozoic. However, compared to the end of the Devonian, early Carboniferous perturbations are much less understood, especially regarding disruptions in the carbon cycle during the LASE event and the geochemical record on the southern shelf of Euroamerica at the Tournaisian isotopic event. Therefore, the subject of the proposed research project is focused on these two major early Carboniferous perturbations that brought about significant environmental changes. The first of the mentioned events were associated with widespread organism extinction (in some regions, it was almost complete), while the second of the investigated events is linked to the burial of significant amounts of organic carbon, resulting in a cooling of the Earth's climate.

It seems reasonable, therefore, to dedicate more attention to these less studied intervals of the Mid-Paleozoic, particularly in relation to the Lower Alum Shale and TICE event, especially in the context of changes in the stable carbon isotope record, which are recognized and proven indicators of ecosystem changes. Therefore, this scientific project aims to fill this gap by investigating, at a high resolution, the changes during the early Carboniferous biotic crises.

The main objective of the proposed research project is to provide detailed documentation of regional changes in the stable carbon isotope record during the early Carboniferous in the Tournaisian stage in Central-Western Europe, with a particular focus on the Holy Cross Mountains area in Poland. The research material has been obtained from sedimentary rock layers in the Holy Cross Mountains (Poland), Rhenish Massif (Germany), Montagne Noire (France), and the Carnic Alps (Austria). The research material consists of several hundred rock samples collected by researchers from the University of Silesia during field studies conducted over the past few years. Additionally, further research expeditions are planned in the Ardennes (Belgium) in the near future to acquire additional material for further investigations.

The most important expected outcomes of the proposed project are the first-ever description of the sedimentary conditions during the Tournaisian Isotopic Carbon Excursion event in the Holy Cross Mountains area of Poland. In Poland, this event has not been previously described in the context of detailed geochemical analyses. Furthermore, the analysis of isotopic signatures from the proposed additional sites will allow for a detailed description of environmental changes occurring during the early Carboniferous events in Central-Western Europe.