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Shocking details about the death of the dinosaurs from alkali feldspars

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Aims: The impact of a ~12 km diameter asteroid sixty-six million years ago caused one of the most devastating mass extinctions in Earth history. Many groups of plants and animals including the non-avian dinosaurs succumbed to a cascade of environmental changes following the event[1]. The 'smoking gun' of this impact is the 200 km diameter Chicxulub structure in Mexico, and detailed analysis of its rocks has revealed a wealth of information on the impact event and its effects on the Earth system. One important new suggestion is that fragments of shock-damaged alkali feldspars from the target rocks were ejected into the Earth's atmosphere where they played an important role in post-impact climate change[2]. This project seeks to test this hypothesis through characterisation of alkali feldspars in Chicxulub and other impact structures in the geological record.

Background: In 2016 the Chicxulub structure was drilled by IODP-ICDP Expedition 364[3] and showed that the target rock comprises carbonates and evaporites overlying a granitoid basement[4]. The basement lithologies experienced pressures of ~16–18 GPa during the impact event, with most minerals showing evidence for shock deformation. Alkali feldspar is abundant in the basement granite, but its response to the impact has received less attention than other common rock-forming minerals (e.g., quartz). Given that the impact structure has been so intensively studied, Chicxulub offers an excellent opportunity to characterise shock deformation of alkali feldspar including the microstructures produced, and any associated chemical and isotopic alteration. Another very important reason for focusing on alkali feldspar is that the mineral is highly effective in nucleating clouds[5] and so could play a major role in the environmental aftereffects of impact events[2, 6]. However, key to understanding the atmospheric properties of feldspars is a good understanding of how shocked mineral grains differ from those from unshocked granites studied previously.

Objectives: This project will characterise the mineralogy, microstructure and chemical/isotopic composition of alkali feldspars from the Chicxulub granite together with samples from other impact structures (e.g., Ries in Germany and Rochechouart in France), and unshocked granites for comparison. Work will use conventional imaging and microanalysis techniques (e.g., scanning electron microscopy, electron probe microanalysis) together with specialist tools for characterising microstructures over length scales from millimetres (electron backscatter diffraction) to nanometres (transmission Kikuchi diffraction, transmission electron microscopy, atom probe tomography). The outcome of that work will be a comprehensive understanding of how alkali feldspars respond to hypervelocity impacts, and the role of shock deformed minerals in environmental change.

Dissemination and skills: The student will be part of a lively team of planetary scientists in Glasgow, collaborate with partners in Europe and the USA, and present results at UK and international conferences. Upon completion they will be equipped with skills that could lead to employment in areas such as space exploration, materials technology, or environmental management.

Application details: The entry requirement is a 2.1 Honours degree or equivalent in geology, Earth science, planetary science, materials science or a cognate discipline. The application deadline is Wednesday 31 January 2024. Interviews will be held in mid-late February 2023, and the studentship will start in October 2024.

Information on how to apply is **here**:

References

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