

BSRG grant application

Autumn Pugh

PhD Work

My PhD investigates the impact of macrofaunal and environmental change in the Lower Jurassic of Bulgaria. The research focuses on two key events: 1) the Early Toarcian mass extinction and 2) the Early Toarcian Oceanic Anoxic Event (OAE). Through studying the long term cause and effects of events such as these, we can predict how modern systems will respond when subjected to similar environmental pressures. This is important as phenomena such as anoxia and ecosystem collapse are beginning to occur in the oceans today.

In the Lower Jurassic these phenomena are documented on a global scale, and are particularly well-studied in present day Western Europe. However, an integrated dataset of sedimentological, palaeontological and geochemical change across Europe is very much incomplete. This prohibits a full understanding of the causes and effects of extreme environmental change and subsequent extinction during the Early Toarcian.

During the Lower Jurassic Europe was covered by an epicontinental epeiric sea, part of the Tethys Ocean. Previous studies have focussed on two key areas, the Boreal Realm to the north and the Tethyan Realm to the south (Figure 1). The Boreal Realm was siliclastic dominated with the deposition of black shales, whereas carbonate platforms developed in Tethyan Realm.



Figure 1. An Early Toarcian (~183ma) palaeogeographic reconstruction of the European Realms comprising the epicontinental Tethys.

So far, few studies have focussed on the eastern edge of the epicontinental Tethys. Bulgaria was situated on this eastern edge, as part of a carbonate shelf in an extensional basin (Figure 1). Through studying sections from this region, my research will provide the first complete record of the extinction and OAE on this side of the ocean. Additionally, its palaeogeographical location is close to the open ocean and is therefore more likely to represent worldwide changes.

Field seasons in Bulgaria have resulted in extensive collections of invertebrate macrofauna and samples for isotope analysis, currently being processed at the University of Leeds. Fieldwork also included detailed logging of thirteen carbonate successions spanning the entire Lower

Jurassic and high resolution sampling to produce over 200 thin sections. Basic analysis of thin sections have so far shown a diverse and varied suite of microfacies across the basin, including deep water spiculites, shallow-water ironstones, sandy crinoidal limestones and glauconitic oolites.

The next crucial step in my PhD is to analyse my palaeobiological data in conjunction with sedimentological records. However, my training and experience thus far has never included carbonate petrography or understanding carbonate shelf deposition. This lack of training in detailed facies analysis severely limits gaining a clear understanding of the complex systems during this time, as carbonate sediments are particularly sensitive to environmental change.

Rationale for application

I require funding to enable me to attend the International Course on Carbonate Microfacies (Flügel Course) which will provide me with world-class microfacies analysis training. The course will take place from 6th March – 10th March 2017 at the Friedrich-Alexander University of Erlangen-Nürnberg, Germany.

Funding for this course through my NERC PhD budget is unobtainable as a large proportion has been spent on four field seasons to Bulgaria for sample collection. Funding also included the cost of field assistants and guides required to work in Bulgaria's national parks.

Attending this course is essential for the progression of my PhD, as it will provide a high level of specialist knowledge that cannot be obtained at my institution. The Flügel Course will give me the opportunity to present my current research, and feedback sessions will be far more rigorous than I would receive at a conference. Through hosting participants from both academia and industry, I will gain insight into other carbonate projects from around the world and also establish contacts and potential collaborations. Through completing this course, I will be able to obtain highly detailed and comprehensive results to publish in leading journals. This in turn may lead to further academic opportunities following my PhD.

Aims of my research that become achievable through attending the Flügel Course:

- Obtain and characterize the first complete and continuous sedimentary archive, including detailed depositional environments, spanning the 27myr of the Lower Jurassic from Bulgaria.
- To use sequence stratigraphy to determine sea level changes and sedimentary cycles in the stratigraphic record on regional and global scales.
- Compare and integrate stratigraphy with other European sections, to gain insight into how palaeogeography and basin setting could influence extinction and anoxic events.

To conclude, receiving BSRG funding to attend the international Flügel Course would allow me to add vital context to my PhD studies in Bulgaria. Furthermore, through extending both my technical knowledge and research network, this course will be hugely beneficial to my overall academic progression.