Research Networking Programmes

Short Visit Grant ☒ or Exchange Visit Grant ☐

(please tick the relevant box)

Scientific Report

The scientific report (WORD or PDF file – maximum of eight A4 pages) should be submitted online within one month of the event. It will be published on the ESF website.

Proposal Title: ESF Short Visit Grant to attend the Urbino Summer School in Paleoclimatology

Application Reference N°: 6861

1) Purpose of the visit

My expectations for participating in the Urbino Summer School in Paleoclimatology (USSP) were that I would be exposed to state-of-the-art techniques, problems, and questions in palaeoclimatic reconstructions. I also expected that the USSP course would help to expand my knowledge of proxies, reconstructions, and modelling techniques of palaeoclimates. Furthermore, lectures, interactive discussions, fieldtrips and exercises, given by several of the world's leading researchers in their respective fields would assist me to expand my expertise and network and, if possible, apply these outcomes directly to my Ph.D. project on Late Oligocene to Early Miocene palaeoclimate.

In addition to the curricular aspects of the program, the summer school would provide a platform to informally present a poster with preliminary results from my Ph.D. project, and to discuss the posters presented by other participants. Such discussions would allow me to directly build on knowledge acquired at the school and might lead to future collaborations and long-lasting friendships with other USSP participants.

2) Description of the work carried out during the visit

During the two-week summer school, I attended lectures, completed supervised exercises, and participated in a field trip. I was introduced to many different theories and hypotheses related to Cretaceous and Cenozoic climate change, such as the OAE2 (Ocean Anoxic Event 2), the PETM (Palaeocene-Eocene Thermal Maximum), or more recent Plio-Pleistocene climate variability. Some of these theories and hypotheses are unpublished and potentially controversial in their specific field, and led to intriguing discussions between staff and students on cutting edge scientific problems in our disciplines. These discussions encouraged me to critically review some of the lectures and the methods used in each theory, as different lecturers would sometimes present alternative interpretations. These discussions also enabled me to gain not only general but also in-depth up-to-date knowledge of palaeoclimatic proxies, reconstructions, and models of these events.

3) Description of the main results obtained

USSP was characterised by many unique educational modules, and three of the modules stood out from the rest. First of all, during the full day field exercise we visited several classic outcrops near Gubbio (Italy) of past extreme climatic events presented by world-leading experts. The USSP students could get hands-on experience with these events, while being educated in the scientific and historic background of the events.

One of the key locations was at the Contessa Valley, which includes the "Livello Bonarelli", where the Cretaceous Ocean Anoxic Event 2 (OAE2) is exposed. It is hypothesised that this event was caused by intense upwelling conditions that lead to eutrophic and anoxic conditions. The Contessa sequence also contains the Palaeocene Eocene Thermal Maximum (PETM), which has been interpreted as rapid global warming and ocean acidification.

We were also introduced to the famous Bottaccione Gorge with the Cretaceous-Palaeogene (K-Pg) boundary. The Bottaccione section contains the outcrop studied by Alvarez and colleagues, which resulted in their seminal paper arguing for the extra-terrestrial implications of the observed iridium anomaly.

The second highlight of the USSP course was Maureen Raymo's lecture regarding the Plio-Pleistocene world. This time interval is very different from the glaciation event "Mi1" at the Oligocene-Miocene boundary, which is the main focus of my Ph.D. project, but the general ideas and hypotheses can be extrapolated back in time. Dr. Raymo's lectures greatly extended my knowledge about (benthic) $\delta^{18}O$ records generated using microfossil (foraminifera) shells preserved in deep-sea sediment cores, which record a combination of calcification

temperatures and the δ18O of the (global) seawater, usually directly related to the global ice volume.

The intriguing interplay of the different ice sheets and temperature will influence my way of thinking about the Oligocene-Miocene Mi1-event, the main subject of my Ph.D. The transient benthic δ18O excursion associated with Mi1 is not yet completely understood and the insights I gained from this lecture will help me to better contextualise and understand Mi1 and distinguish between the influence of temperature and ice sheets on the benthic δ18O excursion.

The influence of temperature on the benthic δ18O can be investigated by reconstructing palaeotemperatures, which was the focus of the third special module. Several lectures addressed the theoretical background and the applications in palaeoclimatic research of various methods of palaeotemperature reconstruction, including Mg/Ca, Uk'37, and TEX86. Each method has specific advantages and disadvantages and it was very useful to receive a complete overview of each method and especially why these proxies provide different estimates from the same stratigraphic records. These generic overviews helped me understanding these methods and might enable me to use them not only to the palaeoclimatological aspect of my present Ph.D. project but also in future work.

Another important topic within the USSP lectures was the on-going discussion of the PETM. Many lecturers presented results relating to the PETM and provided their own interpretation of the causes and/or consequences of the event using their own approaches. These discussions made the attendees aware of the different hypotheses and their weaknesses and strengths, and led to some open staff-student discussions regarding the PETM.

A platform of open discussions was one of the core concepts of the summer school and all USSP students were encouraged to actively discuss the research presented by other students and staff. Since all posters were on display for the duration of the summer school, students had ample time to properly discuss each other's work, as well as present their own to their peers.

4) Future collaboration with host institution (if applicable)

Future collaborations with the host institute University of Urbino could be developed, as Simone Galeotti, one of the key organisers of the course, and I both work on time scale development sensu lato, which is a significant part of my Ph.D. project. Although we are working on different subjects at the moment, collaboration might be possible in the future.

5) Projected publications / articles resulting or to result from the grant *(ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant)*

I anticipate collaborating with my fellow USSP alumni and teaching staff, as my palaeomagnetic expertise may be of assistance in answering specific questions in their projects. For example, it might be possible to collaborate with colleagues from University of Colorado (Boulder) in an attempt to date sediments from glacial lakes on Baffin Island using (palaeomagnetic) secular variations. The secular variation record will generate a basic age model for the geochemical and physical proxy records of these cores, which provide a continuous record of Holocene landscape and climatic evolution in the studied area.

Furthermore, some preliminary reconnaissance work has been completed for a possible collaboration with colleagues from University of Utrecht, working on the Late Oligocene warming at Site U1356 (IODP Expedition 318, Wilkes Land Glacial History). A successful collaboration might be possible if we can reconstruct a global climatic signal from the combination of their Antarctic records with the environmental data I am generating from Site U1406 (IODP Expedition 342, Paleogene Newfoundland sediment drifts).

6) Other comments (if any)