GBA Gray-Milne Travel Bursary: Report

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Thanks to the Gray-Milne bursary, I was able to fund most part of a research visit to Zurich, where I was a guest of the Geophysical Fluid Dynamics (GFD) group of Prof. Tackley at ETH. This group is responsible for the code STAGYY, a numerical tool designed to simulate mantle dynamics of planets such as our own Earth. Indeed, this research visit was integral to the main objective of my PhD program: combining experimental seismic data with geodynamic numerical models in order to investigate the heterogeneities of the present day Earth mantle. In fact, a number of recent geophysical observations support a picture of a heterogeneous deep interior of the Earth. Geodynamic models can offer insight into how such heterogeneities may originate and develop. This is where STAGYY comes into play: over the course of my PhD I will need to run a suite of numerical models so that they can later be tested against real seismic data.

Thanks to my guest status, I was granted access to one of ETH's supercomputers, the Euler cluster: a critical preliminary step, since geodynamic models typically need intensive computational resources. GFD researchers walked me through a basic workflow of the code: from setting the relevant physical parameters and initial conditions of the simulation to submitting the job for computation on the cluster. However, running models is only half the work: a careful analysis is also crucial in order to understand them. The first step of such an analysis is visualizing the model. To this end, a tutorial session was dedicated to the software ParaView, a widely used tool for scientific visualization. The second step is post-processing. This allows to perform further calculations on top of the models and extract useful diagnostics. On this topic, I was introduced to two different tools: StagLab (a MATLAB add-on) and StagPy (a Python module). Additionally, I was shown how to access the STAGYY source code, how to create my personal branch of the project and track any edits to the code through Git.
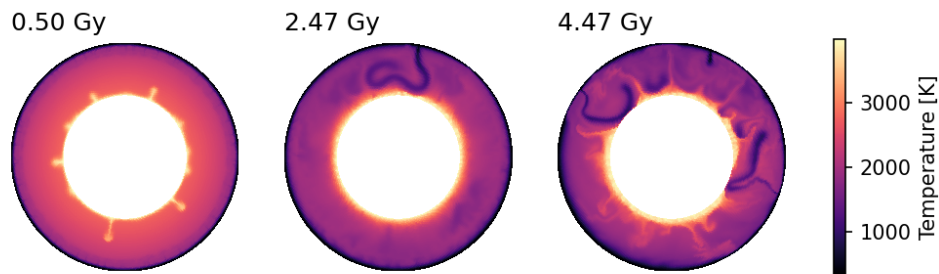

Figure 1: Example of a numerical model at three different time steps of its evolution.

Finally, it is worth mentioning that, at the time of the visit, the global coronavirus pandemic was still ongoing. Restrictions were in place for people entering the UK from several countries. This meant that meeting in London at the University College was highly impractical, both for me and my advisor, Dr. Maxim Ballmer. However, this bursary allowed this meeting to happen at ETH, since no such restrictions were in place in Zurich at the time. In this sense, the Gray-Milne had a key role in kick-starting this PhD project.

Figure 2: A tutorial session with researchers of the GFD group. Matteo Desiderio is the one on the right (picture taken by Dr M. Ballmer).