Deep Earth explorers

The Cambridge Deep Earth Seismology group has an exhibition at the Sedgwick Museum, Cambridge, aimed at increasing understanding of our planet and changing perceptions of geophysics – and geophysicists. Group members Jennifer Jenkins, Jess Bartlet and Sanne Cottaar tell us more.

"Welcome to the Deep Earth Explorers Exhibition: The Earth is an incredible place. As far as we know it is the only planet where humans can currently live. The 'Deep Earth Explorers' team is fascinated by what is in the Earth's interior, and how it is changing with time. There is still so much to discover about how our planet works." These words greet visitors to our exhibition at the Sedgwick Museum of Earth Sciences at the University of Cambridge. The Deep Earth Seismology group at the university worked with museum staff to design the exhibition, which will run into 2021; and, as a result of the Covid-19 pandemic, the exhibition is now available online.

Working as a deep-Earth scientist can sometimes feel very academic. We tease out information through seismology, thermodynamics and big data computing; we seek to identify unknown material and reveal mysterious features hidden within the deep Earth; we map unexplored intricate details in the Earth's mantle, revealing how much we still don't know or fully understand. Yet our focus on these exciting structures far beneath our feet can make it difficult to appreciate the impact of our work on the public. Designing a research exhibition gave us an opportunity to share our passion for the science we work on, and some key facts about the planet we live on.

Opportunity for awareness

Most people will only ever get a brief introduction to geophysics in high-school geography or chemistry syllabuses, learning about plate tectonics or the rock cycle. Designing an exhibition about deep Earth structure provided an excellent opportunity to increase awareness of what goes on beneath our feet, as well as to introduce some of the new discoveries still being made in this very young and evolving discipline. In fact, the very core of the Earth was discovered just over a century ago, and the theory of plate tectonics was proposed only half a century ago.

1 *What do geophysicists do all day? The cartoons of members of the team used here are taken from the exhibition.* (Gautier Nicoli)

"People wanted to know more about us, the scientists: who we are, how we got here and what we actually do, day to day"

As academics it is easy to forget that we use jargon that is meaningless to much of the rest of the world, so it can be hard for us to know how to pitch content to the public at a level that is interesting and engaging, while at the same time accessible. To tackle this, we worked with a dedicated public engagement coordinator and staff at the museum experienced in public communication of science. Based on their advice, we ran initial ideas past museum visitors, to gauge the level of understanding of our target audience and find out what they are actually interested in learning about. A surprising result of this evaluation was that people's interest goes beyond the science: they wanted to know more about us, the scientists – who we are, how we got here and what we actually do, day to day. This interaction with the people we actually want to reach was key in designing accessible and interesting exhibits, as well as shaping the rest of the exhibition.

Interactive exhibits

Our main aim when designing the exhibition was to increase public understanding around the deep Earth. We were keen to communicate research around lesser-known structures and features within the Earth, the surprising timescales of Earth dynamics and how, despite earthquakes being destructive events, they can be used as imaging tools to understand our planet. We also wanted our exhibition to break out of the conventional museum space of beautiful ancient specimens in glass cases, and to be as hands-on and interactive as possible. The exhibition includes three interactive components:

- Videos explaining the diverse seismic waves we use to investigate different parts of the planet, triggered with electronic tags depicting parts of the Earth. The exhibit explains how earthquakes are both a symptom of a dynamic planet and a tool to understand these dynamics.
- A touchscreen display in which the user controls convection within the mantle by inputting hot or cold regions (figure 3). The user can also pause the convection to create an earthquake and watch waves propagate through the model, illustrating the challenge we face in trying to understand the full mantle dynamics by imaging one snapshot

in time. This feature is adapted from the online version written by Ian Rose (ian-r-rose.github.io/interactive_earth).

● A 3D Earth model created with Amalgam Modelmaking Ltd in Bristol, part-funded by an RAS engagement grant. The open globe shows facts about the basic layers in the Earth's interior (figure 2). Turning the movable "pages" of the major Earth layers reveals additional details and complexities that members of our research group work on.

Cartoons

Around these three interactive components, we give information linking our key concepts of Earth structure, convection and earthquakes as imaging tools, to the history of the field and ongoing research in the group. Driven by visitors' feedback about the researchers themselves, we worked with petrologist and cartoonist Gautier Nicoli to illustrate the exhibition, bringing the research group to life in cartoon form (figure 1). This put faces to the scientists behind the research, making the whole exhibition more accessible and personal. The cartoons are scattered through the exhibition, and on a storyboard showing the research cycle and our day-to-day work.

While our main aim is to increase understanding of our subject, public engagement also has the power to change perceptions of science and of us scientists. By focusing on the members of our team, with our range of genders, nationalities and academic backgrounds, we provide visibility of different role models for people considering STEM careers. We also highlight the work of RAS Fellow Inge Lehmann, the prominent historical female seismologist who discovered the inner core in 1936, which will be introduced in the feminist tours run by the Sedgwick Museum. And by showing the kind of work we do in terms of computer coding and data analysis, we highlight a different side to Earth sciences beyond the stereotypes of staring at rocks or digging for fossils.

Completing a project of this scale took a lot of time and effort. Everyone in the research group played a part, whether brainstorming exhibit and activity ideas, developing videos and codes for interactive features, spending hours on 3D printing, or working with museum staff to create accessible text and designs for the backboards. For our recently formed and growing research group, this was a chance to work on a project as part of a larger team and learn some new skills. It brought us closer as a group, resulting in a more collaborative research atmosphere.

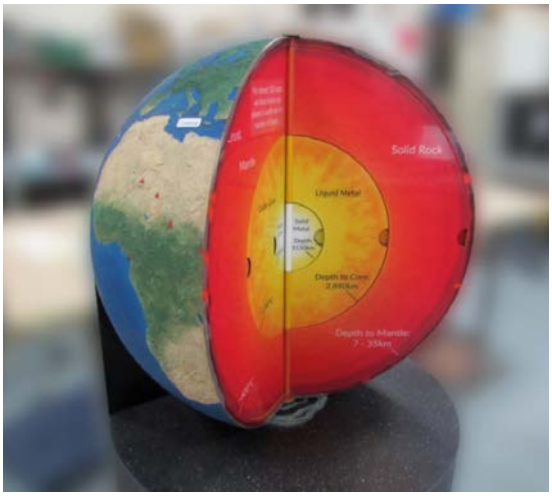
Events

The exhibition opened with an evening event on 6 March 2020, where the talented Matthew Kemp of Geologise Theatre provided entertainment with a self-written song about our deep-Earth research. Sadly, within days the museum had to respond to the battle against coronavirus by cancelling the Super Science Saturday event where the exhibition would have featured and the research group had planned a range of hands-on activities; the museum closed fully soon afterwards.

But all is not lost. Since then, the team has found time to build an online version of the exhibition. As well as all the interactive exhibits, the website features profiles of scientists within the group and their research, and a range of activities to try at home. We hope the website provides a timely, fun and educational resource, allowing us to reach beyond those people who would have visited in person.

When we move out of this difficult time, the Deep Earth Explorers exhibit will be waiting to introduce more people to the mysteries within our planet at the Sedgwick Museum of Earth Sciences in Cambridge. Until then, feel free to explore online from the comfort of your own home: deepearth.esc.cam.ac.uk. ●

2 *3D interactive Earth model made by Amalgam in Bristol.*



3 *A touchscreen allows visitors to interact with convection and earthquakes within the mantle. Coded by Dr Ian Rose.*

AUTHORS

Dr Sanne Cottaar (far left), **Dr Jennifer Jenkins** (front left), and **Jess Bartlet** (front centre), Deep Earth Group, Dept of Earth Sciences, University of Cambridge, UK

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