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Deep Earth dynamics: what is happening underneath our feet?

Monday 25 July | 15:45 - 17:00 | Charter 2

The study of the Earth's deep interior is one of the most active frontiers of Earth sciences. Using a multiscale approach, the session will highlight how the Earth is constantly shifting under our feet, controlled by the slow plastic deformation of the mantle. It will look into the spectacular world of volcanoes and the remarkable, unpredictable and alarming occurrence of eruptions. Diamonds and their inclusions are the deepest materials originating from the Earth's interior and reaching its surface. They can shed light on questions such as the role of carbon recycled from the surface and whether the Earth's mantle holds a secret water store.

Speakers

Sierd Cloetingh

Utrecht University, The Netherlands

Prof. Cloetingh is Head of the Tectonics Group at Utrecht University and President of the Academia Europaea. A former Vice-President of the ERC, he was distinguished in 2004 as Chevalier de la Légion d'Honneur for his contributions to science and European scientific cooperation in research and education.

Patrick Cordier

ERC grantee

Lille University of Science and Technology, France

Patrick Cordier is a professor in the Physics Department at the University of Lille in France. His research focuses on plastic deformation of minerals. In recent years he devoted special attention to high-pressure mantle phases. He is Chief Editor of the European Journal of Mineralogy and Associate Editor of the American Mineralogist. Prof. Cordier is a fellow the Mineralogical Society of America (MSA). In 2016, he was awarded the Dana Medal of the MSA.

Yan Lavallée

ERC grantee

University of Liverpool, UK

A Canadian national, Yan Lavallée studied in Canada and the USA before obtaining his PhD in Mineralogy in Germany. He is currently Chair of Volcanology and Magmatic Processes at the University of Liverpool that he joined in 2012. Dr Lavallée's research aims to describe the mechanics of magma and rocks and their impact on volcanic processes, earthquakes and geothermal exploration. His results could help refine models simulating and monitoring volcanic eruption and contribute to developing the new models of the Earth.

Fabrizio Nestola

ERC grantee

University of Padua, Italy

Fabrizio Nestola is Full Professor of Mineralogy. He graduated in Geology at the University of Turin and obtained his PhD in Mineralogy from the University of Modena. He was awarded the Medal for Research Excellence by the European Mineralogic Union in 2010. He studies natural diamonds and their mineral inclusions to shed more light on the composition of the Earth.

Eleonora Rivalta

ERC grantee

GFZ Postdam, Germany

Eleonora Rivalta leads a research group at the Helmholtz Centre Potsdam of the GFZ German Research Centre for Geosciences. She specialises in physics of earthquakes and volcanoes. Before joining the Helmholtz Centre she was a researcher at the Universities of Hamburg and Bologna and lectured at the University of Leeds.

Minerals reveal the flow patterns inside the Earth

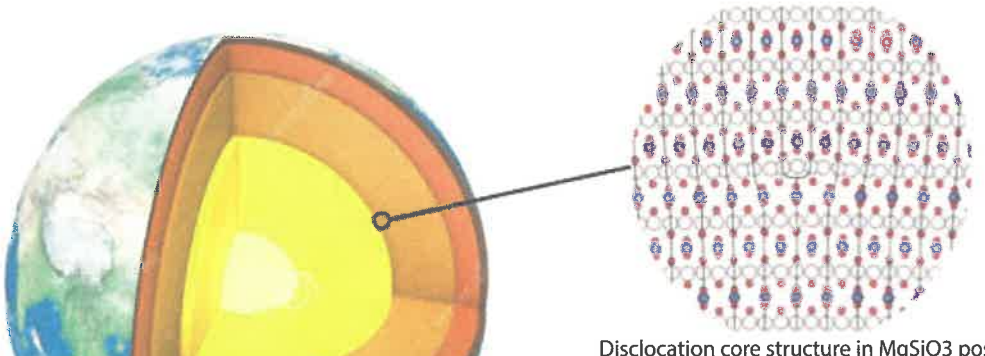
The Earth is made of layers, just like a big onion, composed of different materials. However, the compounds forming these layers are not static, flowing from one stratum to another, following patterns still not entirely understood. Prof. Patrick Cordier tries to model the real conditions minerals are subjected to beneath the Earth's crust. His aim is to understand the forces driving tectonic plates so we can better comprehend phenomena like earthquakes and volcanic eruptions.

Understanding the inside of our planet is not an easy task: a whole discipline, rheology, is dedicated to the study of the flows inside the Earth, which stir the solid rocks of the mantle to dissipate the Earth's internal heat. Funded by the ERC, Prof. Cordier and his team apply a novel approach to materials science, called multiscale modelling, to shed new light on these mechanisms. This technique consists in accurately describing the forces which operate at the atomic scale under the high pressures of the deep Earth. Prof. Cordier's team wants to understand how small defects in the rocks have an impact on the flow of materials.

Prof. Cordier is modelling minerals like wadsleyite, ringwoodite, silicate perovskite and post-perovskite, which are found in their stable state at great depths only, to find the viscosity profile of the lower mantle (around 670 to 2 900 km below the Earth's surface) and its differences with the transition zone to the upper mantle (410-670 km deep). Additionally, he aims to understand how rocks flow at the core-mantle boundary – the very last layer before the Earth's inner metallic core, 2 900 km under our feet.

Started in 2012, the RHEOMAN project has generated promising advances: it has proposed a new mechanism to explain how deformations occur on olivine-based rocks, the most abundant materials in the Earth's upper mantle. Prof. Cordier's team is looking into how these defects, named disclinations, affect the mobility of materials in all the phases of the mantle. Their observations could lead to a whole new understanding of the rheology of planetary interiors.

Researcher: Patrick Cordier, Lille University of Science and Technology (France)
ERC Project: Multiscale modelling of the rheology of mantle minerals (RheoMan)
ERC funding: Advanced Grant 2011, € 2.17 million for six years



Disclocation core structure in MgSiO3 post-perovskite
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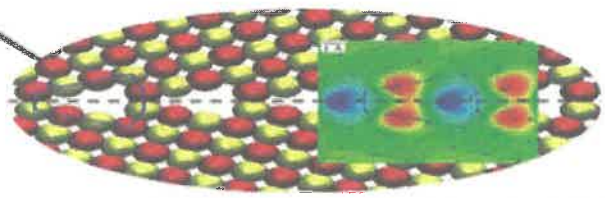

Disclination structure of a grain boundary in MgO
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