

Precipice

Earth Sciences in the
Anthropocene

The 52nd Herdman Symposium
8th February 2025, Central Teaching Hub



UNIVERSITY OF
LIVERPOOL



Herdman Symposium

The Herdman Symposium is run annually by the Herdman Earth Sciences Society and the Department of Earth, Ocean and Ecological Sciences at the University of Liverpool. It has been held every year since 1973.

The Herdman Earth Sciences Society is the student geology society at the University of Liverpool. Founded in 1918, it is one of the oldest such societies in the UK.

Sponsors

It would not be possible to hold the Herdman Symposium without the generous support of our sponsors. More information is included later in this brochure.




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The climate stripes used on the cover, headers and footers of this brochure are the work of Prof. Ed Hawkins. They are the climate stripes for Liverpool using 1850–2023 data, generated as part of his *#showyourstripes* project. The project can be viewed at showyourstripes.info.



“The Holocene has ended. The Garden of Eden is no more. We have changed the world so much that scientists say we are in a new geological age: the **Anthropocene**, the age of humans.”

- Sir David Attenborough





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Itinerary

- 9:50 **Introduction**
Prof. Peter Burgess (Professor of Sedimentary Geology, University of Liverpool), Asriel Wilde (President of the Herdman Society), Jennifer Mackie (Herdman Symposium Secretary)
- 10:10 **Prof. Mark Maslin (University College London)**
How humans caused the Anthropocene
- 11:00 **Dr. Karen Hanghøj (British Geological Survey)**
Perspectives on the energy transition: It starts with a rock
- 11:50 *Break*
- 12:10 **Dr. Claus-Dieter Hillenbrand (British Antarctic Survey)**
How geological records from Antarctica can provide context for current and future ice sheet changes
- 13:00 *Lunch*
- 13:50 **Prof. Babette Hoogakker (Herriot-Watt University)**
Ocean oxygenation and climate tipping points
- 14:40 **Prof. Chris Jackson (WSP)**
The geological disposal of nuclear waste: Why, how and where?
- 15:30 *Break*
- 15:50 **Prof. Richard Worden (University of Liverpool)**
Carbon Capture and Storage (CCS)
- 16:40 **Closing remarks**
- 17:00 *Drinks reception: Pen Factory, 13 Hope Street*

Important information

Health and safety information

We are not anticipating a fire drill on the day of the Symposium. If the fire alarms sound, calmly make your way to the illuminated fire exits and follow the instructions of the fire wardens. Do not stop to collect personal belongings.

An attendee has a life-threatening allergy to **bananas**. Please do not bring or consume bananas at the Symposium.

Speaker and privacy information

All talks are being recorded and filmed, to be uploaded to GeoHub YouTube page. Any questions asked by the audience will be captured as part of these recordings.



Prof. Mark Maslin

Professor of Earth System Science, **University College London**

“Anthropocene: A history of environmental destruction and redemption”

Abstract

There is general scientific agreement that human activity has been a geologically recent, yet profound, influence on the Earth System. Humans have in fact become a geological superpower on a par with plate tectonics or a meteorite impact. It has, therefore, been proposed that we should refer to the present, not as within the Holocene Epoch but instead as within the Anthropocene Epoch. To some the Anthropocene symbolises a future of superlative control of our environment. To others it is the height of hubris, the illusion of our mastery over nature. Whatever your view, just below the surface of this odd-sounding scientific word, the Anthropocene, is a heady mix of science, philosophy, religion and politics linked to our deepest fears and utopian visions. By tracing the development of human society through its five major stages (hunter- gatherer, agricultural, mercantile capitalism, industrial capitalism and consumer capitalism) and documenting the dramatic and significant increase in the impact of humans on the Earth Mark Maslin shows what the new epoch means for the future of humanity, the planet and life itself.

About the Speaker

Mark Maslin is a Professor of Earth System Science at University College London and its Pro-Vice Provost for the Climate Crisis Grand Challenge. He also holds a Royal Society Industrial Fellowship, is the Executive Director of Rezatec Ltd. and Director of the London NERC Doctoral Training Fellowship. He is a Strategy Advisor for Net Zero Now and Lansons, and was a member of Cheltenham Science Festival Advisory Committee for over 10 years. His areas of scientific expertise include causes of global climate change and humanity’s impact on our planet. He also works on monitoring land carbon sinks using remote sensing and ecological models. Prof. Maslin has delivered over 70 talks over the last three years, including to Twitter, Google, the Royal Geographical Society and more. He has authored over 10 popular books, and over 70 popular articles for multiple publications.



Dr. Karen Hanghøj

Director, **British Geological Survey**

“Perspectives on the energy transition: It starts with a rock”

Abstract

Geoscience is essential in finding solution to many societal challenges such as how to:

- use natural resources responsibly and sustainably
- manage environmental change
- be resilient to environmental hazards

The sustainable use of natural resources is essential for the energy transition and for reaching Net Zero. This presentation will especially focus on the importance of knowledge about minerals and metals in this context.

Emerging energy and mobility technologies create a strong demand for certain raw materials, where demand will dramatically exceed current production in the next decades. Potential scarcity and criticality of these materials might negatively impact the energy transition, and the downstream supply chain significantly. Sustainable and responsible sourcing of these metals is thus going to be important on a global level in the decades ahead.

To meet these challenges we need to design smarter solutions for the sustainable extraction, processing and use/repairing/recycling of raw materials from both primary and secondary sources. Furthermore, we must ensure that used materials and products find their way into new product lifecycles in an energetically and economically meaningful way. We need to maintain products and materials in the economy as long as possible through waste valorization, industrial symbiosis, reuse, repairing, remanufacturing and recycling.

About the Speaker

Karen Hanghøj has been the Director of the British Geological Survey since October 2019. Karen has a background in the minerals and metals industry and research and innovation management. Her work involves understanding the complexity of resource management, environmental and social sustainability and the role of geosciences in finding solutions to societal challenges. She was awarded the William Smith Medal from the Geological Society in 2023.



Dr. Claus-Dieter Hillenbrand

Senior Marine Geologist,
British Antarctic Survey

“How geological records from Antarctica can provide context for current and future ice-sheet changes”

Abstract

Satellite and field observations show that parts of the Antarctic Ice Sheet are currently undergoing rapid ice loss, thereby increasingly contributing to global sea-level rise. The direct observational record, however, spans just a few decades, raising the question whether this “snapshot” of ice-sheet changes is representative or exceptional in a longer-term context. The only reliable method to establish the long-term framework of Antarctic ice-sheet variability and, thus, to evaluate, if present ice loss is related to human-influenced global warming, is the reconstruction of past ice-sheet configurations from the geological record. Here I will demonstrate how research on the marine geological imprint left by the ice sheet on the continental margin around Antarctica has improved our understanding of past and present ice-sheet dynamics. This newly acquired knowledge helps to evaluate the reliability of numerical models in simulating past ice-sheet changes and, thus, improves model-based predictions of future ice loss and associated global sea-level rise.

About the Speaker

Claus-Dieter Hillenbrand is a sedimentologist and marine geologist at the British Antarctic Survey, in the “Palaeoenvironments, Ice Sheets and Climate Change” team. He is the UK Principal Investigator for the “Thwaites Glacier Offshore Research (THOR)” project of the Natural Environment Research Council (NERC)-funded programme “International Thwaites Glacier Collaboration (ITGC)”. His research focus for the last 30 years has been the study of Late Miocene to Holocene glacial and marine sediments from the West Antarctic continental shelf, slope and rise, and he has participated in 18 marine geological and geophysical cruises onboard RRS James Clark Ross, RV Polarstern, RRS Discovery, RV JOIDES Resolution, RV/IB Nathaniel B. Palmer and RV Sonne. His research currently focuses on the glacial history of the West Antarctic Ice Sheet during the Late Cenozoic by analysing sediment cores in combination with marine geophysical data.



Prof. Babette Hoogakker

Professor in Palaeoceanography and Biogeochemistry, **Herriot-Watt University**

“How can the past inform the future? The fate of ocean oxygenation in a warming world”

Abstract

Oxygen is critical to the health of all forms of higher life, including fish and marine organisms. Since observations began ~50 years ago, scientists have found that oxygen levels in the ocean have decreased by 2%. This decrease is expected to continue into the future, driven by global heating. The climate model simulations, that predict that this decrease will continue for hundreds of years, carry considerable uncertainties: they do not all agree and underestimate the decrease that took place in the last 50 years.

During this talk we will look at the processes that are causing our ocean to lose oxygen. We will investigate how the past can help us understand how oxygen contents of the ocean may respond to prolonged anthropogenic heating. We will travel back in time for millions of years to when the Pacific Ocean (currently largest low-oxygen body in the ocean) used to be better oxygenated, and find out what conditions led to the subsequent development of one of the most intense oxygen deficient zones in its subsurface waters.

About the Speaker

Babette Hoogakker is a Professor of Palaeoceanography and Biogeochemistry in the Lyell Centre at Herriot-Watt University, Edinburgh and a UKRI Future Leaders Fellow. She is a NERC Fellow and is a past Foraminifera Group Chair for the Micropalaeontological Society. Prof. Hoogakker's research involves the use of various palaeoceanographic proxy methods and climate models to understand how oxygen levels in the ocean have varied in the geological past. Her research group works with sediments from the International Ocean Discovery Program to determine if there have been changes in the extent of the Atlantic Ocean, and over the last four years they have studied the effect of the closure of the Panama Isthmus on ocean oxygenation through deep time sediment reconstructions and climate modelling. They are currently studying more recent warm periods, in the Pliocene and Pleistocene. Prof. Hoogakker was awarded the Philip Leverhulme Prize in Earth Sciences in 2018.



Prof. Chris Jackson

Technical Director of
Subsurface Storage, **WSP in
the UK**

“The Geological Disposal of Nuclear Waste; Why, How, and Where?”

Abstract

Nuclear power will likely play an increasingly important role in the energy transition, as we seek to reduce dependency on hydrocarbons and combat climate change. However, a key question is, “what will be done with the arising nuclear waste?”. It is internationally recognised that the safest method for the permanent disposal of higher-activity radioactive waste is in a deep, underground Geological Disposal Facility (GDF). The UK has, along with several countries, has embarked on a project to identify potential sites for the construction of a GDF, noting the suitability criteria includes a detailed understanding of the local and regional geology. In this talk I will outline the UK GDF programme, and the key role that subsurface-focused scientists play in site characterisation, safety case development, and ultimately, the engineering of a subsurface repository for nuclear waste.

About the Speaker

Chris Jackson is the Technical Director of Subsurface Storage at WSP in the UK. Prior to this, he was Director of Sustainable Geoscience at Jacobs. Before entering industry, Chris held positions at the University of Manchester and Imperial College London, where he used 3D seismic, borehole, field data and physical models to constrain the spatial and temporal evolution of sedimentary basins. Chris is a renowned geocommunicator: He delivered one of the Royal Institution’s Christmas Lectures in 2020, has delivered numerous TED talks and has been featured by publications including the BBC, the Guardian and New Scientist. He has appeared in numerous documentaries, including ‘Expedition Volcano’ (BBC2), ‘A Day in the Life of Planet Earth’ (BBC4), ‘X-Ray Earth’ (National Geographic), ‘The Pompeii Prophecy: Countdown to Disaster’ (Channel 5), and ‘Ancient Mysteries - Rome’s Sunken City’ (Channel 5/Smithsonian).




Prof. Richard Worden

Professor of Geology,
University of Liverpool

“Geological storage of CO₂ in the UK; plans for the use of saline aquifers and the novel redeployment of depleted gas fields”

Abstract

The UK is now engaging strongly with the transition away from the predominant use of fossil fuels to provide energy for the UK. This much-needed transition will have a major effect on the way we live in the UK, despite bland assertions by governments, advisory bodies and some companies. One major change is the drive to cut greenhouse gas emissions; this has led to the move to sustainable energy sources (wind, solar, etc). Another major change is the requirement to prevent CO₂ release from the use of fossil fuels, leading to the move away from internal combustion engine vehicles, gas and oil-powered central heating and release from industrial sources. However, the continued use of fossil fuels is planned globally for at least the next 20 to 30 years, as transition technologies are invented and adopted, requiring strategies to mitigate release of greenhouse gas emissions. Geological disposal of CO₂ can be achieved, but only if the generation of CO₂ is from a small number of point sources such as power stations, cement factories and industrial sites (as opposed to millions of cars and houses) thus explaining the drive towards electric vehicles and electric heat-pumps in houses. The UK is pushing ahead with two completely different approaches to the geological disposal of CO₂. One novel approach is to re-fill subsurface structures that previously held natural gas (mainly methane), known as depleted gas fields. The other, slightly better understood approach is to displace water with injected CO₂ in deep, porous, water-filled geological structures, known as saline aquifers. In this talk, the pros and cons of the use of depleted gas fields and saline aquifers for CO₂ disposal will be presented. The UK's first planned CO₂ storage sites of the depleted Hamilton Gas Field, offshore from Liverpool, in the East Irish Sea Basin, and the Northern Endurance Project, in the Southern North Sea Basin, will be compared. The quantity of CO₂ that can be stored and probable injection rates of CO₂, and how these relate to the UK's CO₂ emissions, will be discussed. The ways that the subsurface movement of CO₂ can be monitored will be contrasted. There will also be a discussion of the different risks and uncertainties associated with CO₂ storage in depleted gas fields and saline aquifers.



Social licence is essential to the success of these important CO₂ storage projects so that sustained discussion with the wider public is essential. After listening to this talk, it is hoped that the audience will extend the discussion to family, friends, and colleagues, especially those not typically involved in discussions about the pivotal role of geology in the energy transition.

About the Speaker

Richard Worden is a Professor at the University of Liverpool and a non-Executive Director at Geo-Engines Ltd. who has more than 20 years of experience in Carbon Capture and Storage (CCS) research, and has more recently researched hydrogen storage and nuclear waste disposal in low-strength sedimentary rocks. He applies aspects of petrophysics, reservoir quality, geomechanics and well log and core analysis to his research, with focuses on sandstone, mudstone and carbonate petrography, diagenesis, reservoir petrophysics, geochemistry, CO₂-water-rock interactions, petroleum-water-rock interactions and thermochemical sulphate reduction. He has taught numerous professional courses in Carbon Capture and Storage.



Liverpool Geological Society

The Liverpool Geological Society (LGS) has been a consistent sponsor of the Herdman Symposium for many years, for which we are very grateful.

The LGS was formed in 1859. Our Past President and Member, Professor William Herdman and his wife endowed a Chair of Geology in the University of Liverpool in 1916 in memory of their son Lieutenant George Herdman who was killed in the First World War. With the opening of a Department of Geology in 1929, again due to Professor Herdman's generosity in memory of his wife, Jane, many LGS meetings were held in that building at the invitation of Professor PGH Boswell, the first Professor of Geology at the University of Liverpool.

After more than 160 years, meetings continue to be held in the University of Liverpool, although are now held in the Central Teaching Hub. The Society still flourishes and offers a varied programme of illustrated talks, occasional practical sessions, and field excursions.

Lecture meetings and practical sessions are held on selected Tuesday evenings from October to April. Guest speakers include local experts and internationally recognised scientists. Field excursions, usually on selected weekends during March to September, include nearby day trips as well as residential visits to more distant parts of the UK or overseas. Visitors and new members are welcome at all meetings.

For more information about the society and its activities, click [here](#) or view the Society's website at liverpoolgeologicalsociety.org.



The Geologists' Association

Since its formation in 1858, the GA has actively promoted the study of geology to all who are interested in the past, present and future of the natural world. It is a friendly and inclusive organisation and welcomes everyone, regardless of the level of their knowledge.

In August 1858, a letter appeared in the magazine *The Geologist* proposing the formation of 'an Association of Amateur Geologists' so that 'solitary' students of the science could form a society where they 'could compare notes, give an account of our rambles, examine one another's fossils and minerals and ... be of great assistance to one another.' As a result, an initial meeting by interested parties was held in London on 29 November 1858, to discuss the establishment of such a society. The name 'The Geologists' Association' was formally adopted at a meeting of the organising committee on 17 December 1858, and a 'Prospectus' was circulated with *The Geologist* of January 1859. The first Ordinary Meeting, held on 11 January 1859, was attended by some 200 persons and the first Annual General Meeting took place on 2 January 1860. In the formation of the Association, particular emphasis was placed on the holding of 'Excursions or Field Meetings'. These, together with a regular programme of lectures and an annual exhibition, have remained the 'backbone of the Association' since. Another early objective of the Association was the formation of Local Groups, in order to advance the interests of the Association, initially in the home counties, both for the benefit of members and to liaise with other 'Field-clubs and Societies'. With the passage of time, our Local groups have since spread across the country.

Unlike the Geological Society of London (established in 1807 to cater for the needs of professional geologists), where women were not admitted to membership until 1919, 'Ladies' were eligible for membership of the Association from its formation in 1858. In the same spirit, there has never been an age limit on members of the Association (in 1862, a boy of 7 years of age was made a Life Member of the Association by his father), and there have been many subsequent instances of teenagers among our membership. Today, the needs of the youngest members of the Association are catered for by our junior club, Rockwatch, (sponsored by Anglo American, Statoil and the Geological Society) established in 1992; again, elder excursions play a large part in its activities.

For more information about the society and its activities, click [here](http://geologistsassociation.org.uk) or view the Association's website at geologistsassociation.org.uk.



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As technical services and data acquisition specialists, we're proud to work on important projects. These projects enable our economy and society to grow, and become more sustainable. This includes places to work and places to live; road and rail, tunnels and bridges; heat, light, power and water.

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'Earthrise', Bill Anders/NASA (1968).