HERDMAN SYMPOSIUM
BOLD IDEAS IN EARTH SCIENCES

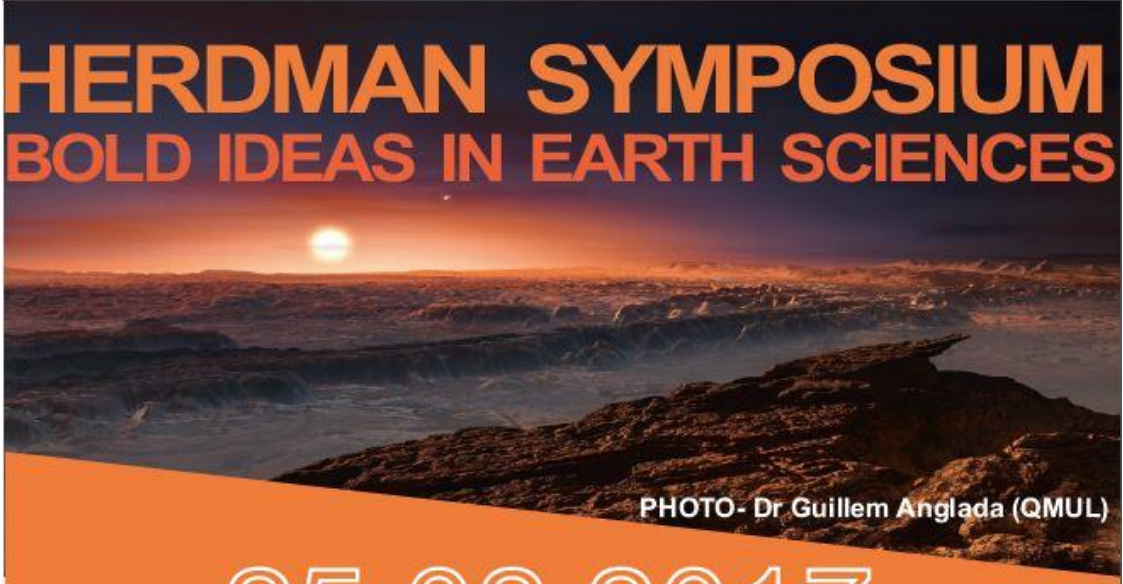

PHOTO- Dr Guillem Anglada (QMUL)

25.02.2017

TIME:

Registration from 9:30

10am-5pm

Wine reception 5pm-6pm

LOCATION:

CENTRAL TEACHING HUB

University of Liverpool

PHOTO- Hugh Tuffen (Lancaster)

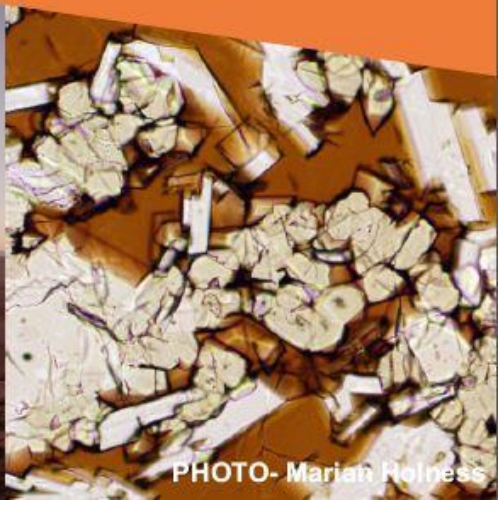

PHOTO- Marian Holness

BOLD IDEAS IN EARTH SCIENCE 2017

HERDMAN SYMPOSIUM PROGRAMME

Saturday 25th February

09.30 *Arrival (Tea, Coffee & Soft Drinks Available)*

10.00 Welcome: Jake Dolan (Herdman Society President), Holly Izzard & Bradley Falcus (Herdman Symposium Secretaries) and Jim Marshall

10.05 Hugh Tuffen- (Lancaster) *'Rhyolitic Magma on the Move.'*

10.50 *Coffee Break*

11.20 Stuart Haszeldine- (Edinburgh) *'Importance and impact of fossil fuels: atmosphere and climate protection by capturing and re capturing carbon.'*

12.05 Kate Hendry- (Bristol) *'The beauty and usefulness of sponges to reconstruct Ocean Chemistry.'*

13.00 *Buffet Lunch*

14.00 Marian Holness- (Cambridge) *'Seeing not looking: petrographic decoding of mafic rocks.'*

14.45 *Tea Break*

15.15 Sarah Davies- (Leicester) *'The rise of a new terrestrial ecosystem in the early Carboniferous.'*

16.00 Guillem Anglada- (QMUL) *'Proxima b, planets around red dwarfs and the search for life beyond the Solar System.'*

16.45 *Wine Reception (Wine and Soft Drinks Available)*

Dr Hugh Tuffen – (Lancaster) *'Rhyolitic Magma on the move.'*

TALK ABSTRACT

Rhyolitic magma is responsible for some of the world's greatest eruptions and creates the glassy obsidian revered by geologists and archaeologists alike. However, our understanding of rhyolite falls far behind that of basalt, as rhyolitic eruptions are seldom seen. Unresolved questions include why rhyolitic eruptions switch from violent explosivity to gentler lava effusion, how rhyolitic obsidian lava advances, and how shallow intrusions relate to activity at the surface.

It is an exciting time to be studying rhyolite, as two recent eruptions and one geothermal drilling accident are providing unprecedented insights into this enigmatic magma type. The eruptions of Chaitén and Cordón Caulle in Chile permitted close observation of explosive activity and lava effusion, whereas the IDDP-1 borehole at Krafla, Iceland intercepted a rhyolitic intrusion at a depth of two kilometres.

We will use the new evidence from Chile and Iceland to take a fresh look at rhyolite magma on the move. Surprisingly, rhyolitic lavas advance in a remarkably similar manner to their runnier basaltic counterparts, existing models of explosive-effusive transitions need to be completely reformulated, and intrusions may be driven by eruptions, rather than vice versa. To conclude,

we will anticipate future rhyolite research, including the tantalising prospect of extracting powerful geothermal energy directly from underground rhyolite magma.

ABOUT THE SPEAKER

Hugh became fascinated by rocks as a kid growing up amongst the Cumbrian fells, and studied rhyolitic eruptions in Iceland for a PhD at the Open University, which entailed months of camping in familiarly horizontal rain. He has since held a number of research fellowships in the UK and abroad, and is now a Reader in Volcanology at Lancaster University supported by the Royal Society. Hugh's research addresses the mechanisms controlling silicic eruptions, and combines field, geochemical and experimental approaches. He hopes that, in this age of ever more sophisticated machines, we will continue to look and learn from the rocks beneath our feet.

Prof Stuart Haszeldine – (Edinburgh)

'Importance and impact of fossil fuels: atmosphere and climate protection by capturing and re-capturing carbon.'

TALK ABSTRACT

Fossil fuels are the energy foundation of a wealthy industrialised society since 1750. Yet extraction of fossil or biomass carbon, and conversion into atmosphere CO2 is driving global warming, sea level rise, and ocean acidification with a geologically unprecedented pace. Future affluent lifestyles, in the UK and elsewhere need to reduce greenhouse gas emissions per person to those of present day India. This can be achieved by pathways which combine much greater efficiency of carbon fuel use, electricity generation from renewable sources, and capture of CO2 emissions at source for power, heat, industry, and transport. The geological features of CCS will be described. In principle this is straightforward, and utilizes fluids seals and reservoirs understanding adapted from decades of hydrocarbon geology and engineering expertise. Carbon Capture and Storage is a politically favoured technology suite, but is progressing only slowly. Some technical, political, and financial blockages will be explained. Remedies for becoming un-stuck include political prioritization of geological storage, or Direct Air Capture of CO2 – or banning fossil fuels (which is unpopular, globally).

ABOUT THE SPEAKER

Stuart Haszeldine trained as a geologist, and has 40 years research and industry experience. The first half of his career was extracting hydrocarbons from the ground, and increasing greenhouse gases. The second half of his career is trying to put greenhouse gases from the atmosphere and ocean back into their geological and biological storage. He works on climate engineering, radioactive waste, biochar, and Carbon Capture and Storage - which is gradually developing the North Sea subsurface into a European sized CCS industry. He is occasionally advises both UK and Scottish governments, when facts and logic are fashionable. He was awarded the Geological Society William Smith Medal for applied geology in 2011, and in 2012 was appointed OBE for services to climate change technologies.

Dr Kate Hendry – (Bristol) *'The beauty and usefulness of sponges to reconstruct Ocean Chemistry.'*

TALK ABSTRACT

Dissolved silicon, silicic acid, is an essential nutrient for several marine organisms that contribute to carbon uptake and cycling in the oceans. Silicic acid is released from the weathering of terrestrial rocks and soils, processed through land plants, and flows into the oceans. The major oceanic sink of silicic acid is the production of biogenic silica (opal) by diatoms, which are photosynthetic algae that make their intricate shells from amorphous silica that contribute towards a significant proportion of the export of organic carbon out of the surface waters into the deep-ocean. However, diatoms efficiently take up nutrients from surface waters, and rely on upwelling supplies of silicic acid for growth. As such, understanding and quantifying deep ocean silicic acid concentrations and supply mechanisms is essential for understanding diatom productivity in the past, and the interaction between marine biological uptake of carbon dioxide, climate and ocean circulation. The development of silicon isotope analysis in seawater and biogenic opal has led to advances in our understanding of the silicon biogeochemical cycle. Here, I will be exploring some of the new developments in the use of intricate sponge skeletal elements – spicules - as archives of nutrient cycling. I will present some new case studies to illustrate that combined downcore isotope

records hold great promise for the reconstruction of water column silicon cycling in the past, constraining not only silicon input and availability but also uptake and utilisation in surface waters. Such reconstructions can shed light on changes in marine ecology and carbon uptake that occur during periods of climatic change.

ABOUT THE SPEAKER

Kate Hendry is a biogeochemist and chemical oceanographer at the University of Bristol, interested in understanding nutrient cycling in the modern ocean, and the link between past climatic change, ocean circulation, nutrient supply and biological productivity. She did her PhD at Oxford University, working on trace metal cycling in coastal Antarctic waters. She then went on as a postdoctoral research assistant, and then won a Doherty Scholarship to work at Woods Hole Oceanographic Institution, USA. Here, she worked on the stable isotopes of silicon in biogenic opal, a substance produced by some kinds of algae (diatoms), some protists (radiolarians, for example) and deep-sea sponges. After returning to the UK, she worked at Cardiff University for 18 months, before moving to Bristol as a Royal Society Research Fellow and lecturer.

Prof Marian Holness – (Cambridge)
'Seeking not looking: petrographic decoding of mafic rocks.'

TALK ABSTRACT

In recent years, the emphasis in igneous petrological research has moved away from fundamental observations of rocks in thin section towards geochemical analysis. In this talk I will show how it is possible to use very simple microstructural parameters to decode the cooling history of mafic rocks, and in particular to trace the effects of thermal buffering during the cooling of complex fractionating liquids.

ABOUT THE SPEAKER

I began my microstructural career as a metamorphic petrologist, looking at the effects of fluid flow in meta-carbonates. I gradually moved up-temperature, via migmatites, to the study of gabbroic layered intrusions. My work involves the decoding of solidification history using a combination of microstructural observations, field work and geochemistry. I am currently focussing on the layered intrusions of Rum, Skaergaard and Bushveld.

Dr Sarah Davies – (Leicester) '*The rise of a new terrestrial ecosystem in the early Carboniferous.'*

TALK ABSTRACT

The end Devonian mass extinction was a major turning point in terrestrial evolution with extinctions in tetrapods, fishes and plants. It was followed by the development of new terrestrial habitats which are recorded in Mississippian (Carboniferous) sedimentary rocks that crop out across the border of England and Scotland. New fossil discoveries provide insights into the change from primitive aquatic forms to the terrestrial fauna with robust pentadactyl limbs. This talk will explore why these successions preserve such abundant fossil evidence of early terrestrial ecosystems and the link between the palaeoenvironment and the evolution of land-based tetrapods.

The Ballagan Formation represents deposition across an extensive coastal-alluvial plain. Fluvial systems include multi-storey meandering and sheet-like bodies and single channel forms. Diverse palaeosols, with a dominance of entisols and inceptisols, suggest brief periods of soil development on the floodplain, with vertisols indicating times of more established vegetation. The changing vegetation is recorded in the fossils spores: sometimes thickets of Oxroadia, a low-lying creeping plant, dominated whereas at other times the floodplains were populated by established arborescent lycopods. Mean annual rainfall estimates

from palaeosol compositions are 1000–1500 mm yr^{-1}. Key vertebrate (actinopterygians, rhizodonts, dipnoans, chondrichthyans and tetrapods), invertebrate and plant fossils are preserved in sandy siltstones, a previously under-recognised floodplain facies. Interpreted as the deposits of cohesive debris flows originating from overbank floods and localised floodplain transport at times of high rainfall, the siltstones incorporate lithic clasts and preserve some fossils with a greater degree of articulation compared to those found in the basal conglomerates of fluvial channels.

Dolostone beds represent an unusual floodplain lake environment, inhabited by rhizodonts, actinoptergyians, molluscs and ostracods. Ichnofauna indicate repeated, short-lived marine interactions which influenced lake development. Dolostones in equivalent successions further south, represent more lagoonal to marginal marine settings.

Early Mississippian tetrapods therefore occupied a complex mosaic of sub-environments, including lakes, swamps, streams and floodplains, which experienced significant floral changes following the end Devonian mass extinction. There is evidence for a strongly seasonal climate. These paleoenvironments existed for *ca*.12 million years and the region provided a range of habitats for tetrapods to develop terrestrial capabilities and suitable settings for their preservation.

ABOUT THE SPEAKER

Sarah Davies qualified with a BSc (Hons) in Geological Sciences from the University of Leeds and a PhD in Sedimentology from the University of Leicester. She joined the University of Leicester as a lecturer in June 1999, following posts at the universities of Liverpool (1993-1997) and Edinburgh (1997-1999), and was appointed to a Personal Chair in 2013. Sarah was Chair of the British Sedimentology Research Group (2003-2006). In 2007 she was received a British Sedimentology Research Group Award recognising noteworthy published research in any field of sedimentology. A major NERC-funded project (The Mid-Palaeozoic biotic crisis: setting the trajectory of tetrapod evolution, 2012-2017) forms a cornerstone of her current sedimentological research. It is this aspect of her research that is the basis of her Herdman Symposium talk.

Dr Guillem Anglada- (QMUL) *'Proxima b, planets around red dwarfs and the search for life beyond the Solar System.'*

TALK ABSTRACT

The recent detection of a small planet in a warm orbit around Proxima Centauri highlights the relevance of red-dwarf stars (normal stars with masses below 0.5 that of the Sun) in the search and characterization of planetary systems beyond our own. In particular, the very favourable planet star size and mass ratio allows to detect terrestrial planet analogues with current technology and begin the quest for the search for life in our Galaxy. I will review the exoplanetary discoveries made to the date and where planets like Proxima b are leading in terms of scientific exploration and discovery.

ABOUT THE SPEAKER

His PhD thesis was devoted to development of software and data-analysis techniques for the Gaia Space Astrometry mission (ESA). After obtaining his PhD (2007), he moved to the Carnegie Institution for Science at Washington/DC, where he worked side-by-side with exoplanet pioneers such as Alan Boss and Paul Butler. In a remote observatory in Chile (2011), he realized that the existing data-analysis methods did not exploit the potential of the existing spectrographs; and developed a suite of new algorithms and codes which led to

unprecedented Doppler precision, especially when applied to small red-dwarf stars such as Proxima. He then moved to Univ. of Goettingen (Germany) as a postdoctoral researcher where he worked on design and construction of new spectrometers for exoplanet detection around red dwarf stars (ESO's VLT upgraded CRIRES+ instrument and the visual+near infrared spectrometer called CARMENES). Soon after that, he joined forces with Mikko Tuomi to develop Bayesian and global optimization methods for detection of small signals in time series (2012). Soon, new small planets were discovered in existing datasets, including most of the potentially habitable ones reported to date near to the Sun. However, the sensitivity and reliability of their methods were finally acknowledged after winning the double-blind test competition organized by the exoplanet community in Yale 2015. In Sep 2015, Guillem Anglada-Escude was appointed as Lecturer in astrophysics at Queen Mary University of London. Guillem leads the 'Pale Red Dot' campaign whose results were presented on Aug 24th at ESO.

Notes