Chris Ballentine gained his PhD from Cambridge, and has spent his scientific career developing and applying the noble gas isotope tool to different Earth systems. These include identifying the processes controlling the origin, migration and interaction of subsurface water, hydrocarbons and magmatic fluids in a variety of continental settings. His interests also encompass understanding how the Earth gained its gaseous inventory and the processes controlling terrestrial reservoir interaction and evolution over time. His career has taken him to Switzerland (Paul Scherrer Institute and ETH Zurich); the US (University of Michigan), back to the UK (Manchester) and most recently to Oxford.

The origin, residence and migration of carbon-rich fluids

This talk takes a short tour through some early discoveries showing how we track the role water plays in hydrocarbon systems, presents evidence for what really happens to carbon-dioxide if we try and bury it to reduce anthropogenic emissions, and then takes a more detailed look at some of the oldest subsurface carbon-rich fluids in the world.

These ancient fluids are found in the Canadian Archaean continental crust and have existed on Ga timescales. Water rock reactions in such systems provide half of the entire global hydrogen flux (the other half is mostly at mid ocean ridge hydrothermal systems) and locally contain the energy sources, in the absence of light, and nutrients that can and do support microbial life. The stability and longevity of such ecosystems provide a new view on how life may have survived early cataclysmic events on Earth, pushing back the time when life could have existed, and is a natural analogue for understanding how life may survive and where it is likely to be found on other planets or moons in our solar system and beyond.
As a clastic sedimentologist, Professor Davies' research seeks to understand the processes that controlled deposition and erosion in non-marine and shallow-marine settings preserved in the geological record. Her most recent research has focussed on fine-grained sedimentary successions from these settings and examines how these depositional environments evolve spatially and temporally. Current research awards include a NERC Consortium Grant (2012-2016): research at Leicester is providing insights into the environmental conditions that existed during rebuilding of an early Carboniferous ecosystem and contributed to the preferential preservation of early tetrapods. This work builds on earlier research evaluating the global Carboniferous sedimentary record to elucidate the climate response to glacial events.

The rise of the terrestrial ecosystem:

insights from the Carboniferous

New terrestrial habitats developed following the end-Devonian mass extinction but there is a hiatus in the fossil record of tetrapods from the end Devonian to the mid-Mississippian. This interval, of approximately 25 million years, has been termed ‘Romer’s Gap’. Late Devonian tetrapods were aquatic or semi-aquatic and fish-like whereas the late Mississippian terrestrial tetrapod fauna had robust pentadactyl limbs. As new tetrapod taxa were discovered in the early Mississippian Ballagan Formation that is exposed across the borders regions of England and Scotland, it became clear that tetrapods were not absent from the record. Building on these initial discoveries, the formation is the focus of an ongoing NERC-funded research project that investigates all aspects of the development and evolution of the early terrestrial ecosystem. Placing newly discovered tetrapods in their palaeoenvironmental context, this research project investigates why these particular sedimentary successions, comprising fluvial, overbank and saline-hypersaline lake depositional settings, preserve such abundant fossil evidence. The study identifies the key sedimentary process acting to concentrate and preserve faunal and floral material as the frequent transport of fine-grained sediment across seasonally wet floodplains. These successions provide a unique opportunity to enhance our knowledge of this important phase in the development of terrestrial ecosystems.
Professor Hazel Rymer has developed and championed the use of microgravity as a tool for monitoring active volcanoes. She has used this method to identify sub-surface processes at calderas in a state of unrest and at persistently active volcanoes and this has given geoscientists considerable insight into the range of mechanisms responsible for initiating and sustaining volcanic activity. The technique she pioneered is now the standard method for gravity monitoring on volcanoes; it remains the only way to quantify the sub-surface mass changes that occur before, during and after eruptions.

Volcanology and the role of the Citizen Scientist

Volcanic degassing is an unspectacular but major hazard to communities at persistently active volcanoes. Continued long-term exposure to the primary volcanic gases can result in a range of chronic ailments, reduced agricultural output and acidification of rain and groundwater that contaminates water supplies. The activity also indirectly impedes development and poverty reduction efforts. This research seeks to understand and mitigate the impact on the local environment and population of the persistent volcanic activity at Masaya (Nicaragua).

Citizen Scientists are volunteers from all walks of life. They help with the collection and processing of data and more than 250 have been involved so far in this project over 20 years. The contribution of volunteers allows far more data to be collected than would be possible otherwise.
Chris Stringer first worked at the Natural History Museum (NHM) in 1969-1970, but joined the permanent staff in 1973, where he's now a Research Leader in Human Origins. His early research was on the relationship of Neanderthals and early modern humans in Europe, but through his work on the Recent African Origin model for modern human origins, he now collaborate with archaeologists, dating specialists, and geneticists in attempting to reconstruct the evolution of modern humans globally.

He's excavated at sites in Britain and abroad. As well as many scientific papers, Chris has also written a number of books, most recently The Origin of Our Species (2012, published in the USA as Lone Survivors: how we came to be the only humans on Earth).

The origin and evolution of Homo sapiens

Human Evolution can be divided into two main phases. A pre-human phase in Africa prior to 2 million years ago, where walking upright had evolved but many other characteristics were still essentially ape-like. And a human phase, with an increase in both brain size and behavioural complexity, and an expansion from Africa. Evidence points strongly to Africa as the major centre for the genetic, physical and behavioural origins of both ancient and modern humans, but new discoveries are prompting a rethink of some aspects of our evolutionary origins, including the likelihood of interbreeding between archaic humans (for example the Neanderthals) and modern humans.
Professor John Underhill

John’s primary research interests are in the use of seismic and sequence stratigraphic methods through fieldwork and subsurface interpretation to investigate and quantify the structure, stratigraphy and depositional history of sedimentary basins. Recent studies have focused upon understanding the development and evolution of structural styles, the tectonic controls on sediment dispersal and the petroleum habitat in rift-related, tectonically inverted, contractional and salt-influenced basins such as the North Sea, the Wessex Basin of Southern England, the Gulf of Suez, the Western USA, the East African Rift, the South Atlantic and the Hellenides of Western Greece. Access to well-calibrated and extensive 3-D seismic coverage from the North Sea rift province has provided a superb natural laboratory in which to demonstrate and quantify the effects of, and feedback resulting from, thermal doming and extensional fault growth. Most recently, restoration for the effects of Jurassic deformation have also revealed the hitherto unknown and poorly understood nature of

The Geoscientific Search for Ancient Ithaca – a geological and geophysical study that reveals ancient Mycenaean landscapes

The presentation will describe the geoscientific research that has been undertaken to test the proposition that the island of Ithaca may have been accurately described in Homer’s Odyssey as the furthest west of a group of four islands off the western coast of Greece, facing dusk, the open sea and being of low elevation. The talk will explore the veracity of descriptions provided by Homer in the Odyssey and also a later reference by the geographer Strabo that described a partially submerged isthmus at the narrowest part of the island of Kefalonia.

If this isthmus (now called the Thinia valley) was once submerged, then the western peninsula of Kefalonia (now called Paliki) would have been a free-standing island in its own right, thereby fitting Homer’s description accurately and help explain the presence of substantive Mycenaean-era remains that have been previously found on Kefalonia, including on the Paliki Peninsula itself.
Latitudinal biodiversity patterns in Deep Time

At the present time, biodiversity is highest in the tropical zones and decreases towards the poles. This modern latitudinal biodiversity gradient (LBG) is seen in most extant organisms, with only a few exceptions. Macroecologists typically explain this pattern in terms of climatic factors such as insolation and seasonality, both of which favour a build up of diversity in the tropics. Palaeobiologists have claimed that the same ‘modern type’ pattern can be traced back in the fossil record to at least 400 million years ago. Such long-term stability of LBGs through ‘Deep Time’ runs counter to climatic explanations of the LBG, and suggests that intrinsic biological factors relating to speciation and extinction rates are responsible. We have examined these issues by building a large /data set on the occurrences of Cretaceous land vertebrates. The Cretaceous is an important and interesting time in Earth history, witnessing the origin and radiation of groups such as flowering plants, placental mammals, neornithine birds and dinosaurs (e.g., tyrannosaurs). The Cretaceous also experienced much warmer conditions than those prevailing today, reaching peak temperatures c. 95 million years ago. Analysis of our Cretaceous data set using methods that take into account the uneven sampling of the fossil record, indicates that land vertebrate diversity actually peaked in temperate latitudes and decreased towards both poles and tropics. This pattern seems to reflect both the overall warmer conditions (which made higher latitudes more hospitable) and the prevalence of semi-arid and arid conditions in the tropics. One key-controlling factor is the diversity of land plants, which also peaked in temperate latitudes, potentially in response to climatic conditions favouring higher productivity. The transition to the modern-day LBG seems to have occurred approximately 30-35 million years ago, reflecting increasing global cooling as the Earth entered an Icehouse climatic regime. Collation of the currently available palaeobiological studies of LBGs (covering the past 400 million years) suggests a general pattern in which temperate peaks in latitudinal diversity occur in Greenhouse climates, and tropical peaks occur in Icehouse climates. This might represent a general macroecological ‘rule’ governing the interactions between climate and latitudinal diversity.
Jonathan Burley is a geophysicist working on the interactions between volcanism and glacial cycles over the past million years.

Jonathan won the McKerrow Cup this year and will be giving his winning presentation at this year's Oxford Colloquium.

Glacial Cycles, Sea Level and Volcanism:
Coupled Oscillations

Glacial cycles are not a fully understood phenomenon. The accepted picture is variable energy from the Sun arriving at Earth (called ‘Milankovitch Cycles’) causing small temperature changes, then feedbacks from CO$_2$ in the atmosphere and ice sheet growth collectively acting to cause large temperature changes and thus 'ice ages'. However, this picture does not explain why these glacial cycles are currently at 100 kyrs despite the Sun varying on a predominantly 40 kyr cycle.

This talk will discuss how volcanic CO$_2$ emissions might be coupled to glacial cycles, and how this could resolve some of the key problems in our understanding of glacial cycles.

This proposed coupling is as follows:

1) glacial cycles affect volcanic CO$_2$,

2) volcanic CO$_2$ alters the climate, which

3) affects glacial cycles, and so on.

The first step is not immediately obvious, but simple physics shows that changes in ice sheets and sea level during glacial cycles cause large enough pressure changes on volcanic systems to alter volcanic CO$_2$ emissions by >10% globally. Importantly, mid-ocean ridge volcanoes' CO$_2$ emissions change ~100 kyrs after sea level change, potentially giving the Earth's climate system a reason to oscillate at 100 kyrs in response to solar forcing at 40kyrs.