Takeaway Science
Earth Science Rocks!

Mike Bullivant
Welcome to takeaway science, another in the series of short podcasts produced by BLAST! at the Open University. There's a definite Earth Science bias to this particular podcast. Later Sarah Davies catches up with a unique Open University project that enables OU students with mobility problems actually to take part in a geology field trip in the Scottish Highlands. We also have OU senior lecturer, Dr Mark Brandon talking to post graduate student, Wes Fraser about his, that's Mark's research on the melting ice sheets in the Antarctic. But to open proceedings let's eavesdrop on a conversation between OU academic fellow, Dr Will Gosling and research fellow, Dr Pallavi Anand. In it they discuss, amongst other things, how an examination of the Earth's history can give us a better understanding of what climate change has in store for us.

Dr Pallavi Anand
The reason why we study past climate change because it helps us understanding or at least, er, reducing the uncertainties for the future climate predictions. Since we don't know how the response will be for the increasing greenhouse gases in the world we are living at the moment, um, and how the, the different systems, er, in the different Earth system will respond to the rising greenhouse gases, we have to, um, we have to look in the past and give examples or how much uncertainties we can put into the system, for example, how the climate will change on a decadal basis, what will happen to the ice sheets or how the vegetation will respond to the greenhouse gases or how the regional rainfall will change in warm climate.

Dr Will Gosling
Yeah, that's, that's, that's very, very important. How do we obtain these records of past environmental change? What do we, what do we need to look at to be able to do that?

Dr Pallavi Anand
Yes, for that we go, um, we can look on the land system, so terrestrial, um, system, for example, look in the lake sediments which you will, you are involved in and, er, we can also go to the oceans where there are lots of sediments preserved and they are, um, they are time recorders so you can go back, you can log it and then you see the sediments deposited in different environment and different time slices.

Dr Will Gosling
What you are saying is that these, er, natural records of environmental change have been accumulating over millions of years and incorporating things within them from, er, the environment around them and what us as paleo-ecologists – people who are interested in old ecology or paleo-climatologist people who are interested in past climate change can do is go along and extract these fossils from the, er, sedimentary record and examine them to make interpretations about past environments and climate. So we can start to correlate the different records from the, the different, different times and the sort of information that I'm interested in extracting from the terrestrial records is information which we find in the, um, fossil pollen record. So there's a whole range of different proxies from terrestrial and from your marine sources which can help to build up this picture of past global change.

Dr Pallavi Anand
Yes and I guess once we go back in time, er, we have by means of plate tectonics, we can reconstruct the paleo-latitude and longitude where these, wherever we go sites are, were in the past and therefore we, we understand about how the circulation, surface circulation as well as deep circulation, in the ocean were at that time and also what would have been constraining factors, for example, some of the evolutionary information we gain from the, after

the breaking up of the continent is also from the fossils which are preserved in the, the sediments, for example.

Dr Will Gosling
Okay. So understanding all these different proxies tells us a lot about how the Earth systems have worked and how, um, the climate is functioning and the way things might react in the future.

Dr Pallavi Anand
Yes, and I think one thing is very important to understand in this field. It's not just one particular proxy that we look at, it's the several proxies and interplay between ecology, environment, um, you know, preservation, lots of other factors you have to take into account before you reach to a conclusion how the temperature or any particular parameter of the environment was in the past.

Dr Will Gosling
So we have all these different methods of looking at, at past environmental change or, sort of, the, the records of what was there but it's not until we can start plugging these together that we can start thinking about the sort of feedbacks and mechanisms that are operating as a global system. So we need all these different strands of evidence to get that, um, that bigger picture about, about the Earth systems.

Dr Pallavi Anand
Yes, because it's very important to understand the world we are living in now and creating is nothing like what we have seen before. For example, one could take analogy of rising temperature and CO2 for the, er, um, Paleocene / Eocene thermal maximum but the issue is that then, back then you didn't have ice sheets but at the moment we have ice sheets, so there is a natural phenomena by which the climate goes in a cycle but when, when we do to the environment extra bit we don't know how the responses will be. Therefore it's more important to understand different parts of the time when different conditions changed.

Dr Will Gosling
So, if we can run our model predictions backwards and verify what we can observe in the, er, in the past environment, then we can have more confidence that the predictions that were running into the future are, are more likely to be correct.

Mike Bullivant
Drs Will Gosling and Pallavi Anand from the Open University's Department of Earth and Environmental Sciences chewing the fat about the geological record of environmental change and believe it or not there's an OU course entitled just that. "The Geological Record of Environmental Change" is a third level course comprising three books with study commentaries, DVDs and a returnable kit of rock specimens. The first book explores the nature of sedimentary sequences produced by changes of relative sea level and the likely roles played by climatic and tectonic processes. The second book looks at the greenhouse role of the cretaceous and examines tropical/sub-tropical marine environments, high latitude terrestrial environments, the extent and effect of large igneous provinces and meteorite impacts on the environment and the mass extinction event that took place at the end of the cretaceous period. The course's third book documents the ice age and offers possible explanations for the natural climatic changes that have taken place over the last 2.6 million years. Well if you want to learn more about this or any other OU science course log onto ww3, that's the numeral 3, ww3.open.ac.uk/study, click on to the link to science on the right hand side of the page and follow the appropriate links. In the next sequence in this takeaway science podcast Open University lecturer Sarah Davies talks to some of the people behind a quite remarkable Open University project that enables students with mobility problems actually to take part in a practical third level geology field trip up in the Scottish Highlands. Over to Sarah for the details.

Sarah Davies
Okay, so I'm here with Mark Gavid and, er, Mark's our technical, um, expert in the field here today and he's set up the equipment for today's field course. Mark can you tell us a little bit about what we've got here today?

Mark Gavid
Sure, what we're doing is we're helping a mobility impaired student, er, get to access a, er, geology field site that they might otherwise have difficulty getting to. It's a very rocky foreshore and you can probably hear the sea in the background. What we've done is we've set up a little network. We have a small digital, er, camera and laptop, um, at each end, er, one with the student and one with the geologist who's actually at the field site, er, we call them the sherpa and, um, they are connected together using a wireless network and, um, this allows the two parts, the student and the field geologist to talk to each other. We use walkie-talkies for that. And, um, the student can see what the geologist is doing, er with a video camera which is built into the laptop so as the geologist moves around they can see where they are moving and this gives them a sense of presence, gives them an idea of the general broad landscape so it's very important for the geology students to get a sense of the landscape. When they are getting into an area or getting close to an area that they want to look at in more detail the student can guide the geologist to, um, look at a specific, er, a close up perhaps, a rock outcrop and ask them to take a high resolution digital still image which is then sent down the network and on to the student's machine so they can look at it. The student works with a geology tutor so the geology tutor sits with the student, um, back at, we could call it base.

Clive Mitchell
Hi Mark, it's Clive, you might, um, given the resolution on the camera, er, you may need to give us a clue as to what rocks, um, er, or what we're looking at in terms of the dark and the light bands in particular, okay, over.

Sarah Davies
The, er, next site which is about half an hours drive at a place called "Skatie Shore". It's, er, a beautiful little bay and the weather's cleared up a little bit and I wouldn't say it's exactly bright but it's, it's nice and dry at the moment so the students have moved on to the next site and are looking at the geology of this site. There's a, a large fault line that runs right through the bay so we're going to be looking at both sides of this fault line. Right I'm here with, er, John Marshall, our student this week and, er, Clive Mitchell who's one of the tutors who's been sitting with John, um, and helping him out. Okay John, so, um, you've been enjoying this week? Um, how's the geology been going?

John Marshall
Yes, it's, um, very interesting, it's a lot to learn and, er, a lot of interest, you know, being given out by the tutors.

Sarah Davies
So you've been able to access some sites but, um, for the rest of the sites you've either been sitting on the shore or sitting in your car and, um, getting messages and, and images relayed to you?

John Marshall
Yeah, that's right, it's, um, a complicated system but it's working very well. Um, it's a new system and there are one or two hiccups but it's, they are being ironed out so, um, every day gets better and, um, the learning curve increases so, er, you know, we've put, things are improving all the way along.

Sarah Davies
Okay then, so, er, Clive can you tell us a little bit about the geology of this region and what the students are looking at?

Clive Mitchell
Um, throughout the week the students get to look at some important parts of the, the Grampian Highlands in Scotland and, um, er, there are, with those bits of information are able to see how the whole setting of the, er, Grampian Mountains were formed in, um, er, about 400 and odd million years ago and the, the important part about where we are just now looking over the golf course at, er, Stonehaven, is that, er, here we see the Highland Boundary Fault which is literally the line that runs from here across to the other side of Scotland through the south end of Loch Lomond and into Northern Ireland, er, that marks the southern limit of the, of the Grampian Highlands and was a key, um, what's called a, a terrain boundary, a major discontinuity in, um, in the crustal, um, the continental fragments that were floating around as it were at the time which all came together to produce the Grampian Highlands so this is a really, um, key structural, um, component.

Mike Bullivant
Sarah Davies from the Open University's Department of Earth and Environmental Sciences talking with the man who designed the technology behind the project, Mark Gavid and Open University student making use of it, John Marshall and one of the Geology associate lecturers teaching the course, Clive Mitchell. The OU course featured in that sequence is actually called, "Ancient Mountains Practical Geology in Scotland". At the course's core is a 6 day residential school at which students study the field evidence for the growth and demise of an ancient mountain range formed more than 400 million years ago, a mountain range that actually formed the basis of today's Scottish Highlands. At third level the course is designed to provide students with the practical field work and complementary laboratory experience that they'll need for an Open University qualification specialising in Earth sciences. In particular "Ancient Mountains Practical Geology in Scotland" introduces the study of igneous, metamorphic and structurally complex rocks in situ and actually integrates this with laboratory work. As usual if you want to find out more about the course log onto ww3, remember that's the numeral 3, ww3.open.ac.uk/study, click on the link to science on the right hand side of the page and follow the appropriate links. In this podcast's final sequence we feature the first part of a conversation that Wes Fraser, a post-graduate research student from the Open University's Department of Earth and Environmental Sciences had with OU oceanographer and senior lecturer in Environmental Science, Dr Mark Brandon. In it they chat about the research that Mark's doing on the melting ice sheets in the Antarctic. The second part of this conversation features in another science takeaway podcast. Here's Wes to introduce the first sequence.

Wes Fraser
Okay, so Mark can you, er, briefly explain what you actually do as a researcher?

Dr Mark Brandon
Well my job in the OU is actually two parts, one part of it is teaching one part's the research part, er, so just like in a conventional university we actually go out and do research and what I actually do is polar oceanography which means I go out to polar regions. Since, 19, I've been in this business now since 1990 but probably since 1994 I've concentrated on going to the Antarctic which I've found is a lot, er, safer and a lot nicer than going to the Arctic.

Wes Fraser
Why is that?

Dr Mark Brandon
Well the obvious one is, you know, you don't have any polar bears in, in the Antarctic and the other reason I prefer the Antarctic is because, ironically, it's, er, the sorts of, the parts I work in, it's much warmer in the Antarctic than it is in the Arctic, it's far too cold for an old man like me [chuckles].

Wes Fraser
So you feature, you focus mostly on Antarctic research?

Dr Mark Brandon
Antarctic research at the moment and what I've been working on is polar oceans, um, so what I actually go down is, I measure, er, the, I measure the density structure of the water and the way I do that is I lower, I go down on ships or, or I go and work on sea ice and dig a hole through the ice into the ocean and I look, lower equipment into the sea and the equipment, er, is connected to the surface through a wire and it measures the temperature and the amount of salt in the water, um and I also have these really neat little bottles which can take water samples at any depth. So what I've been doing is going down on ships to the edge of the Antarctic ice shelf rim and lowering instruments down into the water off the edge of the ice and measuring the temperature of the water that's actually flowing and touching the ice on the edge of the Antarctic continent.

Wes Fraser
That sounds fascinating.

Dr Mark Brandon
It is fascinating. One thing that, one thing I should say about Antarctica, it's actually really made up of 2 parts, there's a, a continent of Antarctica which is land and on top of that continent is ice, a large amount of ice, the average ice thickness on the Antarctic continent is probably about 3 and a half kilometres which is a huge amount of ice but where the ice meets the edge of the continent sometimes it floats on the ice into what are called ice shelves so we end up with large areas of ice shelf which is you know, ice, perhaps a kilometre thick floating out in some places, perhaps 1 or 2 hundred kilometres from the edge of the coast so out over the sea and with, floating on sea water with sea water underneath it. So what I've been doing is going to the edge of these ice shelves on research ships, lowering equipment at the edge of the ice shelves and measuring the temperature and salinity of the water that's flowing underneath the ice shelf to hopefully work out how much some of them are melting.

Wes Fraser
So that links in with some of the recent reports that's been in the news about the Wilkins Ice Shelf?

Dr Mark Brandon
Well, funnily enough, the Wilkins Ice Shelf is an ice shelf that I visited last year.

Wes Fraser
Really.

Dr Mark Brandon
Now, um, if you, if you've ever seen a picture of Antarctica it's kind of circular and then there's this big finger of er, land which sort of points off towards South America and that, that sort of finger is called the Antarctic Peninsular and in the satellite era what we've seen is the ice shelves in the, from the northern-ward extension of this peninsular moving southwards have been collapsing so a few years ago one called the Larsen collapsed, um, and we measured that by satellite so what we expect to go next is an ice shelf called the King George VI and the Wilkins. So last year I was working on a research trip that was led by, er, Dr Debra Shoesmith from the British Antarctic Survey where we went down to the ice shelves that we believe are most vulnerable in that part of the Antarctic and the Wilkins is actually one of them. Now the funny thing is earlier I described that these ice shelves float out over the edge of Antarctica um, and they tend to be in sort of U-shaped bays. So you get land either side and then ice across the middle but in the Wilkins ice shelf that's a bit, it's a bit different because there's a series of islands with the ice shelf across all of the islands. So what we did on the ship is go all the way around the Wilkins ice shelf and lower these instruments that would measure the temperature and salinity so we know exactly how, what the temperature of the water and the salinity of the water going in the ice shelf or in, going underneath the ice shelf was, we also know exactly what the temperature and salinity of the water coming out was so that actually with those two measurements we can work out exactly how much the ice shelf's melting and those are the calculations we are doing at the moment. Unfortunately the ice shelf's beaten us by a few weeks and it's actually collapsing now which is a bit of a surprise to, even, you know, even to us.

Wes Fraser
So what will actually happen when it does collapse?

Dr Mark Brandon
Well because it's a floating ice shelf, you can do this experiment at home with, er, you know, either a glass of coke and some ice or some gin if that way you're inclined, the gin and ice, but if you have ice that's floating in water then because the ice is floating it's displacing the water so as it melts the sea level won't change so when the ice shelf melts it's not going to affect sea level at all. But the ice shelf itself is fed, fed by glaciers which come out over land and these glaciers feed, feed into the ice shelf and it grows and it grows but once you take the ice shelf away the glaciers we know now are speeding up so when the Wilkins ice shelf goes which it's almost, almost gone now it will probably go in the next month or two then the glaciers over the next year or 2 will actually, that flow into where the Wilkins is, will speed up and because that ice is on land and not floating it's extra ice being added to the sea so the sea level will go up and that might not be a problem to us at the moment but to some parts of the world, the sea level rising even a couple of centimetres can make quite a lot of difference to the viability of whether it's possible to live there, for example, Bangladesh, Tuvalu, places like that.

Mike Bullivant
Wes Fraser and Mark Brandon there. While we're on the subject did you know that the OU offers a second level course called, "Environmental Science". It's a course that draws together the relevant biology, chemistry, Earth science and physics and students taking it are encouraged to develop a holistic approach that encompasses the processes, links, interactions and feedback mechanisms that operate within different environments. A special feature of the course is the 2 virtual multi-media interactive field trips in which students explore an area visually, observe habitats, gather data and analyse their observations. By the end of the course you should be able to lead a group of students through a new virtual environment, make critical analyses of landforms, soils and water flows, identify flora and fauna habitats and comment on anthropogenic influences on the environment and their likely consequences. To find out more about "Environmental Science" log onto ww3.open.ac.uk/study, click on the link to science on the right hand side of the page and follow the appropriate links. Well that's the end of another takeaway science podcast brought to you by BLAST! at the Open University. For other podcasts in this series revisit the Open University Science Faculty website at open.ac.uk/science and if you want to find out more about some of the science outreach work carried out by the OU, visit the BLAST! web pages at blast.open.ac.uk. Well that's all for now, so from me, Mike Bullivant, Adios Amigos!