North Eastern Geological Society

Newsletter February,2018

UPCOMING EVENTS

AGM 16th March 2018 7.15 – 7.30

Followed at 7.30 by: **The Anthropocene**

Professor Colin Waters, Univ. Leicester

Dr Colin Waters is currently Secretary of the Anthropocene Working Group of the International Commission on Stratigraphy and is highly active in Anthropocene research, a theme that has attained an extraordinary academic and public profile over the past few years. He is lead author, for instance, of the recent high-impact Science paper on the Anthropocene and has a central role (and is highly regarded) in co-ordinating activities of the Working Group members, who include Nobel laureate Paul Crutzen. Dr Waters will help achieve a critical mass of Anthropocene workers based around the University (which includes our Professors Jan Zalasiewicz and Mark Williams), to help develop, and exploit the research (and teaching) opportunities of this remarkable, and growing concept.

NORTHUMBRIA OUGS FIELD EVENT

Saturday 24 March - Seaham
See http://ougs.org/northumbria/

LECTURE REPORTS

1. **January 19th**

Unlocking a Volcanoes secrets through crystal specific studies.
George Cooper. Durham University.

Geologists can be heard to say that some research will eventually save lives. Dr Cooper (George) brought an account of his research into the workings of super volcanic eruptions that introduced his research into recent super volcanic eruptions, this may offer a technique that will help us to understand and thus better predict super eruptions.

George clarified our understanding of the term 'magma chamber' by explaining that no such liquid structures have ever been identified at a very large scale, rather a crystalline mush, at least 50% solid, forms the bulk of the area that underpins volcanic eruptions. Pockets of lava contribute to the overall mass. Studies of erupted materials display cumulate masses which have been examined to support this understanding. Crystals from erupted material are now allowing the study of timelines and the evolution of mineral composition that reflects the origin and properties of the source magma together with later magma masses.

Case studies in New Zealand (Mt Ngauruhoe, a classic composite cone in contrast to Long Valley Caldera, in California, that is physically a massive (20kms) structure developed from

multiple eruptions) have allowed George to obtain research samples that he has investigated in a forensic manner with lasers and electron guns to identifyminute compositional structures in crystals that reveal changes over time. Far from a popular assumption that supervolcanic eruptions have a very long timeline his New Zealand work points to rapid re eruptions being possible when the conditions are appropriate.

Supervolcanoes produce huge amounts of ejecta. 1000 km^3 being not unusual, (this would cover NE England to a depth of 100 m) much is pulverised rock material producing the dangerous pyroclastic flow phenomenon but also fall deposits with igneous glass and magma droplets and flows, again containing glass. These can provide the crystals that formed over the life of the super volcano allowing analysis and interpretation of the evidence.

The Earth has evidence of ten super eruptions in the last 2.5 m years.
New Zealand has four of these, reflecting the intense forces affecting the area. There is no apparent link between the timing of eruptions and the size of the eruption. The eruption typically produces masses of distinctive pumice that can contain crystals ideal for the analysis that George is able to apply, in addition to material obtained from magma bodies.

Zircon crystals are one example of the research material being studied. One crystal can be dated and analysis reveal the origin and properties of the source magma. The research confirms the results by analysis of large numbers of such crystals. Quartz crystals can show zoning, reflecting the growth history of the crystal. Compositional changes allow the changes in melt composition to be recognised and interpreted. Techniques employed include microprobes and laser ablation, allowing minute sampling.

Work on the timescales indicated by the crystals may enhance our ability to predict eruptions and the time gap between eruptions. Zircon is studied with uranium lead isotopes, this indicates the great lead time of eruptions. Study of diffusion in crystals allows an understanding of the changes over time, right up to an eruption.

The Taupo zone in North Island NZ is 1.6m yrs in age, a very concentrated zone of rhyolitic eruptions. One vent, called Mangakino has been dated to 1.6-1.0 m yrs with a debris deposit (7m thick at 150 kms from the vent) lying mainly to the NW of the vent. A younger eruption, the Rocky Hill, produced 200 km^3 of material but lies in the debris field of its predecessor. Compositional changes in the magma types were studied in the fall deposits. Three compositional types were identified with some mixing of the materials. The changed composition resulted in significant changes in erosional resistance. The first fall developing a thin soil horizon prior to a later deposit covering it.

Zircon analysis is considered to provide reliable results as the decay rate (U-Pb) is very slow and very small scale techniques

can be successfully applied. For example, a 200,000 year date was calculated for the growth of a crystal, this equates to the magma development thus reflecting the genesis of the super eruption.

Orthopyroxenes are also reliable source minerals for this research. Samples show dark zones, light zones and an absence of zoning. Inclusion of the element manganese accounts for the darkening which in turn implies a change in the source magma.

Using diffusion analysis provides relative dating rather than the absolute dating from Zircon.
The crystal core reflects temperature, pressure and chemistry of the magma in the original core. The changes can repeat themselves within a single crystal reflecting changes in the magma.
A sharp boundary implies a time scale for the change of 19 years, a blurred boundary implies 350- 980 years. Pre-eruption analysis indicates a time scale between 0 and 600 years. These changes reflect interaction with magma prior to eruption so identifying the nature of the boundaries in early erupted material may allow a super eruption to be predicted with greater certainty.

George returned to the early models of magma masses below a super volcano. The initial mush can be identified with a 200,000 year age, no eruptions occur from such material. Rejuvenation processes, for example intrusive masses of magma and/ or fault zones can energise the system so that an eruption could occur within 10-20 years. These form the tell tale evidence in the mineral crystals. These findings allow us to say that magma storage occurs within a mush of crystalline material and eruptible material, whilst typically slow to develop, can develop quickly allowing repeat eruptions.

This fascinating account of volcanic research enthused the audience, George responded to a variety of perceptive questions with candour! A really stimulating presentation that attracted a very warm applause from the audience.

Gordon Liddle

A related paper, with useful diagram can be found at:
http://www.geologypage.com/2017/10/magma-chambers-sponge-like-structure.html

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2. February 16th

What is happening to the World's largest Ice Sheet?

Professor Chris Stokes, Durham University

Professor Stokes made a welcome return to NEGS updating work being done on the Antarctic Ice Sheet.

Over the last 450,000 years five glacial cycles have been identified. The cause of these cycles is now widely accepted as minor fluctuations in the solar rotation / radiation pattern i.e. not a human effect. Glaciations have an important link with sea level that potentially affect the way

we can live on Earth. The ten degrees of average temperature change the Earth experiences with glacial cycles can produce vast ice caps with sea level reductions of 120 metres at one extreme. At the other extreme small but persistent ice occurs in limited areas and sea levels are higher.

Sea level changes have been shown to change erratically with periods of rapid change attributed to ice cap changes which may be linked to topographic controls on what we consider to be extensive land masses -- such as the ice sheets that spread over the Canada. Such variability is a concern as the explanations are poorly understood but potentially affect all the predictions of sea level rise currently being considered. A peak increase of 4 m in 100 years has been identified. This compares to the increase today which is trending close to 3mm a year and accelerating. Some of this current increase is attributed to thermal expansion of our sea water and melting of small land glaciers.

The Greenland Ice Sheet is being closely studied and reveals melting to be occurring at the surface due to global warming, added to by increased flows of ice streams removing ice from the interior of the ice sheet. This is probably linked to a warming ocean, melting the oceanic margins of the ice sheet, this in turn allows the ice streams to flow more easily to the sea. The melting of this ice sheet is occurring at an increasing rate leading to a rise in sea level. If the Ice sheet were to melt sea level would rise by about 6 metres.

The Antarctic Ice Sheet (which has persisted for about 30 million years) holds sufficient water to raise sea level by 58 metres so changes there are clearly very significant.

Ice sheet melt as the Earth warms but also as the rate of glacial drainage increases within the ice sheet. Today satellite measurements are able to reveal changes in the amount of ice in an ice sheet. (the measurements are very accurate allowing for isostatic changes and areal changes within the ice sheet) locally ice streams have been measured to move at 1000 m/ yr producing huge changes in the ice front as calving removes ice from the ice sheet. The Pine Island area of western Antarctica is closely monitored as an ice stream is accelerating but the study reveals that ice on the margins of the stream appears to be static. The changes in this area indicate that the balance between ice sheet growth through precipitation and loss through calving are not in balance meaning the ice cap is shrinking.

An ice stream in Greenland has been measured at 10,000 m/ yr. this is the fastest flow in the world. The explanation appears to favour warm sea water reaching the base of the ice, melting it and allowing the ice stream flow to be unrestricted.

In Antarctica, only the smaller western area has been closely studied due to access issues and because it has traditionally been assumed to be the most sensitive part of Antarctica. This holds enough water to raise sea level by 4 m, small compared to the eastern part of the ice sheet.

In the east, evidence for changes are limited, localised increases in ice loss appear to be balanced by accumulation in other areas of the ice sheet. (Global warming is probably causing snow fall in the Antarctic to increase)

Funding for research in eastern Antarctica has increased (Chris is heading up a new, large programme) this will gather data on the changes that are occurring and give an indication of the rate of change that is observed. Experts do not agree on the changes that may be occurring, hopefully the new research will allow the situation to become a little clearer.

Is the situation of concern?
Satellite data reveals a thinning (1.5 m/ yr) ice cap in western Antarctica whilst eastern Antarctica has variable changes attributed to marine melting but the relative balance of loss and gain is not clear. One area of eastern Antarctica, Wilkes Land , appears to be retreating as marine melting removes sea ice allowing the ice streams to accelerate. We need to understand the situation in detail as the consequences of wide scale melting in the eastern Antarctica ice sheet would be profound. Of interest is the appearance of surface melt ponds on the ice, if this water were to flow to the base of the ice cap (but it is several Kms thick) it could facilitate ice flow, accelerating the ice flows. Research into oceanic sediments around Antarctica show that part of the Ice Sheet did collapse in the Pliocene.

The future certainly will bring change to sea level, the rate of this change and its extent will affect global climate, coastal margins and many aspects of life that we take for granted today.

Chris took some perceptive questions exploring, for example, the impact on carbon dioxide absorption by an increased sea level and similar challenging aspects associated with his presentation.

The audio- visual support for the presentation was again excellent, which coupled with the superb account Chris provided fully justified the thanks of the large audience.
Summariser: Gordon Liddle

NEWS AND LOCAL EVENTS

20th–21st October 2018,

GA ANNUAL CONFERENCE
Lapworth Museum, Birmingham.

3rd-4th November

FESTIVAL OF GEOLOGY. UCL

North Pennines AONB

Look out for news of William Smith Map (1816) coming to Bowlees Visitor Centre from March 17th for a month or so.

FIELD TRIPS

APRIL 22nd – Sunday

Askrigg

Leader: Lesley Collins

Meet 10.30am at Askrigg village centre, by the Church. Free parking in small

village car park and by the Church. Village shop & cafe and 3 Pubs. Public toilets available at all times in the Village (Temperance) Hall.

MAY 19ththth – Saturday

The geology of St. Mary's Island to Seaton Sluice.

Leaders: Derek Teasdale and Eric Johnson

A joint meeting between NEGS and the Natural History Society of Northumbria.

JUNE3rd – Sunday

Howick Bay

Leader: Ian Kille

A joint Meeting with NOUGS

JULY 7th – Saturday

The Eildon Hills

Leader: Louis Golightley

August 18th - Saturday

Leader: Karl Egeland-Eriksen

Runswick Bay

Joint Meeting with NOUGS

September 16th – Sunday

Leader: Karl Egeland-Eriksen

Tunstall Hill and Ryhope Railway Cutting

Joint Meeting with NOUGS

NORTHUMBRIA OUGS FIELD EVENTS

Saturday 21 April - Cheviots/Wooler
Sunday 13 May - Roughting Linn
Weekend 16th/17th June – Keswick
Saturday 3oth June – Kingwater
Saturday 21st July – Sleightholme Beck
Weekend 1st/2nd September – Borders, Dobs Linn

ADMINISTRATION

Two events have been booked for 2018
Heritage Open Day (see Field Trips)

September 6th – Thursday.
Chris Taylor - Building Stones of Newcastle
September 7th – Friday.
Andy Lane – Sunderland Coast, north of River Wear
We will require member support for these events, one or two names have been submitted but more will be required. Please contact negsec@gmail.com to volunteer to help plan, run, back-mark on these events.

NEGS requires a representative to the GEOLOGISTS ASSOCIATION, this person needs to be a member of the Geologists Association who will report back from meetings. GA pays some expenses

2018 FEES ARE DUE AT THE AGM

Address for cheques: Judy Harrison, 28 St Ann's Quay, 4 St Ann's Street, Newcastle upon Tyne, NE1 2DJ.

For internet banking:	
Sort code	09-01-51
Account number	75189803

Fees subject to voting at AGM