

East Midlands Regional Group meeting reports 2008

Killer Landslides - Causes and Mechanisms - 20 January

Report by Geoffrey Jago

In our opening lecture of 2008 on 22 January and following our Group's Annual General Meeting, the earth moved for our audience, albeit only in simulation. Our speaker was Dr. Bill Murphy, of the School of Earth & Environment, Centre for Engineering, Geology and Hydrogeology at the University of Leeds. The screen at British Geological Survey, Keyworth came alive with a film taken of a wooded slope in Japan violently assuming a lower position.

Are Landslides a problem?

By comparison, of recorded damaging events in 2006, volcanoes accounted for 600, earthquakes for 10,000 and landslides for 5000. In documented accounts alone, landslides have been responsible for well over a million deaths world-wide. Showing many aerial photographs of landslides, Dr. Murphy described a number of renowned examples.

What causes Landslides?

Movement can be triggered by earthquakes, by vulcanism, by intense rainfall, by flooding, by coastal and fluvial erosion and by man-made activities such as construction vibration.

1. Gravity

As erosion progresses, certain rock masses reach a point when they become unstable, the shape and form of the breaks depending upon the type of rock and the presence of existing fractures or weak planes. A geometric diagram of gravity acting on a typical sliding block showed the relationships between restraining forces, downforce and angle of slope. A complication can arise when the angle of a slip face changes from shallow to steep and this type of slide is very difficult to predict. A common form assumed by the moving rock is that of a curved rotational slip which leaves behind a steep exposure. The curve of the slipface of some landslides results in the toe actually being pushed upwards, such toe-bulges being a particularly poor place to build.

2. Water

Probably the most important factor in studying stability is that movement increases with greater pore water pressure. The Mount Sarno, Italy, disaster of 1998 when 155 people died, followed two days of rain. Several slides occurred side by side burying parts of five towns. Of European countries prone to landslides, Italy suffers the most.

3. Earthquakes

Slides triggered by earthquakes are not uncommon in the Andes but most cause few deaths. However this was unfortunately not the case in the Peruvian Huscaran rock avalanche when a slide thirty metres thick travelling at 475 Km per hour fell on a glacier, trapping air which

added to the fluidity of the slide. An earthquake wave passing across an unstable area has been known to affect the higher parts of the slide differently from the toe.

4. Man

Human activity led to Europe's most disastrous landslide in Italy in 1963. The Vaiont dam was built in a narrow part of the Piave valley, with strong sidewalls of Cretaceous limestone. The reservoir water led to some rock movement in 1960 and lowering the water level provided stabilisation. However in October 1963 well over two million cubic metres of rock suddenly slid into the water on a steeper slipface. While the dam did not fail, a 70m overtopping wave killed 1,700 people downstream.

Future Dangers

Dr. Murphy told us that work after the event shows that most landslides could have been avoided by prior study. Hence areas prone to landslide can be managed. A foremost factor to be borne in mind is the danger following heavy rainfall.

The possibility has been postulated of a danger should a west-facing coastal slope fail at Cumbre de Vieja in the Canary Islands. A sudden large landslide here could produce a tsunami large enough to affect those living on the shores of the north west Atlantic, However, these denizens can take comfort from current opinion which is that while small movements are possible, a large slide is unlikely.

Andy Gibson gave a speech of thanks for an excellent presentation.

OneGeology

Meeting at British Geological Survey, Keyworth, 16 April, 2008.

Report by Geoffrey Jago

History tells us that the British mind has an unrivalled record for generating good ideas and putting them into practice.

A New Enterprise

Yes, the title is right: OneGeology is one word, and an exciting concept. Imagine a geological map of the whole globe plotted to a single scale. This is the concept that, together with colleagues here and in other countries, our speaker, Ian Jackson, Chief of Operations at British Geological Survey, is putting into practice.

OneGeology is an exciting new initiative that is uniting geological surveys world-wide towards creating the first digital geological map of the planet at 1:1 million scale. Conceived from humble origins only as recently as February 2006, it took hold within six months and soon everyone wanted to be on board. This led to a conference at Brighton In March 2007 when the "Brighton Accord", an International project, was formed. Already 78 countries are co-

operating as are eight major international organisations including UNESCO and the International Union of Geological Sciences.

Presenting Geology

Geologists could improve their performance in advertising the enormous bearing geology exerts on most projects; and this means that avoidable errors are still being made, especially in building. Currently too fragmented as a discipline, geologists need the benefit of integration and harmony. Not long ago a leading company spent much in sending five staff members to Africa to seek information which in future can be made available on the web. Disagreement is not uncommon, together with an often needless compulsion to see all ends tied up before publication. A poet once said that a poem is never completed, only put aside. As with poetry, so with science and, to quote another poet: in delay there lies no plenty. If progress is to be made, whatever information is valuable is wanted now, not when it is perfectly polished. Those steering OneGeology have the stimulus to see the work through with minimum delay, and not to leave it to the next generation.

Accord Between Nations

The refreshingly inspiring nature of OneGeology lies with its success in achieving friendly accord with so many nations, in recognising that different nations have different abilities to participate and in accepting data in any format. Likewise it recognises the need to transfer know-how to those that require it and to stimulate a rapid increase in interoperability. Crucially, OneGeology is about making geological data accessible in a standard data structure without necessarily reconciling the interpretation of the geology across national boundaries.

Progress

So how are matters progressing at the moment? A web site was soon established, and theirs is an impressive one. It incorporates, already working in prototype, a magnificent provider of information called PORTAL. There are handy Cook Books, or manuals to explain first principles of how to put data on the web; and preparation is in hand for a launch at the 33rd International Geological Congress in Oslo.

Displaying the Goods

The web site and PORTAL were demonstrated on a large touch-screen display, which BGS have recently installed in their meeting rooms. Now a speaker can use the screen as one controls a laptop, by finger touch, calling up items, selecting maps and dragging them to size, all to stunning effect. Despite its youth as an application, PORTAL made a prodigious impact, calling up relevant live transmissions from more than one web source across the world. We were truly impressed.

Outreach and Public Relations

Via a conference of newspeople, BGS struck the right chord with the press by the phrase “mapping the world”. The Guardian devoted half a page and world-wide publicity followed. A nine-minute video has been produced, in popular serious television style, explaining the project.

Thanks

Vanessa Banks, Chair of our Regional Group, gave a speech of thanks for this most interesting and impressive presentation and reminded us that we had also enjoyed hearing Ian speak at our Group meeting exactly ten years ago when, as Head of BGS's Geospatial Information Systems, he spoke on Digital Geological Maps.

Geoscience Sets an Example

OneGeology is thoroughly pragmatic. It will help to make existing data available to the world, adding value to existing resources. As a legacy it will transfer know-how between nations, spread standards and facilitate mutual operation.

Now that international agreement is so gravely necessary to avoid climate change, it is an example to the world and greatly to the credit of the OneGeology team that they have achieved such an important agreement between nations in so short a time.

And So To Web

And the web site address is: www.onegeology.org

Field Excursion to Ecton Mine

Saturday 30th August 2008

Report by Geoffrey Jago, Vanessa Banks and David Boon

Amid scenery worthy of a Wagnerian backdrop lie the exhausted remains of one of the most intriguing metal workings in Britain.

Led by Peter Kennett and Tim Colman, we were guests of the Ecton Mine Centre for our combined lecture and field trip featuring a study, both on surface and underground, of an historic site in the Peak District on the Derbyshire - Staffordshire border.

The Ecton copper mine lies near Warslow, west of Matlock, beside the pretty River Manifold which here divides the two counties. While the Manifold can scarcely compete with Wagner's Rhine, each side of its valley towers intimidatingly, rising 150 metres in 400 to the summit of Ecton Hill on the Derbyshire side.

Mine History

The day began as we took the steep path up to the buildings of the Ecton Mine Centre and listened to Peter's fascinating history of the workings from the earliest times to its final abandonment in 1891. Ecton mine was, in its day, one of the richest and deepest copper mines in Europe. Antler picks give evidence that the Bronze Age derived some of its metal from surface workings and the Elizabethans and their successors began operations on a small scale before 1640. It has been asserted that Ecton miners saw the first use of rock blasting by gunpowder in 1672 or earlier. Or heard, at least.

Then in 1750 the Duke of Devonshire and later the Burgoyne family woke up to the fact that they owned the mineral rights in adjacent areas of a deposit that was a real lulu. Despite the equivalent of sixteen million pounds in today's money being carried off by gambling partners of the Duchess, the Duke was still able to use the bonanza to build local schools and other amenities as well as to redevelop much of Buxton including the admirable public buildings in use there today.

Geology and Mineralogy

The country rock is of the lower beds of Carboniferous limestone near the crest of an anticline, exposures revealing some heroic contortions. The metal minerals occurred mostly in enormous irregular vertical deposits of roughly cylindrical form, known as pipes, together with some especially rich saddle-shaped ore-pockets near the axis of anticlines or synclines and some linear veins more typical of the Derbyshire orefield. Whereas, elsewhere in the Derbyshire orefield, the word "pipe" is used for irregularly cylindrical horizontal pockets of ore, at Ecton the pipes tend to lie vertically.

The copper ore was principally deep golden chalcopyrite with some dark grey chalcocite and the attractive bornite with its iridescent colours, samples of which are sold in mineral shops as "peacock ore". All are sulphides of copper, chalcopyrite and bornite containing iron as well. Some lead, the metal most associated with Derbyshire mines, also contributed to the wealth of the mine while deposits of sphalerite, zinc sulphide, ignored until the 1830s, were mined when its value rose with the advent of new smelting methods.

The workings, now flooded below river level, contain very large cavities where the ore was removed, the limestone being sufficiently massive to stand with little or no support. The ore body narrowed towards the lowest level of the mine but it was never finally bottomed.

Smelting

Some copper smelting was done nearby but pack horses took most of the ores twelve kilometres down the valley to Whiston, where coal was available by canal, or to Ripley and Cheadle.

Pumping

In the early stages of working, water presented little problem because the upper parts of the ore body inside the lofty Ecton Hill were above river level and horizontal tunnels known as adits (or, when used to drain water, soughs) allowed natural drainage; but, as the mine deepened, rag and chain pumps were initially fitted, operated by horses or manpower. This onerous work was then taken over by an underground water wheel fed from a waterway skirting around the north of the hill. The wheel's tail water ran out via the adit, joined by the water it pumped from below. In 1788 a steam engine (see below) was installed near the top of Ecton Hill working a rope winder rather than a pump, the water wheel apparently continuing to cope very cost-effectively with the dewatering. The mine sump lies 430m below the drainage level.

Ore genesis

Study continues regarding the origin of the metals. Certainly hydrothermal waters were involved and previously it was assumed that Hades in the guise of a granite batholith forced the stuff upwards; but nowadays most accept the concept that mineral-rich water moved laterally and downwards, carrying metals in solution dissolved from Carboniferous shales until the lime initiated precipitation.

Field Work

After Peter's talk, our party formed two groups under the leadership of our two guides. While one group strode up the steep slopes of Ecton Hill the others, troglodyte-like, went underground.

In the Open Air

From the mine entrance we ascended Ecton Hill, initially in a southerly direction, pausing to consider the depth of incision of the River Manifold, the distribution of visible remains of mine workings and the impacts of glaciations, then turned to take more of an easterly direction to Dutchman Level. There was a discharge of water from Dutchman Level. It was explained that the adit forms the potable supply to the mine. At the entrance to Dutchman Level layers of interbedded cherts were evident. Adjacent stone walls were suspected to indicate the location of a former coe (small building utilised by the miners for changing). From Dutchman's Level we continued on to look at the Engine House associated with Deep Shaft. The Engine House was built in 1788 to house a Boulton and Watt beam engine (Ford and Rieuwerts, 2000). The shape of the building and absence of the chimney was noted. Ford and Rieuwerts (2000) record that the roof was lowered ~ 70 years ago. The open space to the east of Deep Shaft was noted as being the location of a former Gin (horse rope-haulage device), the position of which influenced the alignment of the Engine House, because it was necessary to maintain operation of the Gin during construction of the Engine House.

From the Engine House the group took a southeasterly route, passing the former position of a reservoir, to look at some shafts. It was noted that many of the shafts occurred in pairs, the smaller shaft being for human access, via stemples (wooden steps) down to the workings and the larger shaft being used for mineral recovery via kibbles (ore buckets) that were wound to the surface. Remnant ginging (stone lining) was admired in one of the shafts. Whilst speculating about which shafts overlay the Salt's Level, we were informed about the disappearance of a tractor into one of the shafts, which can be seen inside Salt's Level, a relatively recent example of the introduction of metal underground.

The group moved farther to the southeast to a boundary wall that contained good examples of crinoidal limestone and samples of corals. We looked across at the River Valley to the north east and considered how changes in vegetation mark the boundary between the limestones and overlying shales and discussed the drainage of the mines via soughs, initially to the northeast and later lower down the valley, to the southwest. It was also noted that initially there was a dressing floor to the northeast, but this impeded the valley access and was moved farther south.

After returning to Deep Shaft we followed a footpath in a northwesterly direction past the former Powder Store. This comprised a rectangular solid stone walled building with a tiled roof.

In Nether Regions

The parties then changing over, hard hat and lamp clad, we took to the mine via the tunnel known as Salt's Level which is adjacent to the Mine Centre. Being well above adit level, this part of the mine is dry without even anticipated drips from the roof. The hard rock requires no support so we were able to examine the limestone, with its joints, occasional faults and contortions. The route led us several hundred metres into the hill, past the vertical shaft and with numerous side cavities where the ore had been won. But of attractive yellow chalcopyrite and multicoloured bornite, did we see examples underground or on surface? Neither trace nor smidgen. An occasional flash of malachite in the surface dumps gave the only glimmer that there had been any copper about. The astute miners appear to have winkled out every bit with toothpicks.

Earned Sustenance

Appetites whetted by one o'clock, the day was completed with good food and affable conversation in the charismatic Staffordshire Knot at the nearby village of Sheen.

Our thanks are extended to the Ecton Mine Educational Trust and to guides Peter Kennett and Tim Colman for this very worthwhile and well-attended excursion.

References:

Ford, T.D. and Rieuwerts, J.H. Eds. 2000. Lead Mining in the Peak District. 4th Ed. 207pp. Landmark Publishing Limited.
A web search for "Ecton Mine" provides further reading.

Making Conceptual Site Modelling Easy

19th November, 2008 at BGS, Keyworth

Report by Geoffrey Jago

A blank worksheet stares at you defiantly. You are faced with the task of planning site work where pollutants may be a hazard. Where to start?

In a welcome follow-up to her talk to us in April 2006 (q.v.), past Group Chair Judith Nathanail, Senior Environmental Consultant with Land Quality Management Ltd. (LQM), provided the answer: an easy lead in to Conceptual Site Modelling (CSM).

Pollutants and Provenance

When potential pollutants are present you need to pinpoint where and what they are, where they may travel and where they may end up. So the CSM is a description of environmental conditions on a site and in the surrounding area. It clearly identifies source-pathway-receptor pollutant linkages and uncertainties. It is a method of assembling the relevant information that is known about a site, allowing the addition of new data as it comes to hand, until all relevant facts can be presented in a form readily understandable to scientist and layman.

Sketching Out

You can begin by making a rough sketch map. Judith's notional site was a former garage and petrol station which was to be redeveloped as housing, her sketch showing each feature: workshops, tanks, site shop and dwelling within a site boundary. Next, a cross-section is sketched to show the surface features in relation to the geology. The relationship between sources (e.g. fuel tanks), pathways (surface, aquifers) and receptors (rivers, aquifers) becomes clearer.

A3 size paper worksheets called Conceptual Site Model Pads (CMP) can be used to list the contaminant information in columns: Source, pathway and receptor, a line devoted to each item on site. However, diagrams and matrices on paper can become complex and are difficult to modify.

KeyCSM Software

Accompanied by metaphorical trumpets, step in the computer and KeyCSM, software produced by Keynetix Ltd in association with LQM whose years of proven experience have distilled the task into a comprehensive entity, empowering users of KeyCSM to benefit from such experience. Modules are included such as Diagram Manager, to make neat printable plans and sections, and Data Manager, to allow tables of information to be readily modifiable. Plan, section and data are linked to minimise reentry of information. For instance, once the sources, pathways and receptors have been defined on the plan they can be quickly assigned on the cross section so that they are shown with the same format (e.g. colour, stroke style) and label as on the plan view.

Linking Up

Linkages which join source with pathway and pathway with receptor are vital to Site Models and these are organised using the Linkage Manager, after which, a network diagram or matrix can be generated automatically. As the Model approaches a final draft each component can be edited quickly. If required, e.g. at the end of a Phase 1, the whole models can be "locked" so there is a record of the understanding of the site at that point in the work. Sometimes standard pathways or sets of data can be useful in more than one project and the sections called Shape Library and Data Library allow copying to other jobs.

Remediation

An ultimate and essential aim is remediation and here KeyCSM can be used to evaluate possible remediation strategies as various options are appraised.

In Conclusion

Concluding, Judith said that KeyCSM has been proved to be customisable, editable, flexible and cost effective. The software continues to be developed as users feedback on useful features to further enhance conceptual model creation.

Vanessa Banks thanked Judith for an interesting and instructive evening.

Special Christmas Lecture, 2008. How Hazardous is Geology?

Report by Geoffrey Jago

The importance of studying geological hazard is brought home by the number of British dwellings that are at a significant potential risk within a geological hazard zone: slope instability (1%), soluble rocks (4%), running sand (1%), swelling or shrinking clays (19%) and collapsible and compressible material (9%).

In a well filled De la Beche theatre at British Geological Survey, Keyworth at our Christmas lecture on 16th December, 2008, popular presenter Professor Martin Culshaw gave a thoroughly scientific and entertaining account of the hazards presented by the rocks beneath the feet of the world's denizens. Martin's years of work at BGS have made him a foremost expert on geohazards.

Clear speaking

At the outset Martin stressed the importance of clear communication between geoscientists, other professionals and the public at large. Geoscientists must agree the definition of their terms between themselves. Authors, are too often so familiar with their own terms that they forget that readers may be at a loss. For example one should beware the use of 'probability' which may be based on incomplete data or inadequately understood processes. Can risk be adequately quantified and does it matter? No it can't but yes it does.

Types of Geohazard

Of geohazards, the primary ones (volcanic and earthquake) are regional and generally unpredictable. These are best mitigated by engineering design and by focusing on secondary hazards. Secondary geohazards like those listed at the beginning of this account are local and often triggered by primary events. They are best mitigated by planning, insurance and site-specific engineering.

Primary geohazards may or may not be cyclical in their occurrence and we do not know because sufficient data have yet to be collected. An assumption that they are cyclical, however, makes it easier to gain an idea of the degree of hazard. The 'frequency' of a given magnitude of earthquake needs to be assumed to enable us to design structures and the like; but we should not assume that it is 'correct'!

British Problems

Britain escapes volcanic eruptions and severe earthquakes but suffers from many secondary geohazards. A number of dramatic photographs illustrated severe effects, one showing part of the Holbeck Hall Hotel, Scarborough, which was abruptly ruined by a coastal translational landslide. The picture included Martin photographing, through a broken window, half a breakfast the recipient of which had considered it wiser to forego.

Human activities are responsible for hazards such as mineral extraction (deep mine subsidence, shallow ditto, mine entrances, rising mine water) and activities on or just below ground, waste placed on or under the ground, polluted mine water, gases and fault reactivation.

Data Collection

Data on geohazards in the UK has only been collected for about 30 years but such work as well as geohazard monitoring is vital. Because benefits are long-term, funding is a problem.

Truth and Consequences

The severity of an event often cannot be related to the intensity of the consequences. A heavy earthquake beneath a large desert may be of little consequence compared to a light one beneath a city. For example, an earthquake of 6.6 at Bam, Iran in Dec 2003 killed 40,000 whereas one of 7.1 in California in October 1989 killed 63. Insurance pay-outs are rising: of £8.23 billion from 1975 to 2004, three quarters has been incurred in the last two decades.

Prediction

Your correspondent read somewhere that prediction of the future is precluded by the Second Law of Thermodynamics which, amongst other truths, states that information cannot flow backwards in time. This is bad news for palmists, skryers and soothsayers; but the geologist knows that the past can speak for the present, so those with Martin's experience can have a pretty good go.

Firstly, let's eliminate primary geohazards because they are unpredictable by either seismologists or volcanologists. The processes of secondary geohazards are broadly understood; but the databases are inadequate and the main drivers - climate and human activity - are changing rapidly.

Martin can, however, predict that the next damaging earthquake will occur outside Britain along either a subduction zone or a spreading centre. Also that the next landslide in Britain will be of small to medium size, will occur where there is a slope greater than about seven degrees (1 in eight) and when two to three days of continuous rain falls on saturated ground, or when there is a period of about an hour of intense rainfall. He believes that geoscientists should concentrate on assessing secondary seismic and volcanic hazards together with such matters as ground motion amplification, liquefaction, landslides, fault ruptures, tsunamis, ash falls, lava flows and pyroclastic flows.

Hazard Assessment

And so to hazard assessment. It involves a number of steps: understanding the geohazard processes; the development of classification systems, the systematic accumulation of data on past hazard events (for example landslide mapping and historical earthquake data collection) and then determining the relative susceptibility of different areas to a hazard by identification of the controlling processes and factors, and zoning accordingly. By combining this knowledge a prediction of the likelihood of future events can then be made.

Small features are best recorded individually, medium or complex features need remote or surface surveying and large scale work calls for remote sensing.

Case Studies

With photographs and maps, Martin presented case studies of rock instability on the island of St. Helena and of tsunami erosion at the coastal town of Banda Aceh, Sumatra which was destroyed by the earthquake and tsunami of December 2004. He explained that applied geological mapping, subsurface data collection and 3D modelling can provide the geological information necessary for decisions about developmental reconstruction but we need to plan before disasters, not after, because early modest investment can achieve major savings. At the same time one must not forget to take account of people's physical, emotional and economic attachment to their locality.

Informing the Layman

Martin listed the planning, construction and legal professions affected by geohazards. Research into the subject is ongoing and much thought has gone into ways to provide the results in a universally understandable form. The digital data system: Geohazard Susceptibility Package (GHASP) for the insurance industry led to the geohazard information system GeoSure making information available to different user groups.

Summing Up

It is in the public interest to investigate geohazards.

Current data holdings are far from comprehensive but, in many countries, we have a good understanding of where geohazards are likely to occur.

There is a continuing short, medium and long term need to gather and interpret primary geodata.

Geohazards need long term monitoring to assess the effect of climate change and the actions of people.

Geohazard information systems are never 'complete' but should be continually improved.

Research should put more emphasis on risk reduction and communication.

A Tribute

In giving a speech of thanks, Andy Gibson paid tribute to Martin's work, when in his twenties, on the island of St Helena. Rock falls from the steep slopes had caused eighty deaths over the years. Martin's work which enabled planned buildings to be repositioned doubtless avoided further tragedies