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Why geologists don't listen and the public can't read geological maps[1]

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Introduction

Geology is a science that is not only tremendously interesting and exciting; it is also of fundamental importance to our lives, our environment and our assets? No argument with this is there? This statement is obviously true, right?

Well if your answer is yes, then why are the majority of our politicians completely unaware of the financial and human cost of ignoring geological hazards?; why had the guy you met in a bar the other evening never heard of your organisation?; why are geological surveys so poorly funded?; and just in case you are still not convinced, why are you so poorly paid?

Geology is not irrelevant, but for decades we geologists have been largely creating products that appeal only to one audience: ourselves. I concede they may be much sought after for colourful wall posters, but have you ever met anyone outside the profession who could understand a conventional geological map, let alone comprehend what that map has to say about risks and resources? And what geological maps are trying to reveal of the 3rd dimension remains a mystery to the majority.

Hold on, I hear you say, now we are in the 21st Century and things have changed; we've got sophisticated new computers with GIS and 3D modelling software, and we can devise all sorts of colourful coverages, dynamic databases and mutating models! OK, but how convinced are you that the public (who, I might add, provocatively, probably pay your salary though their taxes) now understand our message any better? Geological maps and models (digital or analogue) are crucial, but they must not be seen as the end point; they are only a means to an end; and that end must be ensuring our science is understood and meets the needs of our users and not just us. If you work for a geological survey this has to be your over-riding priority.

In addition to examining the relevance and perception of geological surveys, this paper will take a critical look at traditional products (and some recent digital ones), review some alternative options and discuss the issues which arise when a geological survey tries to take the products of geological

[1] With acknowledgements and apologies to Allan & Barbara Pease, authors of the best-selling book "Why men don't listen and women can't read maps"

surveying and research out of the sophisticated, but limited, circles of the geoscience cognoscenti (yes, that's us!) into the real world.

Relevant – Yes; Understood and appreciated - No

Geological factors are important in disaster mitigation and planning, environmental protection and resource exploitation. An understanding of them is essential in establishing policies for sustainable development and can assist in addressing a range of socio-economic, biodiversity and landscape issues. However, decision–makers, the politicians, planners, financiers, businessmen and the legal profession, often fail to take geology into account, leading to increased financial costs (e.g. badly located construction schemes, inadequate planning for the use of natural resources), reduction in the quality of life of citizens (e.g. radon emission, pollution of water supply) and at worst, loss of life (e.g. landslides).

Examples from Great Britain (a relatively geologically stable country) show the majority of politicians and planners seemingly unaware of, for instance, the swelling and shrinking properties of clay or the dissolution of gypsum, and allowing housing development that is inappropriate in terms of both location and design. Roads and car parks have been constructed over landslipped ground causing death and injury. The importance of including geoscience knowledge in the prediction of radon-affected areas is only just being recognized. In GB a lawyer would be deemed as professionally negligent if s/he did not obtain a report into possible coal mining beneath a property prior to purchase. But at the moment there is no compulsion to seek out information on potentially damaging natural hazards and yet the case is equally compelling. The estimate of insured losses due to natural geological instability in GB is approximately 450 million Euros per year.

There are more than 40 individual nations in greater Europe and each of these countries has a geological survey organisation (GSO). There exists within each geological survey an enormous wealth of relevant geological data and knowledge. Information, that can, for example, help to mitigate the affects of radon, flood-risk and subsidence. But this is a knowledge base that is grossly under-used and it will stay that way until we understand better how to convert it into the products and services that people want.

At the beginning of the 21st century, at a time when "the environment" has the highest of profiles, geoscience knowledge should be occupying a more prominent role. But it is not. It is a sad fact that the importance of geology to the environment, and to human health, property and assets is not well understood outside the geological profession. Geoscientists and geological surveys and research institutions must accept a substantial part of the responsibility for this lack of understanding and for the failure to persuade potential users to use the geoscience knowledge base. Traditionally the output of a geoscientist's work has been complex, technical and academic maps and reports. The quality of the science is not in question but too often that science remains obscure and remote from the end-user and its significance to society and the environment is not obvious to the public, to governments and to commerce.

It is worth making clear that this paper is not challenging the absolute necessity of a strong foundation of high quality geoscience research and information. But there is an need to reassess the balance and the traditional focus on "academic" output. There is a need to build products that genuinely meet society's requirements. These products must be expressed and provided in a way that is meaningful to an audience that does not, for the most part, have geological training. Traditional geological output, such as lithostratigraphical maps, may be perfectly clear to a professional geologist, however, they convey little or nothing to the non-geologist. The various "stratigraphical" schemes and codes that we use, almost without exception, on geological maps, may allow geoscientists to share information, but they are just impenetrable *secret codes* to other potential users. These users seek straightforward information on the rock types, their physical properties and their hazard or resource potential. They want our knowledge articulated in a way that will help them solve their problems.

If we try and understand what the users want, we have never been better equipped to be able to meet it. The availability of inexpensive, powerful and sophisticated IT tools provides all surveys with the facility to provide customised and flexible products based on their unique geoscience knowledge bases. But how well are we doing with this? Not as well as perhaps we might. Instead of helping to disseminate our message to a wider audience, GIS and other software is often only being used to recreate digitally products as equally indecipherable as those we produced by manual methods in the past.

There may be another factor in our failure to reach the wider audience – the tension between short-term research/scientific advancement, and reliable long-term survey programmes. Many of the new users of geological survey digital data not only seek information that is intelligible to them; they also expect data that are consistent and available nationally. It is a fact that much of our work in the past has taken the form of local (spatially restricted) research projects, which, however innovative and scientifically stimulating, collectively produce neither consistency, nor extensive geographic cover. In the geological surveys of many countries there is a powerful case for spending a greater proportion of the funding on managing existing datasets more coherently and effectively, converting more legacy data into digital form and making these data consistent; rather than focusing excessively on new research and acquisition. This would put us in a position to be able to exploit our already extensive knowledge bases more fully. While this may be a deeply unpopular strategy amongst some geoscientists, many of our potential may view it differently.

Think like a wise man, but communicate in the language of the people?

The quotation is from W B Yeats, an Irish writer; perhaps this should be a guiding principle behind our new products and services?

Over the last 20 years the British Geological Survey (BGS) has had to progressively increase its earnings from external sources to around 50% of its income, i.e. the BGS grant from the UK Government now covers only half its costs. While this funding model has at times produced a number of problems for the organisation, one obvious benefit has been that, because of the need to earn income, priority and much effort has been devoted to trying to better understand what BGS' users want, and then to attempt to design and deliver appropriate products and services for them. In business-speak BGS is aspiring to market-pull and not product-push. A variety of products has been developed, some very successful, some less so, but in many of them there is no longer a presumption that the user must have a qualification in geology, the talents to visualise 3D objects from a 2D representation, locate themselves by grid reference or even be able to read a map!

In 1993 BGS developed GHASP (GeoHAzard Susceptibility Package) aimed at the UK insurance industry. It was a simple assessment of geohazard potential, which by utilizing digital mapping and GIS, effectively distilled geological knowledge down to a spreadsheet containing a list of GB post(zip)codes and a potential hazard rating between 1 and 10! GHASP proved to be a considerable success. Subsequently BGS developed ALGI (Address Linked Geological Inventory) for the urban areas of Bristol and London. This was a prototype turnkey system to supply geological information for those involved in property transactions. It used GIS, in combination with an address/coordinate database and automated report writing scripts to deliver a standard geological report on any specific address. It was a major advance, but its restricted geographic extent and the geoscientific nature of the information provided, limited its usefulness and take-up.

Developing GHASP and ALGI provided experience and the basis for a range of products and services that BGS is offering today. In 2002 the GeoReports service was launched (Figure 1 and http://www.bgs.ac.uk/georeports/home.cfm). This is a full e-commerce service that uses a number of national databases of geohazards, GIS, address-linking, and automated report-writing scripts. It allows customers to select from a variety of report types using postal address or grid reference and then receive the report (in secure PDF format) by email. Report types range from a simple listing of the data BGS

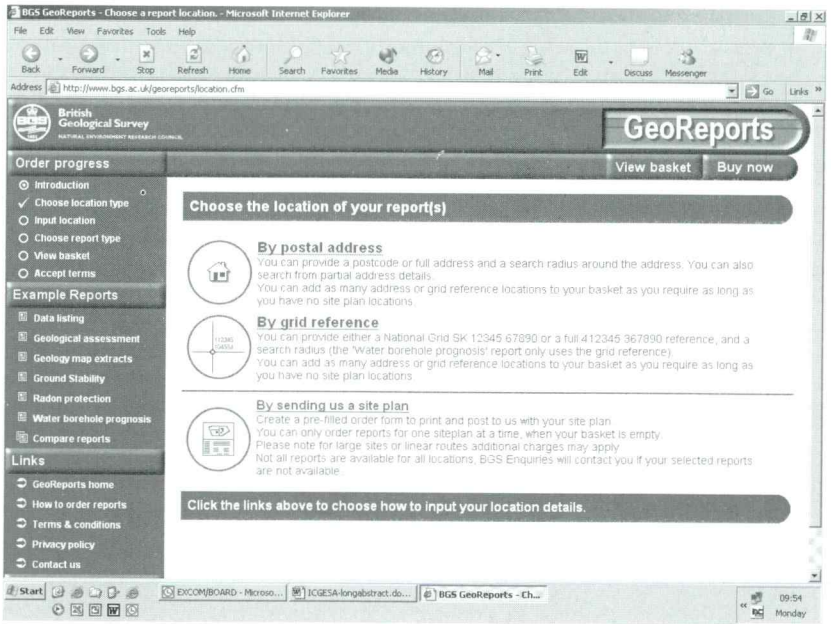

Figure 1. "The location entry" screen of the BGS GeoReports e-commerce service

holds for the specified area, to reports describing potential radon risk or natural ground stability hazards in non-technical language. A portion of a report on natural ground stability is included as Figure 2. Note that after assessing the likelihood of any hazard the report first advises the client on what they should do next and only then gives information on the likely cause; the concern of most members of the public is not what may cause the geological hazard, but what they should now do about it.

BGS continues to try and understand users' needs better. This is not an easy task, in part because many users are not really aware of the range of data and potential services a geological survey can offer and often have difficulty articulating their needs. But through one-to-one dialogues, partnerships and user forums (including a regular Parliamentary briefing) our appreciation of the real requirement is slowly growing. In recent months new discussions have taken place with representatives of the insurance companies, the legal profession and the financial sector on the content and design of potential new products they might wish BGS to supply. Additionally, continuing negotiations are taking place with local administrations, transport infrastructure organisations and national environmental and conservation agencies. For these major organisations, which have an ongoing need for geological data, the opportunity of direct and dynamic, customised access to BGS knowledge via Virtual Private Networks and web services is being explored.

Working outside the comfort zone?

Going beyond the delivery of conventional geological maps and reports and reaching out to a non-traditional user base means facing a new set of problems. If a GSO then charges for these products and services, even if on a non-profit making basis, only to recover costs, then these problems are compounded.

The first of the problems is resources; in addition to the costs of defining and developing the products, there are the operational costs of delivery and maintenance. Creating the products may divert staff away from their (perhaps preferred?) core duties of survey and research and cause tensions in the organisation. Running a service which provides information to the public will probably require a help-line or inquiry point to deal with enquiries and complaints. The issue of liability and the risk of being sued for supplying erroneous information is not new, but it does increase considerably, as these new products are going to an audience that

GeoReports

Natural Ground Stability Professional Search

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Search Results:
Important notes
The term 'search **area**' as used throughout this report means the property extent and a 150m buffer zone. The property extent will be defined using the original details specified by the client
This search is concerned with potential ground stability related to NATURAL geological hazards only. It does not search for man-made hazards, such as contaminated land or mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service (*www.coalminingreports.co.uk/*)

Question 1	Answer
Is significant natural ground instability possible in the area?	YES

Question 2	Answer
How significant could natural ground instability be in the area on a scale of 1 to 4 (low to high)?	**Level 3**

Question 3	Answer
What action should be taken?	If natural ground instability has been indicated, then this means there is potential in your area for some properties to suffer subsidence damage. However, it does not necessarily mean that your property will be affected, and in order to find out if this is the case or not you, should obtain further advice from a qualified expert, such as a building surveyor. Show them this report and ask them to evaluate the property and its surroundings for any signs of existing subsidence damage as well as advise on the likelihood for subsidence to occur in the future. The notes at the end of this report may be useful in this regard. Note that the type of building and its surroundings (e.g. the presence of trees) are also very important when considering subsidence risk. Many types of properties, particularly newer ones, are very well constructed and unlikely to be affected by subsidence, even in areas of very significant ground movements.

Question 4	Answer
Which natural geological hazards could be contributing to the ground instability in the area? *How much ground instability each hazard may cause is indicated by the Level 1 to 4 in brackets. This corresponds to the ('low' to 'high' significance) scale used in Q.2*	Clays that can swell when wet and shrink when dry, causing the ground to rise and fall ('Swelling Clays Hazard') (LEVEL 2) Weak or unstable rocks that could slip downhill on steep slopes (greater than c. 5 degrees) or into excavations ('Landslip Hazard') (LEVEL 1) Very soft ground that might compress and progressively sink under the weight of a building ('Compressible Ground Hazard') (LEVEL 3)

Figure 2. Part of a sample report on natural ground stability from the BGS GeoReports service

is not familiar with the "fuzzy" nature of geological information and may misuse them. The cost of legal advice to make sure the products are properly described and "caveat-ed" must be taken into account, as must the potential cost of legal representation, should someone actually take you to court.

National and European directives and statutes may prescribe whether a GSO may provide such services and also what and how they may charge for them (if anything!).

The whole issue of charging and pricing policy is complex; should data be licenced or sold outright, how much should be charged,

should the charges differentiate between commercial use and public good use? In the UK the 1998 Competition Act, enforced by the Office of Fair Trading, introduces a further set of rules with which BGS must comply; these relate to operating fairly within the commercial market place,. Intellectual Property Rights (IPR) and copyright are equally complex issues, not only in terms of the protection of data originating in the GSO but also because data from other organisations may have been used in developing the new product (for instance a digital elevation model or mine plan data).

Perhaps one of the most difficult issues is the dilemma posed by the problem of "blight". Geological maps have always contained implied information about hazards and resources that may affect decisions about planning in general and property in particular, but that information has been understood by only a few. When one develops products and services that make that information accessible to and understandable by the general public, suddenly any potentially damaging implications for health and property are there for all to see. It is not difficult for, instance, to envisage the affects on property prices of a GSO releasing information that describes a particular area of a city having a potential risk from subsidence or landslipping. Some will argue that making such information available (information which can only ever be indicative and never site specific or definitive) is irresponsible, others will assert that this is precisely the duty of a responsible public body. Making the potential hazard information available has not increased the actual level of risk, but it has given it a higher profile. It is also true that, however comprehensive the disclaimers or explanations, there is always a possibility that some users will, innocently or otherwise, misinterpret the information. Bringing science to the public is not always easy.