Appendix 1

Edited Abstracts of other oral and poster presentations from the 18th Extractive Industry Geology Conference 2014 and Technical Meeting 2015

held at

University Of St Andrews

11th to 14th June 2014

and

Stratford-upon-Avon, Warwickshire

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(Edited abstracts are given in alphabetical order of the first author)

EDITED ABSTRACTS 2014

INDUSTRIAL MINERAL EXPLORATION ON A CROWDED ISLAND

S. Abraham and J. Elvins

British Gypsum

The location of potential exploration targets can be identified using freely available open-source data from the Ordnance Survey (OS), the British Geological Survey (BGS) and the mapping of geographical constraints from DEFRA's Magic database, in combination with historical exploration data and existing mining operation data. The presentation reviews this process and the process of gaining the necessary regulatory and other approvals (Health and Safety Executive (HSE), Environment Agency (EA), BGS, local authority, surface/mineral owner). Organisational tools that manage the drilling process from inception to completion, alongside specific contractor induction and supervision systems, including contract specifics etc. will also be described.

GROUNDWATER AND SHALE GAS – AN OVERVIEW

R. Bell

British Geological Survey

Unconventional gas exploration (shale gas and coal bed methane) in the UK is still at a very early stage, but there are steps that need to be taken before further development occurs to ensure that groundwater resources are protected. The main considerations with regard to groundwater are additional water resource demands and the potential for pollutants and pathways related to shale gas operations. Shale gas extraction requires water for both drilling and fracking, and although the overall water demand is not projected to be significant relative to other uses, there is still a need to understand local water requirements/constraints. This is especially important in areas such as the south east, to avoid shortages in times of water stress. There is also a need to assess sources of potential contamination and the pathways and mechanisms through which groundwater may be impacted.

In the UK a number of potentially exploitable shale units are located below principal aquifers, and as such there is a need to understand, firstly, where these overlaps occur, to be able to identify which aquifers may be impacted and secondly where there is potential for groundwater contamination from operations on the surface. Groundwater may be potentially contaminated by the constituents of the shale gas itself (methane), from the fracturing fluid, which contains a number of different chemicals, and from the flowback water which needs to be stored and treated at the surface. As yet there is little information available specific to the UK, so it is essential that we learn from the experiences in the US, where this is relevant and reliable.

TRUE COMMUNITY ENGAGEMENT: A NEW MODEL FOR MINERAL DEVELOPMENT

W.J. Birch[1] and T.J. White[2]

[1]Blast Log Ltd and New Crofton Co-operative Colliery,
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Although our high standard of living relies on a continuous supply of basic raw materials, new mineral extraction projects usually attract significant opposition from local residents and special interest groups. Decisions on mineral planning applications depend on a wide variety of environmental and social factors, but public opinion is often a significant issue, and can make mineral developers reluctant to pursue a project. Although most applications are successful, the planning process can be hugely laborious.

Historically many UK mining and quarrying companies have used a 'top down' approach, where the first discussions regarding a potential development are between senior managers in the development company and the officer in the Mineral Planning Authority (MPA). This can make elected politicians nervous and local electors/residents suspicious. On 18th November 2013, a planning application was submitted by New Crofton Co-operative Colliery (NCCC) to Wakefield Council for the development of a new underground drift mine to extract 4.9 million tonnes of coal over 22 years. This was after an extensive period (>18 months) of preparatory work, where NCCC used a 'bottom up' approach which started with a process of political due diligence. This required the local political feasibility of a successful outcome to be examined in detail; discerning party political allegiances, and understanding the key historical political events that had shaped local public opinion. Once this was established, the appropriate company framework and structure were put in place, designed to ensure transparency and true community/stakeholder engagement. An Option and Lease agreement for the land was signed, before approaching the Parish Council to outline the proposals, elicit support and to identify the key community 'gate keepers'. A package of community planning gains was then discussed, to be delivered through a Charitable Trust with directors from NCCC and the community.

Once a degree of mutual trust had been established, the local ward councilors and Mineral Planning Officer were approached to discuss the proposals, closely followed by discussions with two other Parish Councils. At that point, a NCCC Liaison Committee was established. Only after achieving a high level of public acceptance did the statutory process begin; starting with a request for scoping, and leading to the full planning application. Throughout this period regular updates with the local community were maintained through the Liaison Committee, the local village magazine and a website established by NCCC.

SALT WEATHERING OF THE WADDINGTON FELL SANDSTONE BY SODIUM SULPHATE – FORCEFUL GROWTH OF CRYSTAL FIBRES

K. Blacker

University of Leicester

Salt weathering of building materials has been extensively studied in both the laboratory and field, and whilst the cause and mechanism of weathering is relatively well understood, the actual physical process of fracturing by the growth of new crystals is not. The findings of an accelerated weathering study using sodium sulphate (Na_2SO_4) on the Waddington Fell sandstone are presented here, and specifically the microstructural evolution of damaging new minerals, identifying distinct crystal morphologies associated with damaging new mineral growth, and secondary infilling crystal morphologies.

Previous studies using Na_2SO_4 have struggled to explain observed morphologies. Presented here is a new model of crystal growth and dehydration that has been previously observed in copper sulphate whiskers ($CuSO_4$) which suggests that columnar fibres of metastable $Na_2SO_4XH_2O$ work to

provide expansive force. These crystal fibres then dehydrate at a regular spacing of 4-6µm to give the commonly observed 'pitted' textures reported in other studies. It is speculated that this regular spacing is a crystal defect within the columns that arises due to their forceful growth.

Observations made at the microstructural scale have similar, and predictable, macroscale damage types. Textures such as granular disintegration, contour scaling and tafoni etc. were replicated in the experimental setting. Each macroscale damage type appears to be spatially controlled by the location of a mineral growth front, which is in turn controlled by the position of a 'wetted front', where evaporation of supersaturated solution occurs in the pores of the material. Furthermore, strongly contrasting material heterogeneities in the Waddington Fell Sandstone, particularly the presence of clay coats on grains, have given an insight into the basic material properties that control susceptibility to salt weathering in porous materials. Standard material characterisation tests and basic petrography appear to allow limited prediction of the susceptibility of a porous building material to salt weathering.

THE ROLE AND BENEFITS OF QUARRIES IN ALLEVIATING FLOODING – PLANNING OPPORTUNITIES AND TECHNICAL ISSUES

C. Carpenter

GWP Consultants LLP

Following the 2007 floods a two year research project has explored the role and benefits of quarry voids in contributing to flooding alleviation. The findings of the research project are presented, including: the complementarity of quarry flooding with national planning frameworks, Environment Agency flood alleviation strategies and mineral and waste policies; quantifying flood risk reduction benefit; optimisation of inflow and outflow structure designs; necessary local flood protection measures; evaluation of local groundwater flooding risks; relevant water quality issues; and pit stability and mineral resource protection requirements. In the light of recent extensive flooding in late 2013 and early 2014, and particularly groundwater flooding in southern England, the role and benefit the extractive industry can contribute to strategic flood management has never been more relevant.

GEOELECTRICAL IMAGING FOR NATURAL ORNAMENTAL STONE EXPLORATION

J.E. Chambers [1], S. Uhlemann [1], E. Falck [2], A. Espin de Gea [3], A. Tirado Alonso [4], J.L. Fernandez [4], P.B. Wilkinson[1], O. Kuras [1], P.I. Meldrum [1], L. Oxby [1], D. Gunn [1]

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A study is described in which Electrical Resistivity Tomography (ERT) is applied to the investigation of granite and marble ornamental stone resources. The ERT investigations were undertaken in operational quarries and extension areas, alongside other investigative methods including georadar, refraction seismic, GPS surveying and terrestrial LiDAR scanning. The wider goal of the work was to assess the applicability of near surface geophysical methods for hard rock exploration.

Perhaps the biggest challenge to successfully applying electrical methods in these settings is the large contact resistances between the electrode and highly electrically resistive natural stone, which severely limits the magnitude of the injected current and consequently reduces signal to noise characteristics of the measured data. This problem was overcome using plate electrodes and careful preparation of each electrode position. High resolution GPS surveying was required to establish the positions of the survey lines and to accommodate topography in the ERT images. A combination of 2D survey lines and 3D grids were deployed for the imaging studies, and algorithms for the automated edge detection were used to extract interfaces corresponding to structural or lithological boundaries from the electrical images.

Analysis and interpretation of the ERT results revealed key characteristics of the subsurface structure and composition, including variations in the degree of weather, jointing and faulting. These results confirm that electrical methods can be successful applied in highly resistive hard rock environments for the purpose of natural stone exploration.

FURTHER RECENT ADVANCES IN REMOTE GEOLOGICAL AND GEOTECHNICAL SURVEYING

A.C. Charters

QuarryDesign Ltd.

Following a presentation at the EIG 2012 conference on 'recent advances in remote surveying' this presentation gives an update on the substantial advances made in this technology in the last 2 years. The use of UAVs specific to the quarrying industry is presented including examples of how high quality Digital Surface Models (DSMs) have been created from features that would have been dangerous or impossible to survey by traditional methods. In addition to creating DSMs, the resulting 3D models have been used to accurately delineate and digitise geological boundaries (made possible by the high quality aerial images matching exactly the DSM 'survey'). Live video streaming from the UAV to a hand-held computer has also enabled safe quarry face inspections to be undertaken - often alleviating the need for roped access face inspections or enabling a more targeted roped access inspection to be planned. In all cases, a high quality record of the excavation, tip, lagoon or stockpile is obtained that can be referred back to and compared with, if unexpected geological or geotechnical conditions/features are encountered in the future.

APPLICATION OF PRESPLIT BLASTING TO FINAL FACES IN HARD ROCK QUARRIES

S. Cook and B. Duthie

Key Geosolutions Ltd.

A study was undertaken to assess the health and safety and economic implications of using pre-split blasting in the construction of final quarry faces and is presented. Pre-splitting has historically been under-employed in UK quarries as it was perceived to be too costly. The study compared the condition of quarry faces (back-break, under-break and joint dilation) produced after pre- splitting and bulk blasting, determined post-blast face geometries (both pre-split and bulk blasted, to assess the influence of face geometry on the trajectory of potential rockfalls), developed quarry designs for a hypothetical site incorporating final faces generated through pre-splitting and through bulk blasting, and, from those designs, quantified the difference in the volume of rock that could be extracted and the profit/loss figures associated.

The results showed that pre-splitting causes less damage to the rock mass on quarry faces. Joint dilation, back-break and

under-break were all found to be lower when pre-splitting was employed. Pre-splitting generated face geometries that were less likely to promote the projection of rockfalls beyond rock trap bunds and there wass an increase in the volume of rock that could be extracted.

A BIT ABOUT ANDALUSITE AND THE BUSHFELD COMPLEX

D. Crouse

Imerys Filtration & Performance Additives

South Africa and the Bushfeld Complex are the largest producers of chromite in the world. Overall, the Bushfeld contains 80% of the world's chromite reserves, 70% of its platinum group elements, and 40% of the vanadium reserves. But less well known, is that just outside of the world's largest layered intrusive, are the world's largest reserves of andalusite, within the metamorphic aureole hosted within the Transvaal Supergroup. Imerys produces andalusite products from several zones around the complex where the up-dip metamorphosed pelitic sediments are exposed. The Annesley Mines of the Limpopo Province were visited in 2013, and the mining and processing operations to produce the andalusite products will be described.

DESIGN OF SCHEMES OF WATER MONITORING TO SAVE MONEY AND REGULATORY TIME

J. Dodds

Envireau Water

Schemes of water monitoring have historically been a burden on the quarrying industry, whether at planning or operational stages. Changes in water regulation and the implementation of water waste minimisation policies by many companies, means that monitoring is once again being highlighted. The design of a scheme of monitoring must be seen holistically, in that it must collect the correct data; it must deliver the data to the right people and in the right format; it must be auditable; it must work; and it must be easy to operate. Designed in the right way, the scheme can deliver the same data to different audiences/users thereby maximising its value.

To achieve these objectives it is necessary to design schemes as a whole, not piecemeal and to use the data obtained to check that the scheme remains fit for purpose. As data is obtained (particularly environmental data) knowledge of the system improves and monitoring can be directed at the key issues, rather than the broad brush approach that is required at an early stage. This will almost certainly result in a reduced scheme and therefore cost savings. In difficult environmental settings appropriate monitoring schemes, designed on a systematic approach and which are fine-tuned over time will demonstrate to regulators an understanding of the natural system and can alert the operator to any aspect that is behaving unexpectedly. This real time analysis can save time, by giving confidence to regulators by providing transparency and a linkage between the monitoring and mitigation triggers. This presentation describes a systematic approach to monitoring system design and management, illustrated with examples of a high technology approach and the re-design of an old scheme that was no longer fit for purpose, but using more conventional monitoring approaches.

MILWR TUNNEL – THE INVESTIGATION AND REMEDIATION OF A MAJOR MINE DRAINAGE ADIT

M. Downing

Wardell Armstrong LLP

The Milwr Tunnel drains the majority of the former Holywell and Halkyn lead mining field in North East Wales and was vital to the operation of the underground mines. The annual mean flow is approximately 1m³/s (14,000 gpm) however, during winter, water flows up to 3m³/s (40,000 gpm) have been recorded within the 2.5m diameter tunnel. This represents the greatest flow of any mine drainage adit in the UK. Tunnel construction commenced in 1897, with completion in 1957 at a length of 16km. The tunnel has had significant effects on the hydrogeology of the area, the most notorious being the drying up of St Winifrede's Well in Holywell in 1917. The tunnel has always been an important water supply to local industry, continuing to be so following the closure of the last mine in 1987.

Wardell Armstrong has been involved in the inspection of the tunnel and its associated shafts since 2010. These inspections, together with an assessment of the hydrogeology of the system, resulted in the identification of critical sections of the tunnel that required urgent support works to prevent potential blockage of the tunnel with subsequent environmental impacts. Although only short sections of tunnel required repair, the logistics of transporting materials and undertaking the works in fast flowing water were considerable. Access to the works sites was obtained by re-opening and re-equipping a 180m deep shaft and moving men and materials by boat. As a requirement of the Health and Safety Executive (HSE) Mines Inspectorate, the tunnel had to be re-opened as an operational mine for the duration of the works and all installations and management procedures undertaken in accordance with mining legislation. Comprehensive safety procedures were required to ensure that there was no risk of flooding in the tunnel and to mitigate significant levels of radon gas. The works were successfully completed in 2013 to budget and programme with no accidents or other incidents.

UNDERSTANDING SHALE GAS PLAYS THROUGH THE USE OF INORGANIC GEOCHEMISTRY

A.J. Finlay and J. Martin

Origin Analytical Ltd.

The rapid increase in interest in exploring for shale oil and gas has highlighted the need to develop a thorough understanding of shale units. Possessing a detailed understanding of shale stratigraphy enables accurate volume calculations to be undertaken, but also, knowing the mineralogical composition of shale can provide information on rock mechanics to enable greater well completion success. In addition, a comprehensive understanding of anoxia proxies can be used to identify sweet spots in the play. This information can be potentially provided through the use of inorganic geochemical techniques.

The presentation will discuss a range of techniques from rapid and non-destructive analysis by hand held X-Ray fluorescence, to highly precise and accurate data produced by inductively coupled plasma mass spectrometers. Samples from drill core, side wall core or even drill chippings can be used. How inorganic geochemical analysis can be integrated with other techniques such as XRD and TOC analysis will be shown, and case studies of the UK onshore Bowland shale sections and the key US shale will demonstrate the wide variety of ways that the inorganic geochemical data produced can be utilised to aid in the understanding of shale gas plays.

HOW DO WE RE-INVIGORATE THE UK DIMENSION STONE INDUSTRY? AN EXAMPLE FROM THE ORKNEY ISLANDS

M. Gillespie

British Geological Survey

Quarrying building stone was once a major industry in the UK, providing the raw materials for much of the built heritage and supporting many thousands of jobs. Today only a small fraction of the several thousand historical quarries remain open, and much of the associated knowledge, skills and employment have been lost. However, the growing need to repair ageing built heritage, together with raised awareness of the need to find suitable matches for historic building stones, a renewed interest in using natural stone in new-build constructions, and, increasing concerns about sustainability and economic development in rural areas, mean there is considerable potential for the dimension stone industry to grow once more. Despite the potential, the rate at which dimension stone quarries are opening (or re-opening) is slow, and it is proving difficult for the industry to develop new momentum. The case for opening new dimension stone quarries, and the issues that are slowing the process down are examined using the example of an historical quarry in the Orkney Islands that recently re-opened successfully.

PALAEO-LANDSCAPES AND EARLY HUMAN ACTIVITY (C. 200-300K BP) IN THE SOUTHERN NORTH SEA ; A CASE STUDY IN BEST PRACTICE AS EVIDENCED IN MARINE AGGREGATE DREDGING IN THE ANGLIAN BLOCK

N. Griffiths

Hanson

Area 240 lies in the southern part of the North Sea approximately 11km off the coast of Great Yarmouth. The area is licensed to Hanson Aggregates Marine Ltd (HAML), and has been dredged for approximately 20 years. In 2007/2008, 88 Palaeolithic artefacts, including hand axes, flakes and cores as well as a series of bones (woolly mammoth, woolly rhino, bison, reindeer and horse) were discovered in stockpiles of gravel from Area 240 at the SBV Flushing Wharf in Holland. The fresh condition of some of the hand axes indicated that they came from relatively undisturbed deposits. Since that time other important finds including further hand axes have been made through a series of monitoring trials. These artefacts demonstrated that significant archaeological material can be present in deposits that are being targeted for marine aggregate extraction, and has revealed important information as to palaeo-landscape and context. In Area 240 the finds were dredged from a relatively discrete area and their provenance is secure. The area from which the artefacts were recovered is currently subject to a rectangular exclusion zone based on dredger trackplots, implemented voluntarily by HAML in accordance with the Marine Aggregate Industry Protocol for Reporting Finds of Archaeological Interest.

The work presented here is from an ongoing process of monitoring and outlines the finds, the importance of the area in terms of early man's adaptions to habitats in north west Europe and evaluates hypotheses to-date. Protocols developed with regulators (Marine Management Organisation) and advisors (English Heritage) have enabled continued development in the area whilst further evidencing activity through monitoring of gravel cargos. The large-scale monitoring of dredged material has enabled oversized and small fractions to be scanned after their separation and any finds reported to further build the evolving picture of this area in the Palaeolithic.

By identifying risk factors, using a GIS model to process them, and assigning risk scores and criticality ratings to various receptors, the approach allows a high level risk screening of assets to be carried out. This can be refined as risks become better understood and new datasets become available. The same methodology may also be applicable during the search for future aggregate extraction sites.

LOGISTICS AND THE ECONOMICS OF IRON ORE MINING IN WEST AFRICA

S. Hobbs

SKM Enviros

West Africa has some of the world's greatest untapped iron ore reserves, estimated to be up to half a billion tonnes, with grades up to 65% iron. However, accessing these reserves can pose substantial environmental, social and logistical challenges. Their locations are often remote from market, infrastructure is limited or non-existent and in some cases reserves are set within very sensitive ecological environments. Seasonal climate variations and the terrain can cause major challenges to investigation and infrastructure development and the perception of political stability, corruption and civil war can constrain possible investment. In this presentation some of the challenges of mining iron ore in West Africa are explored including: exploration difficulties such as creating a suitable and safe access for drilling rigs and providing support for drilling teams and transport access, food, water, accommodation, power and medical facilities. Environmental and social challenges, including, understanding the local regulatory regime and the interaction between government, regional and local agencies are presented, as are some of the physical difficulties associated with baseline data collection, including installing, maintaining and keeping monitoring equipment secure; identifying cultural constraints and local issues; and managing local expectations, particularly in countries with high levels of unemployment. Lastly, mine construction and the challenges of getting ore from the mine to market, particularly in sufficient quantities to make a project financially viable over the timescales expected by shareholders is discussed. The challenges highlight why a number of world class iron ore deposits in West Africa have yet to be developed.

THE TELLUS PROJECTS OF UK AND IRELAND – A STIMULUS FOR NEW EXPLORATION AND SUSTAINABLE USE OF NATURAL CAPITAL ASSETS

A. Howard[1], M. Young[2] and M Cowan[2]

[1]British Geological Survey,
[2]Geological Survey of Northern Ireland

Increasing demand for critical minerals is encouraging a renewed interest and investment in exploration in the UK and Ireland. In the early 2000s the geological surveys of Britain, Ireland, Finland and Northern Ireland joined forces to scope out a design for a Resource and Environmental Survey for Ireland (RESI). Its purpose was to survey the natural capital assets embedded in Ireland's soils and rocks, partly to stimulate new exploration investment and licencing in minerals and energy but also to inform research, regulation and management of other environmental assets. The RESI design required airborne magnetic, radiometric and electromagnetic surveys to be combined with ground-based geochemical sampling of soils and stream sediments for up to 50 chemical elements, including selected platinum group elements and rare earths. 'Tellus', the

first of these projects was completed in Northern Ireland in 2005-8, followed in the Republic of Ireland by Tellus Border in 2010–13.

The Tellus South West project in Devon and Cornwall is the first regional scale project of this type in Great Britain, with data released in May 2014. The region presents a unique combination of future mineral and geothermal resource opportunities counter-balanced by environmental constraints on development, some of which relate to the region's industrial legacy and others to a changing natural environment. The Tellus projects demonstrate how established survey methods can be deployed in innovative combinations to support new investment in resources, implementation of environmental regulation and cutting-edge research. In Northern Ireland, Tellus data has led so far to investment of over £30 million in new minerals exploration activity, with exploration licences increasing from 15% to 70% of Northern Ireland's land area. The data are extensively used to inform implementation of soil, water and waste directives, and deliver new maps on diverse themes such as radon hazard, soil carbon stocks, residual Chernobyl fallout and landfill sites and plumes. Furthermore, 10 new Tellus data-based research degrees and 10 short term grants have delivered new science on topics such as cancer epidemiology, wetland ecosystem functioning and trace element toxicology, as well as critical metal potential. These outcomes and benefits were the driver for investment in Tellus South West, and funding and partners are currently being sought to support further Tellus surveys in central Scotland and Wales.

TITANIUM DEPOSITS IN NORWAY

A. Korneliussen

Geological Survey of Norway

Norwegian titanium (Ti) and iron titanium (Fe-Ti) mineral resources are very large, comprising magmatic ilmenite ± vanadiferous magnetite ± apatite deposits, as well as metamorphic deposits with predominant rutile. The Neoproterozoic Rogaland Anorthosite Province in southwest Norway is by far the most important in terms of volume of Ti deposits and Ti-enriched igneous rocks. This province includes two major mineral resources: The Tellnes ilmenite deposit which is operated in a Ti-rich norite intrusion within anorthosite, and the nearby Bjerkreim- Sokndal Layered Intrusion with specific units in the sequence enriched in vanadiferous magnetite, ilmenite and apatite. Metamorphic processes have affected the magmatic Ti deposits to various extents. A rather extreme example is the formation of eclogite from a mafic igneous protolith during Caledonian high-pressure metamorphic phase, during which Fe from ilmenite entered garnet, and the remaining Ti formed rutile. Thus, large volumes of ilmenite-bearing rocks were transformed into rutile bearing eclogite. A number of rutile- eclogite deposits of potential economic interest have been identified, of which the Engebøfjellet deposit in the Sunnfjord region of west Norway is presently under development by Nordic Mining ASA. This presentation explores these deposits and metamorphic processes.

GEOTECHNICAL CHALLENGES IN QUARRY DEVELOPMENT IN STEEP SIDED MOGOTE HILLS

D. Jameson and M. Pritchard

GWP Consultants LLP

Gunung Pedak is a typical tropical mogote hill in Malaysia consisting of a steep sided marble outcrop which rises almost vertically for around 400m above the adjacent flat alluvial plain. Quarrying the marble from the hill and maximising the mineral resource presents many interesting and challenging geotechnical problems some of which are discussed in this presentation.

The hill is riddled by sinkholes up to c.200m high. The sinkholes may be filled with weakly cemented breccias and some are open, and when exposed on the outer flanks of the hillside present a significant rockfall hazard. Geotechnical consideration is being given to whether it is possible, as part of the quarry development, to remove a 100m high open sinkhole located 150m up the sidewall without the adjacent rock mass collapsing and causing devastation to the public infrastructure below, and if not possible what the required standoff margin and land take is. A second challenge at the site relates to access and a tunnel, installed in the 1980's. An original glory hole was poorly positioned and has been worked out, and so all quarried material is taken for processing via the tunnel. The quarry floor lies within 50m of the tunnel crown. Working out what the minimum tunnel crown thickness could be without causing the tunnel to collapse is critical to planning and delivering an alternative access route which will comprise a 120m high road cutting down a sub-vertical and overhanging sidewall.

MINERAL AND CHEMICAL CHARACTERISTICS OF HIGH-WHITENESS CALCITE MARBLES, NORTHERN NORWAY

A. Korneliussen and A. Raaness

Geological Survey of Norway

Carbonates on the Norwegian mainland range in age from Paleoproterozoic to Silurian. Due to differences in chemical composition and extent of recrystallisation during deformation and metamorphism of the precursor rock, their character varies widely. Fourteen carbonate mines currently in operation differ significantly and provide raw materials for industrial production of cement, lime, mineral fillers and soil conditioner. Of particular interest for new developments are calcite and dolomite marble deposits with low contents (<250ppm) of crystal-bound iron (Fe) and manganese (Mn), for the production of high-whiteness carbonate products. However, extensive finely dispersed inclusions of graphite, quartz and other minerals in the carbonate as well as calcite/dolomite intergrowths, present a major obstacle for industrial development. It may not be possible to process such rocks if sufficiently pure carbonate mineral concentrates cannot be produced at sufficiently low cost. To exploit this the minor inclusions of other minerals need be identified and characterised to determine which deposits are compatible with current refinement/processing techniques. Alternatively, a new processing mechanism to handle mineralogically complex deposits could be developed. This presentation describes the mineral and chemical characteristics of these potentially high value carbonate deposits.

PLANNING FOR SUSTAINABLE AGGREGATE PRODUCTION IN ILLINOIS, USA

Z. Lasemi [1], J. Henriksen [2], M. Hansel [3] and M. Krumenacher [4]

[1] Illinois State Geological Survey, Prairie Research Institute, University of Illinois,
[2] Illinois Association of Aggregate Producers,
[3] McHenry County Planning and Development,
[4] GZA GeoEnvironmental, Inc.

Illinois is challenged with the continuous loss of aggregate resources to urban development, due to the expansion of residential and industrial complexes and the lack of specific guidelines from government agencies for managing aggregate resources. Difficult permitting makes it doubtful that new surface mines will be developed in many urbanised areas. Intense competition for land and mineral resources has increased the need for current, detailed geological information ahead of pressing land-use decisions. Three-dimensional geological mapping provides the necessary information in a simple, non-technical format that can be conveyed to local, county, and state planning agencies to help them make informed decisions on land use, preservation, and protection of aggregate resources while at the same time protecting the environment.

Availability of aggregate resources is rarely incorporated into planning programs. Government agencies and industry must work together to ensure that affordable aggregate resources are available for current needs and future generations. McHenry County's experience dealing with these issues in northeastern Illinois illustrates the importance of such cooperation. Gravel mining is a significant industry in the county and a controversial one, as many believe it can have negative environmental (particularly water), health (noise and dust), and infrastructural (roads) consequences. Through zoning ordinances (land-use zoning) and groundwater monitoring ordinances, the county is able to provide sensible and effective regulations to address the concerns of all interested parties. To increase awareness about aggregate sustainability, the Illinois Association of Aggregate Producers (IAAP) initiated a program in collaboration with other bodies to present workshops on sustainable aggregate production. The workshops primary objectives have been to inform the public, state and local governments and planning agencies about the vital importance of construction aggregates to infrastructure and economic development, and, to emphasise that adequate supplies of construction aggregates require the understanding of the local geology and careful land-use planning (including 3-D geological mapping), collaboration between the mining industry and local communities and the adoption of sensible and effective regulations.

THE POTENTIAL APPLICATIONS AND BENEFITS OF DIGITAL DATA COLLECTION IN QUARRIES

C. Leake

Hafren Water

The ready availability of relatively inexpensive and highly capable digital monitoring equipment has led to a rapid increase in the type and volume of environmental data that can be collected. Water flows, both within pipes and open channels, water levels and chemical and physical parameters, amongst others, can all be measured with precision and at great frequency. The benefits of the increased understanding of water systems which can be derived from abundant data are many and include ensuring regulatory compliance, cost reduction, development of accurate water balances, and demonstrating being a responsible operator.

The large amount of data which can now be generated represents a step-change in the potential understanding of systems. However, large volumes of data may be of little value as it can create problems in being very time consuming and hence expensive to process. Great care is therefore needed in designing monitoring systems appropriately. The adoption of digital monitoring equipment has been relatively slow within the quarrying industry. The reasons for this are examined together with the identification of applications of the range of technologies available and a consideration of their pros and cons.

DESIGNING FOR UNDERGROUND EXTRACTION: A DIMENSION STONE ROOM-AND-PILLAR MINE

N. Lee

Wardell Armstrong International

The Isle of Portland in Dorset is an exceptional area of ecological, historical and geological importance. Over the past 350 years Portland has yielded many millions of tonnes of dimensional building stone. The extraction of the stone has historically been undertaken by quarrying and has left a distinctive mark on the landscape. In 2008 Albion Stone PLC began underground mining at their Jordans Mine site extracting dimension stone by room-and-pillar methods at an average production of 60m^3 each week. Wardell Armstrong were appointed to assist with the planning application and to undertake the geotechnical design. The need to ensure both operational and long-term stability has been a main driving force in the mine design.

The design process consisted of a geotechnical assessment of the geological stratum using two rock mass classifications systems: the tunneling quality index 'Q' and Rock Mass Rating (RMR) systems. The roof support was designed with a high redundancy and Factor of Safety (FoS) built in. Pillar design was based on overburden loads; the concentration of these loads on the pillars and their capacity to cope with those loads are expressed as a FoS relating pillar load to pillar strength. This presentation details the geotechnical data collection and design process, the phased and final mine design layout, roof support requirements, room and pillar design and the closure and backfilling options. It also discusses the adopted monitoring schemes and bi-annual geotechnical inspections.

GROUND CONTROL INSTRUMENTATION FOR THE EXTRACTIVE INDUSTRY

K.M. MacAndrew, L. Sneath and J. Toplis

Golder Associates UK Ltd.

A series of recent developments in ground control instrumentation and software that are providing a significant contribution to reducing risks of injury from falls of ground in underground excavations are presented. The remote reading extensometer and telltale system is an innovative application of the well proven visual telltale concept developed by British Coal's Mining Research and Development Establishment prior to the UK industry's privatisation. These developments have been part funded through the European Research Fund for Coal and Steel. The general telltale principles, instruments and their current certification status are described. The latest generation of Golder Remote Reading extensometers/telltales has recently been installed in several locations around the world. This modular system provides staff with movement measurements to an accuracy of 0.1mm (roof and/or sides) from chains of up to 100 electronic telltales or extensometers installed in a tunnel,

excavation or mine. Up to a maximum of 400 telltales or extensometers can be connected to one system. The measurements can be read in situ or can be automatically sent to a computer, either via an ethernet backbone or a dedicated telephone cable. The latest system software (version 3.3.1) is described which provides a range of new features including SMS and email alerts based on absolute movement and rate of movement for each individual anchor as well as the total movement. The software has the ability to view the readings using a GIS display and also real-time data access from any authorised networked PC.

MODELLING AND ASSESSING THE UNCERTAINTY OF MINERAL RESOURCES IN THREE DIMENSIONS: A CASE STUDY BASED ON LEGACY IMAU SAND AND GRAVEL DATA

B. Marchant, K. Mee and J. Mankelow

British Geological Survey

3D models are required to account for mineral, overburden and intercalation when making assessments of the economic viability of mineral resources. Such models have been used to explore how sand and gravels are distributed in both horizontal and vertical space. It would be advantageous to expand these models to represent several mineral gradings simultaneously and give a better indication of the quality of the resource but this leads to statistical challenges which cannot be addressed within standard software packages. The models must be able to reflect the interdependencies between the different gradings. Furthermore mineral resource models are inevitably uncertain since they are derived from the limited set of drilled boreholes in the study region. This uncertainty must be quantified to permit informed decisions about the exploitation of mineral resources. The presentation explores these issues with reference to a 3D mineral resource model developed for a 2400km^2 region close to Reading. The model is estimated from mineral grading analyses of boreholes collected by the British Geological Surveys (BGS') now-disbanded Industrial Minerals Assessment Unit (IMAU). The log-ratio transform and the linear model of regionalisation - techniques that have previously been used to map soil texture classes in 2D were adopted for this project. They lead to a 3D model which can be used to generate thousands of plausible realisations of the mineral resource which fully reflect the extent of our uncertain knowledge.

PETROLOGICAL AND CHEMICAL CHARACTERISATION OF HIGH-PURITY QUARTZ DEPOSITS WITH EXAMPLES FROM NORWAY

A. Mûller, J.E. Wanvik and P.M. Ihlen

Geological Survey of Norway

Demand for high-purity quartz (HPQ) is strongly increasing worldwide owing to growing consumption and an increasing range of high technology applications in the glass, ceramic, semiconductor, telecommunication and photovoltaic industries. Ensuring security of supply requires the identification and characterisation of new HPQ deposits and possibly of a different kind to those currently in production. Prerequisites for developing exploration tools for such deposits are the application of state-of-the-art micro-analytical methods for appropriate petrological and chemical characterisation of potential deposits and to gain a better understanding of the geological environment and conditions of HPQ formation.

HPQ is generally defined as quartz containing less than 50ppm of contaminating elements and industry requires limits on the concentration of a number of detrimental elements in the quartz product. A refined HPQ definition is suggested proposing concentration limits of; Al <30ppm, Ti <10ppm, Na <8ppm, K <8ppm, Li <5ppm, Ca <5ppm, Fe <3ppm, P <2ppm and B <1ppm while the sum of all elements should not exceed 50ppm. The content of these elements is controlled by intracrystalline impurities including; lattice-bound trace elements, submicron inclusions <1µm, and mineral and fluid micro-inclusions (>1µm) in quartz. These impurities cannot be removed by conventional processing. Norweigan deposits include the Melkfjell quartzite, Solør kyanite quartzites, Nedre Øyvollen pegmatite and the Kvalvik, Nesodden and Svanvik hydrothermal quartz veins. They represent a wide range of formation environments including hydrothermal, igneous and metamorphic settings. Impurities in quartz of these deposits were identified and analysed by backscattered electron (BSE) and cathodoluminescence (SEM-CL) imaging and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). The crystallisation processes leading to HPQ formation differ for the various deposits and are many. These processes includes; (i) crystallisation of quartz from primitive niobium-yttrium-fluorine (NYF)-type pegmatite melts (Nedre Øyvollen), (i) crystallisation of hydrothermal quartz at greenschist-facies conditions and subsequent quartz refinement due to postcrystallisation re- crystallisation at greenschistto lower-amphibolite-facies conditions (Nesodden, Kvalvik, Svanvik), and (iii) solid-state crystallisation of quartz-rich rocks at amphibolite-facies conditions and subsequent quartz refinement due to post-crystallisation recrystallisation at greenschist- to lower-amphibolitefacies conditions (Melkfjell, Solør). These processes and formation conditions are described in this presentation.

AN OVERVIEW OF THE GEOLOGY AND MINERAL RESOURCES OF SCOTLAND

R. Robinson[1] and G. Smith[2]

[1]St Andrews University, [2]Border Geo-Science

Scotland contains a great variety of rock types ranging from Precambrian age gneisses to the products of Pleistocene glaciation. The oldest rocks, representing a segment of Proterozoic continental crust, occupy the North-West Highlands with rocks becoming progressively younger towards the south-east. Much of the highlands comprises metasedimentary rocks along with large syn-orogenic basic-ultrabasic and end-orogenic granitoid intrusions. Following uplift and erosion of the highlands there was widespread sedimentation, particularly in the fault-bounded Midland Valley, initially fluvial in character, followed by shallow marine rocks including coal and limestone, and latterly aeolian sandstones. Multiple glaciation events during the Pleistocene led to widespread deposition of till and glaciofluvial sand and gravel.

Such a diversity of rocks inevitably results in a wide range of mineral resources being present, some of which have, or are, or could be worked in the future. In total terms of tonnage won, coal, predominantly from deep mines, tops the list followed by rock for dimension stone and aggregate. Other commodities produced included iron, copper, lead, zinc, chromite, manganese, brick clay, fireclay, limestone and semi-precious gemstones. Today the scene is dominated by off-shore oil and gas and hard rock aggregate quarrying, including one coastal superquarry; coal is but a shadow of its former self with all production since 2002 being from surface mines, and dimension stone has limited output. Barite and silica sand are the other principle modern commodities being extracted. Future developments could include winning of gold, gemstones, critical metals, coal-bed methane and shale gas.

INDIANA LIMESTONE – THE GOLD (WELL, BUFF) STANDARD OF U.S. DIMENSION STONE

N.R. Shaffer and K.R. Shaffer

Nannovations

'Indiana Limestone' is the trade name for the pre-eminent buff coloured dimension stone in the United States. The stone is mined in a limited region of south central Indiana from the Mississippian age Salem Limestone. It is characterised by well-washed sand-sized grains, mostly fossils, and occurs in deposits from 20-80 feet (6-24m) thick. It is a free stone with excellent properties that make it well suited for architectural use, even for carving. Processing innovations include belt saws that increase productivity and allow horizontal as well as vertical cuts for underground mining. Traditional methods of shaping stone have been augmented by computer-controlled tools. Much of the milling uses large, robust saws, planers, and lathes.

Organised mining started in the 1820s and production grew to several hundred thousand cubic feet by the 1870s. Architectural tastes, but more importantly, the nation's economic conditions, control production. Since 1990 production has varied from 2.3 to 3.9 million cubic feet with values from $22 to $47 million. Though small in economic terms, the stone has large cultural effects, cladding thousands of structures including the Empire State Building. Appreciation of the economic and historical values of Indiana and the industry it spawned has led to efforts to honor and preserve this heritage. The district is a candidate for a Global Heritage Stone area by the United Nations. Area museums offer displays and programs about the Limestone. Parades and festivals honoring the stone trade are held annually, as is a Limestone Carving Symposium. Efforts are also underway to preserve an old quarry and mill as a Limestone Heritage Park in Monroe County. Other reuses of the mines and abundant waste blocks are being studied. Venerable Indiana Limestone still has some new tricks to keep it vibrant.

INVESTIGATION TO UNDERSTAND THE GEOLOGICAL FACTORS CONTROLLING IRON OXIDE DISTRIBUTION IN GRANGE MILL, LIMESTONE QUARRY, DERBYSHIRE

A. Smith

NSG

NSG manufactures high quality glass and its quality control procedures involve monitoring the geological supply chain of silica sand and other additives to ensure that tolerance limits are maintained. This project aimed to investigate the geological factors controlling iron oxide (Fe_2O_3) distribution at one of the limestone additive suppliers, Grange Mill, a limestone quarry in Derbyshire. The maximum permitted iron oxide level in limestone (for glass manufacture) intended for low iron applications is 200ppm. Iron oxide levels in limestone >200ppm can have a detrimental effect on the light transmission through some glass, such as solar panel glass.

Geological field work established varying lithologies within and between benches in the quarry. Mineralogical (XRD, SEM and transmitted light thin section microscopy) and geochemical (XRF) investigations were undertaken in the laboratory. A chemical and mineralogical profile map of the deposit was created and an attempt to explain the iron variation was made.

Five possibilities were considered to explain the variation of iron oxide in the limestone produced: (i) localised ferro-dolomitisation, (ii) jointing and fracture patterns controlling the movement of iron oxide enriched groundwater, (iii) clay wayboards resulting from the alteration of intervening Carboniferous basaltic pyroclastic activity contaminating the limestone blast piles, (iv) fault controlled mineralisation, (v) groundwater contamination from overlying late Carboniferous/Permo-Triassic redbeds.

The study found that the main geological factor controlling iron oxide distribution was contamination from interbeddded high iron oxide clay wayboards. This presentation discusses the study undertaken and the findings.

ACHIEVING MINERAL SUPPLY IN AN EU CONTEXT

G. Tiess [1] and J. Cowley [2]

[1] Montanuniversitat Leoban,
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Europe is seen by some as 'played out' in relation to mineral extraction, and future extraction potential is perceived as both unlikely but also undesirable. Without intervention, the thrust of some policies at European Union (EU) and national level may make that perception a reality. Instead, Europe has a significant potential which has, in part, been recognised by the EU in the adoption of the concept of increasing supply from within the EU as one of the pillars to ensure supply of some critical minerals. There has been talk about this supply concept and what is or isn't 'critical' or otherwise important to the EU. But progress in making that concept work, and being 'fit for purpose' for users (industry, land use planning agencies, regulators etc.), as opposed to being an interesting discussion point for ecologists, economists, lawyers, etc. who can hijack the debate, has been markedly absent.

The authors see an increasing imbalance in EU policies which directly and indirectly complicates the achievement of mineral supply. To counter that risk an effective minerals policy is needed. Effective meaning that objectives, and the mechanisms to achieve those objectives, are driven by outcomes and not process. It is clear however that process mechanisms may be weak, primarily because the requirements of 'users' are poorly understood by those promoting policy. There is, for example, an acknowledgement in the EU of the need to prevent mineral resources being unnecessarily sterilised, but a lack of understanding as to the form of the process needed to convert that objective into effective practice. How do we make that, and other processes, effective? The authors believe that a strong framework statement is needed to signify how important minerals are to the EU. Should this be a Directive to give weight in the decision process, or would that be a step to far? The route is not clear. This presentation will consider such questions.

PARTICLE SHAPE EVALUATION: A NEW OBJECTIVE APPROACH USING DYNAMIC IMAGE ANALYSIS APPLIED TO THE FRAC SAND INDUSTRY

K. Vos [1,3], G. Beckmann [2], J. Westermann [2], P. Demecheleer [1] and N. Vandenberghe [3]

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In the process of hydraulic fracturing sand grains are used to prop open induced fractures in tight reservoir rocks to enhance the permeability and conductivity of a well. The sand must meet a number of stringent specifications to be classed as a 'frac sand or proppant', concerning particle shape and structural integrity, acid solubility, turbidity and density. One

characteristic of a frac sand is its specific well-rounded grain shape, which governs to some extent other crucial specifications regarding its use in reservoir stimulation processes.

This presentation proposes a new technique to accurately evaluate particle shape using dynamic image analysis. Using a Camsizer instrument it is possible to measure, with the highest accuracy and repeatability, roundness and sphericity as shape parameters for samples ranging from 150µm up to several mm in diameter. This innovation not only increases measurement reliability and statistics, but also drastically decreases measuring time. The technique would replace the existing, highly subjective method of particle shape evaluation by visual comparison of at least 20 particles per sample to reference charts to obtain the values for sphericity and roundness. This procedure is prone to many errors and is highly dependent on the experience of the operator performing the task. However, as these values have been used in the frac sand industry for many years, it is essential to keep reference to this existing procedure when introducing a new technique.

EDITED POSTER ABSTRACTS

INTEGRATED WATER RESOURCES MANAGEMENT IN THE EXTRACTIVE INDUSTRY – WHAT, WHY AND HOW?

C. Carpenter

GWP Consultants LLP

Climate change is providing increasingly frequent extreme water challenges to all sectors including the extractive industry, on how to operate effectively and efficiently during intense storms as well as extended droughts. The need to manage surface water run-off to prevent on-site flooding and discharge consent non- compliance, as well as ensure access to adequate dry season water supplies for mineral processing and dust suppression in increasingly over-exploited watersheds and aquifers. These challenges require a more integrated approach to water management. This poster introduces recent advances in more integrated surface water management and water supply approaches being used in the extractive, waste and recycling sectors, including rainwater harvesting, groundwater recharge and augmentation, as well as water demand measures; enabling operators to access water resources in otherwise closed catchments and aquifer basins. Opportunities for water- related on-site power generation are also discussed.

IT'S A SMALL, SMALL WORLD: NANOTECHNOLOGY AND INDUSTRIAL MINERALS

N.R. Shaffer

Nannovations

Does nanotechnology have a place in the traditional field of industrial minerals? Currently there is a great deal of media attention, good and bad, for nanotechnology. This term encompasses, ironically like industrial minerals, a large range of materials, processes, and uses. Nanotechnology is technically the science, engineering, study, and manipulation of materials at the billionth (nanometer) scale. This range includes molecules, even individual atoms. New techniques of atomic force microscopy, laser tweezers, organic templates and others have opened new realms of material properties, chemical action, and biotechnical wizardry. One hears almost daily of breakthroughs in medical devices, drug delivery, electronic components, sensors, and almost magical engineering capabilities wrought by nanotechnology. Important questions for geologists are: does the new technology have applications to mineral processing? Will new products eclipse uses of conventional minerals? Can common minerals be part of this small enormous brave new world?

Most mining and processing produce fine, even nano-size materials. Some, such as kaolin, ground calcium carbonate, and various fillers or pigments, are deliberately made in micron sizes and command high prices, but other nanomaterials are considered liabilities or environmental hazards.

Very little has been written to date about nanotech and its application to industrial minerals and even less about how the technology might be applied to mineral processing or beneficiating, nor how current processing could be changed to produce useful nanotech products. Promising applications for nanotech in mining and processing include; the study of mineral surfaces and interfaces; relationships of binders and aggregates or fillers with industrial minerals as very fine templates for crystal growth, even oriented growth, as special optical or electronic materials.

EIG TECHNICAL MEETING 2015: EDITED ABSTRACTS

BENEFITS OF QUARRYING ON FLOOD CONTROL AND WATER MANAGEMENT

C. Carpenter

GWP Consultants LLP

Active quarries and low level after use restoration schemes have the potential to provide flood storage and contribute to flood alleviation. MIST (Minerals Industry Sustainable Technology) funded research in 2010-2011 captured examples of a wide range of flood storage applications, from soft engineering wetlands and backwaters to hard engineering reservoirs, offtake weirs and outlet structures.

This presentation briefly explores some of the detailed technical findings of this work including design considerations that can improve the performance of active and restored quarries in contributing to flood alleviation, dispels the myth of groundwater flood responses removing below ground flood storage, and considers the increased risks flood water storage poses to groundwater pollution and how to mitigate this concern. Case studies from England and West Africa are presented which demonstrate quarry and surface mine void contribution to flood attenuation, and the use of early screening tools and later detailed hydrological, hydraulic and groundwater modelling in the scoping and design process.

The research is brought up to date with discussion of a proposed revised restoration scheme currently under consideration in Scotland, including the probable implications of the recently enacted revised Reservoir Act.

With ever reducing inert waste streams available, opportunities for achieving pre-development ground restoration are becoming increasingly more difficult. The deliberate planning and design of low level restoration schemes to contribute to flood attenuation is therefore not only gaining more interest but will increasingly allow planning permissions to be secured where they might otherwise fail on restoration concerns.

WATER ISSUES WITH UNDERGROUND GYPSUM MINING

J. Elvins

Saint Gobain

Major hazards associated with water (or an inflow of material) and underground gypsum mining will be presented, as will a review of the work undertaken to assess the hydrogeological risks at the Barrow Mine in Leicestershire, the Marblaegis Mine in Nottinghamshire and the Birkshead Mine in Cumbria.

The presentation will stress the importance of: knowing the hazards (aquifers, old mine workings, boreholes, oil wells, water wells etc.), planning additional investigations as necessary, and understanding the importance of getting the geological model right.

AN OVERVIEW OF SHOW STOPPERS

C. Howarth

Mott MacDonald

Whether it be droughts or floods, resource constraints or issues associated with the water environment, all have been widely documented and publicly debated over the past 20 years. As a heavily populated island, the UK is reliant on its surface water and groundwater resources for water supply (for public use, industry and agriculture), and is committed to meeting our environmental obligations to restore (and maintain) our water environment to good status to safeguard our water resources for future generations.

With historical, seasonal and geographical imbalances in water resources, since 2000 our water resources have become more closely managed and regulated (e.g. Catchment Abstraction Management Strategies). With population growth and climate change, the Environment Agency estimate that total water demand could increase up to 35% by the 2050s. As such our water resources are likely to become more, rather than less constrained with time.

Quarrying and mining are not significant consumers of water, nevertheless operations may require significant water abstraction and use prior to its return to the water environment. This has led to potential conflicts with other users of the water environment and to planning/EA policy that can risk significant delays and costs to a site, or ultimately prevent its operation. The uncertainties for the minerals industry with respect of potential watery 'show stoppers' may have significant impacts on planning and operations (in the short and long term, both at strategic and site levels).

This paper will provide a brief overview of potential water related 'show stoppers' that can and do go wrong from the point of view of: planning / regulation; environment; technical ; and perception. This will be balanced with commentary on things that can be done to make them less of a 'show stopper' and more of a 'bump in the road' to be planned for.

REGULATORY ISSUES AND WATER IN QUARRIES

N. Owen

Mineral Products Association

Regulatory issues for the minerals industry has been a discussion point for many years with the regulation of abstracted and transferring water at the forefront. Water management on aggregate sites has typically been poorly monitored due to lack of regulatory requirements and the fact that sites do not actually consume a vast amount of water. Currently sites are exempt from licenses for dewatering activities, but are required to have permits or licenses for direct abstractions, where it is not related to the dewatering activity, and for discharge.

Following the Water Act 2003, the industry awaits the removal of the exemptions, something which has been promised since 2003, but is yet to happen. Meanwhile water regulation continues to move forward, the Government intends to reform the abstraction licensing system for all industries in England and Wales by 2020. The current position is concerning. Quarries do not have licenses for water transfer or for some abstraction activities, so in theory they have 'no right' to a license under the proposed new regime. There is a lack of knowledge and understanding within industry, Government and the regulator as to how much water is used, moved and discharged by industry. There is further confusion over compensation and the rights that operators have if the regulator deems an activity un-licensable.

It could be considered that licenses are not required since industry has been operating successfully for many years, with no major environmental damage. However, Article 11 of the Water Framework Directive requires Member States to have basic measures in place for controlling abstractions from ground and surface water. Government considers that without further regulatory requirements on dewatering activities, they are unable to comply with the Directive. It should be noted that compliance with the Directive was required by October 2012 and the UK are currently facing infraction proceedings.

The requirement under the Directive leaves industry questioning whether we truly need to remove the dewatering exemptions. There are controls under the National Planning Policy Framework and the Environmental Impact Assessment (EIA) process which could be utilised more fully to satisfy the European Commission. The planning process should provide a minerals site 'licence to operate' with the Environment Agency ensuring no pollution is caused during the life of the site and providing permits for that purpose.

The presentation will explore the regulatory background and the current lobbying strategy by industry. The focus will be on the use of planning permissions and EIA to provide satisfactory compliance with the Water Framework Directive.

SAFETY WITH WATER AND PUMPING IN QUARRIES

C. Pickett

Health and Safety Executive

This presentation will discuss the risks associated with working on and near water in quarries and the reasonably practicable steps that can be taken to reduce risks to workers and members of the public. The legislative issues of trespass in abandoned quarries will also be discussed together with the measures that could be reasonably expected to be taken to discourage trespass.