



SEAES PGR Conference 2010

December 9, 2010, Manchester, UK

Energy and Environmental Research @ Manchester

Program and Abstracts

Energy and Environmental Research @ Manchester

**School of Earth, Atmospheric and Environmental Science
Post Graduate Student Research Conference**

2010

Program and Abstracts

Barnes Wallis Building,
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Edited by:

Holly Barden, Ayodeji Oluboyo and Aisha Al-Hajri

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Foreword

It is my pleasure to introduce the program and book of abstracts for the PGR Conference of the School of Earth, Atmospheric and Environmental Science of the University of Manchester. The book includes abstracts of 29 presentations (12 oral and 17 posters) submitted from research groups across the school. The aim of the conference entitled “Energy and Environmental Research @ Manchester” is to showcase the interdisciplinary graduate research being undertaken within the School of Earth, Atmospheric and Environmental Sciences.

The organisers are particularly grateful to Prof. J. Redfern and Dr. M. Huuse who served as Faculty Advisors to the organising committee and Mrs. R. Rana, Senior Education Administrator of the School for the support provided in organising this event. We will also like to thank the keynote speakers Mr. Iain Brown of PGS-Reservoir and Prof. Jon Lloyd the head of Postgraduate Research.

The authors are also to be commended for the ideas and data presented in their respective presentations. Without the invaluable contribution of their time and effort, it would not have been possible to organise this conference. The conference organisers will also like to acknowledge the financial support given by the sponsors particularly Graduate Development in Faculty of Engineering and Physical Sciences and Petroleum Geo-Services.

Ayodeji, P. Oluboyo
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Programme

- 8:15 a.m** **Registration**
- 8:55 a.m** **Introductions**
- 9:00a.m** **Welcome Address:** Prof. Hugh Coe (Head of School, SEAES)
- 9:10 a.m** **Keynote Talk:** Ian Brown (*Interpretation Director, EAME, PGS Reservoir*)

Session One: Oral Presentations

- 9:30 a.m** *Sedimentary Characterisation and Depositional Mode of the Messak Fm, SW Libya*
Jonathan Wood, Stephane Bodin, Jonathan Redfern & Myron Thomas
- 9:45 a.m** *Burial Diagenesis of Fractured Carbonate Systems, Lower Carboniferous, North Wales*
Alanna Juerges, & Cathy Hollis
- 10:00 a.m** *Complex Carbonate Reservoir Quality at the Aptian-Albian Unconformity, Oman: Origin and Regional Distribution*
Aisha Al Hajri, Cathy Hollis, Joachim Amthor and George Warrlich
- 10:15 a.m** *Black carbon measurements from field and lab-based biomass burning*
Taylor, Jonathan W., McMeeking, Gavin R., Craven, Jill, Yokelson, Robert, Akagi, Sheryl, Urbanski, Shawn, Wold, Cyle, Flynn, Michael, Fortner, Ed, Onasch, Tim, Kreidenweis, Sonia M., Lee, Taehyoung, Sullivan, Amy, Holden, Amanda, Collett, Jeffrey, Hao, Wei-Min, Cubison, Michael, J., Jimenez, Jose-Luis, Seinfeld, John and Coe, Hugh
- 10:30 a.m** *Sedimentary Response to the Evolution of Mobile Substrates on Continental Margins*
Ayodeji, P. Oluboyo, Rob Gawthorpe, R.L. and Mads Huuse
- 10:45 a.m** *Seismic characterization of a bottom simulating reflector (BSR) and plumbing system in the Cameroon margin, West Africa*
Anh Ngoc Le, Mads Huuse, Jonathan Redfern, Duncan Irving
- 11: a.m** **Coffee Break**

Session Two: Oral Presentations

- 11:15 a.m** *Improving and assessing vapour pressure estimation methods for organic compounds of atmospheric relevance through Knudsen Effusion Mass Spectrometry (KEMS)*
A.M. Booth, D.O. Topping, G.B. McFiggins, A. Garforth and C.J. Percival

11:30 a.m *Bioreduction and reoxidation of biotite and chlorite and effects on sorption of Cs and Sr*
Kountcheva, D.R., Lloyd, J.R., Patrick, R.A.D.P., & Vaughan, D.J.

11:45 a.m *Microbial ecology and biogeochemistry of nuclear waste storage facilities*
V. E. Evans, C. Boothman, K. Morris, D.Sigee, J.R. Lloyd

12:00 p.m *Identifying the optimal use of renewable power technologies via high-resolution, spatially-explicit modeling*
Kevin Ummel

12:15 p.m *Improved Prediction of Risk from volatile organic compounds*
Nwachukwu A.N., Vandongen, B.E. and Boulton, S.

12:30 p.m *Legacy Industrial Solid Waste Impacts on Water Quality around Northwich, Cheshire*
Kinan Ibrahim, Colin Hughes & Alastair Martin

12:45 p.m **Lunch**

Session Three: Poster Presentations

1:45-2:45 p.m **P1-P6**

2:45-3:45 pm **P7-P12**

3:45-4:45 p.m **P13-P17**

4:45-4:50 p.m **Prize Giving: Dr. Mads Huuse**

4:50-5:00 p.m **Closing Remarks & Adjournment: Prof. Jon Lloyd** (Director of Research,SEAES)

5:00-5:30 p.m **Wine Reception**

Posters

- P1** The involvement of microorganisms in the formation of Ferromanganese nodules. **Ashton, N. J.**, Pattrick, R. A. D., van Dongen, B. E.
- P2** Evidence for Thermo-Chemical Sulphate Reduction in the Miskar Field, Offshore Tunisia. **Hirani, J.**
- P3** Seismic geomorphology of Plio-Quaternary deposits offshore Angola. **Oluboyo, A.P.**, Gawthorpe, R. L. And Huuse, M.
- P4** Landscape response to active extensional faulting and multiple local base levels: the Perachora Peninsula, Eastern Gulf of Corinth, Greece. **Duffy, O. B.**, Brocklehurst, S. H., Gawthorpe, R. L., Finch, E., Leeder, M. R.
- P5** 3D seismic characterization of mud volcanoes from the deepwater Niger Delta. **Benjamin, U.**, Huuse, M. and Hodgetts, D.
- P6** Biogenic magnetic nanoparticles: development and tailoring for potential applications. **Byrne, J. M.**
- P7** *In-situ* and *ex-situ* measurement of greenhouse gas fluxes from upland peat. **Do, P. D.**, Robinson, C. H., Boulton, S., Polya, D. A., van Dongen, B. E.
- P8** Linking onshore and offshore erosion and sediment transport in the Ionian coastline of NE Sicily and SW Calabria, Italy. **Goswami, R.**
- P9** Numerical modelling of climatically-driven drainage capture and sediment flux, South Island, New Zealand. **Rowan, A. V.**, Plummer, M. A., Brocklehurst, S. H.
- P10** The impact of radiation fluxes on microbial cells. **Brown, A. R.**, Pimblott, S. M., Goodacre, R., Lloyd, J. R.
- P11** Bioremediation of plutonium contaminated land. **Kimber, R.**, Purdie, P., Boothman, C., Livens, F., Lloyd, J. R.
- P12** The use of Fourier Transform Infrared Spectroscopy techniques in palaeobiochemistry. **Barden, H. E.**, van Dongen, B. E., Wogelius, R. A., Manning, P. L.
- P13** Role and nature of organic matter in the mobilisation of arsenic in shallow reducing aquifers of Taiwan and Vietnam. **Al Lawati, W. M.**, van Dongen, B. E., Polya, D. A.
- P14** Airborne measurements of organic and inorganic acids by chemical ionization mass spectrometry. **Le Breton, M.**
- P15** Diagenesis, sediment mobilization and fluid flow controls: Implications for Oligocene-Miocene sediment deformation. **Odeyale, O.**
- P16** The geomorphology of Antarctic submarine slopes. **Gales, J.**
- P17** Putting the sub-surface into the cloud. **Rasheed, M.**

Oral presentation abstracts

Complex Carbonate Reservoir Quality at the Aptian-Albian Unconformity, Oman: Origin and Regional Distribution

Aisha Al Hajri*, Cathy Hollis*, Joachim Amthor# and George Warrlich#

**Basin Studies and Petroleum Geosciences, School of Earth, Atmospheric and Environmental Sciences, University of Manchester, #Petroleum Development Oman, Muscat, Oman*

The Aptian Shuaiba Formation is a major hydrocarbon reservoir in the Middle East. Recent studies documented improved porosity and permeability in many fields at the top few meters of the Shuaiba reservoir below the Aptian-Albian unconformity, Oman (Warrlich et al., 2010). The origin of this porosity is unclear and its distribution can not be correlated regionally. Porosity enlargement because of subaerial exposure of the Shuaiba carbonates prior to the deposition of the overlying Nahr Umr shales has been proposed, (Warrlich et al., 2010). However, leaching adjacent to small fractures is observed in cores, suggesting late burial dissolution by corrosive fluids undersaturated with respect of calcite probably influenced porosity and permeability enhancement. These fluids could have been channeled beneath the low permeability Nahr Umr. Alternatively, dissolution following expulsion of saline pore water from Nahr Umr shales into the Shuaiba carbonates during compaction might have caused the porosity development.

This study aims to explore the processes responsible for porosity enhancement and to map the distribution of the porosity in number of fields using petrographic and geochemical analysis. The preliminary analysis demonstrates a complex history of porosity modification at the Aptian-Albian unconformity across the fields, controlled by depositional and diagenetic processes. Porosity improvement caused by dissolution of rudist dominated-facies might be related to near surface meteoric diagenesis. Reduction of porosity takes place by neomorphism, compaction, calcite cementation of primary and secondary porosities and pyrite mineralization, particularly in eastern most fields. Post compaction burial dissolution of all facies enlarged primary porosity (i.e. matrix microporosity, interpartical and intrapartical porosity). Solution-enlarged microfracture porosity postdates chemical compaction features documented almost in all fields.

Warrlich, G., Hillgartner, H., Rameil, N., Gittins, J., Mahruqi, I., Johnson, T., Alexander, D., Wassing, B., van Steenwinkel, M and Droste, H., in press. Reservoir characterisation of data-poor fields with regional analogues: A case study from the Lower Shu'aiba in the Sultanate of Oman. *GeoArabia Special Publication*, 4

Improving and assessing vapour pressure estimation methods for organic compounds of atmospheric relevance through Knudsen Effusion Mass Spectrometry (KEMS)

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Aerosol particles influence climate directly through the scattering and absorbing radiation and indirectly through their role as cloud condensation nuclei (CCN). Traditionally, models aiming to capture the behaviour of aerosols in the atmosphere have concentrated on the role of inorganic compounds. However, organic components, covering a huge range of chemical and physical properties (Jacobson *et.al.*, 2000), may constitute a significant fraction depending on location (Houghton *et.al.*, 2001).

Knowledge of pure component vapour pressures is essential for calculations of gas/particle partitioning. There are many methods of estimating vapour pressures but most of the experimental data

collected to date has been for intermediate or high pressure compounds (and often measured at temperatures considerably above ambient) and the proportion of experimental data for low (less than 100Pa) vapour pressure compounds has been very small. Knudsen Effusion Mass Spectrometer (KEMS) has been used to measure solid state vapour pressures for multifunctional organic compounds based on dicarboxylic acids (*Booth et al 2009*). In the atmosphere these compounds are likely to exist in the sub-cooled state so Differential Scanning Calorimetry (DSC) was used to obtain thermochemical data to effect a correction between solid and sub-cooled vapour pressures. A sensitivity study was undertaken to establish the impact of the new experimentally determined vapour pressures on partitioning models.

Jacobson, M.C., et al. *Rev Geophys.*, 38 (2), 267-294, 2000.

Houghton et al. *Climate Change 2001: The Scientific Basis. Contribution of Working Group 1 to the Third Assessment Report of the IPCC.*, 881 pp., Cambridge University Press, 2001.

Johnson, D., et al. *Atmo. Chem. Phys.*, Vol. 6, 419-431, 2006

Yu, J. Z., et al. *J Atmos Chem.* 34, 207-258, 1999

Booth, A.M. et al *Atmos. Meas. Tech.*, 2,355-361, 2009

Nanoolal, Y. et al *Fluid Phase Equilibria*, 269,117-133., 2008.

Barley, M. et al *Atmos. Chem. Phys.*, -,to be submitted.

Microbial ecology and biogeochemistry of nuclear waste storage facilities

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The UK nuclear waste legacy consists of complex and heterogeneous wastes contaminated with both radioactive isotopes and toxic, stable co-contaminants. Microbial metabolism has the potential to drastically alter the chemistry of radioactively contaminated environments, complicate waste storage management, altering the structure of nuclear waste storage materials and controlling radionuclide speciation and mobility.

This study aims to explore the microbial ecology and biogeochemistry of extreme environments associated with radioactive waste forms, focusing mainly on two contrasting pond facilities used for nuclear fuel storage at Sellafield.

Water samples from the two ponds were collected and filtered through 0.2 µm membranes. DNA extraction and amplification of the highly conserved 16S rRNA phylogenetic marker gene preceded cloning and sequence analysis. Samples from the indoor pond revealed very low species diversity with an organism most closely related to an uncultured Fe(II)-oxidising *Gallionella* species detected as the dominant bacterial species. The outdoor pond water sample analysis conveyed a far greater species diversity with 72 different bacterial families detected and Bacteroidetes and Cyanobacteria the principle phylogenetic groups. This was consistent with several potential external inputs into the pond, including bulk and trace nutrients, into the pond from a range of sources, and also the stimulation of photosynthetic organisms by sunlight.

The identification of these dominant species of microorganisms is an important first step in developing a greater understanding of the pond ecology, and will in turn help to develop a method to control the microbial productivity in the ponds. The results from this study will also lead to a greater understanding of the interactions of radioactive waste with the biosphere and the fundamental role of microorganisms in controlling the environmental behaviour of radionuclides in key UK waste forms.

Legacy Industrial Solid Waste Impacts on Water Quality around Northwich, Cheshire

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As part of a wider study aimed at investigating the impact of 'legacy industrial solid waste' (LISW) on the urban and rural environment around Northwich, 3 'snapshots' of water quality were taken under different seasonal flow conditions. The 375 hectare, study site, has played host to the salt mining industry for 300 years and has also been associated with the heavy chemical industry for over 200 years. The site is cut by 4 water courses: River Weaver, Witton Brook, Marbury Brook and Forge Brook, among which the Weaver is the largest. Historically, the dumping of waste from brine evaporation activities and the Leblanc and Solvay processes for soda ash production on adjacent land was unregulated leading to substantial accumulations of LISW. The purpose of the water sampling was to assess the changes in water chemistry as the courses pass through the LISW accumulations under different seasonal flows. 25 locations for water quality sampling were identified on the network of water courses. The national grid reference for each location was marked by GPS and recorded in a GIS database. For Each snapshot, (winter, spring and summer) each location was sampled on four occasions at different time intervals. Samples were analysed for a range of parameters including pH and conductivity; anions and cations were determined using (ICP-AES) and (IEC). The analyses reveal the elemental signature of LISW components leached from the tips, superimpose on that of the underlying halite geology. In addition, the consequences of upstream industrial activity were observed.

Burial Diagenesis of Fractured Carbonate Systems, Lower Carboniferous, North Wales

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Determining the storage and flow capacity within carbonate reservoirs is a major objective in hydrocarbon exploration and production. Where seismic and well data are unavailable, outcrop analogue and diagenetic studies can be used as a guide for understanding the development of paleohydrological systems with respect to basin evolution. This combination is prerequisite for realistic basin analysis and to guide any geochemical and fluid flow modelling. This study is concerned with constraining the relationship between the diagenetic evolution of fracture and matrix-pore networks in the context of regional and basinal structural evolution of Lower Carboniferous carbonates of the North Wales Platform, UK.

By combining outcrop, petrographical and isotopic investigations, we demonstrate the gradual, pervasive destruction of primary and secondary porosity by fracture related, 'hydrothermal' dolomite and the high degree of heterogeneity in a tight limestone system.

Early diagenesis is recorded as a series of marine and meteoric cements. Subsequent burial cements include vein and interparticle calcite and dolomite, which are contemporaneous with Pb-Zn mineralisation and thought to be deposited during the Variscan Orogeny. Late meteoric intercrystalline cements were deposited post burial. Finally, cross-cutting open-fractures that provide minor improvements in porosity were produced during a secondary, post-Permian, uplift event. (See Figure.1)

Fractures within the North Wales, Lower Carboniferous host rock provided important conduits for the circulation of diagenetic fluids which modified the porosity and permeability of the network and, to a lesser extent, the surrounding matrix. The results of this study have important implications for the understanding of fluid flow in fractured and dolomitised hydrocarbon reservoirs and the exploration of Mississippi Valley Type (MVT) ore deposits.

Bioreduction and reoxidation of biotite and chlorite and effects on sorption of Cs and Sr

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Nuclear power generation offers an alternative to use of fossil fuels, however, it produces highly radioactive short and long-lived ($>10^5$ yr) wastes. The UK already has a large legacy of radioactive waste (including weapons related) and contaminated materials (NDA, 2008). Historical handling and storage of the waste aboveground has led to major soil and water contaminations (e.g. Hanford Site, USA (Zachara *et al.*, 2002)). Geological disposal in a multi-barrier underground waste repository and is now the UK's long-term management strategy (DEFRA, 2008), nonetheless the potential exists for radionuclides to return to the surface before they have decayed to safe levels. A thorough understanding of radionuclide interactions with minerals and microorganisms is required to manage the nuclear waste legacy and plan the safest geodisposal options.

As part of a larger study of radionuclide mobility in the subsurface, the effects of pure cultures of model Fe(III)-reducing bacterium *Shewanella oneidensis* MR1 on the iron-bearing phases biotite and chlorite were investigated. Biotite and chlorite are recognised as key mineral phases in subsurface environments that can control radionuclide mobility. Microbial redox reactions involving iron are important for the stability and properties of these minerals and radionuclide behaviour.

Time course anaerobic batch experiments were conducted. Bioreduction was stimulated by addition of lactate as an electron donor, and oxidation by addition of nitrate to act as an electron acceptor. Changes in sorption capacity were studied by monitoring aqueous, isotopically stable, Cs and Sr concentrations (as analogues for highly radioactive Cs-137 and Sr-90) during the microbial activity. Redox reactivity of the minerals after maximal bioreduction or oxidation was probed using Cr (VI), as a non-radioactive proxy for redox-sensitive radionuclides.

Results show that microbial reduction of structural iron in biotite and chlorite is achieved and promotes mineral dissolution, resulting in a change of active sites on the mineral. Sorption to chlorite is affected more strongly than that to biotite. Microbial redox cycling affected Sr sorption more strongly than Cs sorption suggesting a difference in the adsorption mechanisms. The results show that microbial redox cycling in the subsurface has the potential to significantly impact the interactions between radionuclides and minerals.

DEFRA. (2008) Managing radioactive waste safely a framework for implementing geological disposal. In DEFRA, Ed. TSO, Norwich.
NDA. (2008) The 2007 uk radioactive waste inventory; main report. In N.D. Authority, Ed. *Defra/RAS/08.002; NDA/RWMD/004*, p. 130, UK.

Zachara, J.M., Smith, S.C., Liu, C.X., McKinley, J.P., Serne, R.J., and Gassman, P.L. (2002) Sorption of cs^+ to micaceous subsurface sediments from the hanford site, USA. *Geochimica Et Cosmochimica Acta*, **66**, 193-211.

Seismic characterization of a bottom simulating reflector (BSR) and plumbing system in the Cameroon margin, West Africa

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3D seismic data analysis of the Cameroon margin offshore West Africa reveals a large area of gas hydrate occurrence, including High Gradient Slope (HGS) and Low Gradient Slope (LGS) areas. A Bottom Simulating Reflection (BSR) from the top of free gas beneath gas hydrate bearing sediments is well imaged seismically and shows systematic variations in reflection strength. The gas hydrate occurs over an area of approximately 350 km² in water depths ranging from 500 – 1500 m. The depth below the

seafloor ranges between 0.09-0.21 s TWT, increasing with increasing water depth. The characteristics of the BSR and its relationship with other geological features such as gas chimneys, channel systems and pockmarks have been synthesised. In the LGS, the presence of a strong BSR is associated with gas chimneys, single pockmarks and high amplitude reflections below it. The high amplitude reflections intermediately underneath the BSR indicate the presence of free gas, trapped under the GHSZ seal, creating a high velocity contrast, thus strengthening the BSR. These high amplitude reflections extend 400 ms TWT further down and are interpreted as a complex channel system. In the HGS, the BSR is comparatively weak and is associated with pockmark trains and pockmark clusters at the seafloor. The weakness of the BSR is likely caused by the lack of trapped free gas beneath the BSR.

A widespread distribution of seabed pockmarks is also observed and is classified into three styles defined by their appearance and distribution: (1) single pockmarks, (2) pockmark trains, and (3) pockmark clusters. Each style of pockmarks relate to a particular type of migration pathway which can be used to explain the migration mechanism delivering gas to the shallow succession thus feeding the gas and gas hydrate seal.

Improved Prediction of Risk from volatile organic compounds

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Volatile organic compounds (VOC's) have a variety of negative impacts on human health (Harold, 1998; Barbara *et al*, 2007), some (e.g. benzene and formaldehyde,) are known to be human carcinogens (IARC, 2004). There is, therefore, often a pressing requirement to monitor these compounds. However, monitoring these compounds is not straightforward as their concentrations vary with environmental parameters such as temperature, barometric pressure and groundwater movement. Because of this, the sampling frequency that is used at present is ineffective for determining their representative concentration, therefore, a device which can be left in-situ to collect high temporal resolution data has been developed (gasclam, Ionscience, UK). VOC's are measured by PID, however, PID measures aggregated VOC concentration. Because VOC's have differing toxicities and behaviours, individual identification is required, therefore, a sample must be collected. In order to do this, a sorbent material must be used to transfer the sample to the GC-MS for identification. The sorbent material must be appropriate for the range of VOC's and of sufficient capacity for extended exposure (BS EN ISO 16017-1:2001). The objectives of the work are therefore:

- i. Selection of appropriate sorbent for incorporation into a dual measurement VOC monitoring device, then to use the instrument to
- ii. Derive the optimum VOC monitoring methodology.

Barbara L. Rowe, Patricia L. Toccalino, Michael J. Moran, John S. Zogorski, and Curtis V. Price. 2007. Occurrence and Potential Human-Health Relevance of Volatile Organic

Compounds in Drinking Water from Domestic Wells in the United States. *Environmental Health Perspectives* 115:1539–1546.

IARC, 2004. International Agency for Research on Cancer (IARC), overall evaluation of carcinogenicity to humans, IARC monographs vol. 1-88.

Harold, J. R. 1998. *Odor and VOC Handbook*. McGraw-Hill publishing Companies, USA.

BS EN ISO 16017-1:2001

Indoor, ambient and workplace air. Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography. Pumped sampling.

Sedimentary Response to the Evolution of Mobile Substrates on Continental Margins

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Deformation above mobile salt along continental margins results in a complex array of structures that have a profound effect on seafloor geomorphology. Such deformation, typically expressed as up-dip extensional growth faulting, and rafts, that passes down slope into salt walls, diapirs and allochthonous salt sheets and, in lower slope settings, deepwater fold and thrust belts. Although the geometry and timing of individual structures is complex, at the margin scale, deformation is diachronous, with a general basinward-younging in the timing of deformation. This margin-scale down-dip variability of deformation style and timing leads to marked differences in the response of turbidite channel complexes to embryonic and pre-existing salt related structures. It also exerts a strong control on the location, size, geometry and stacking patterns of potential reservoir units in deepwater settings. This presentation utilises a regionally extensive 3D seismic volume to illustrate the response of the Oligo-Miocene stratigraphic succession to salt-related deformation along the West African margin.

Case studies from the autochthonous domain of the Lower Congo Basin (a salt influenced passive margin) are utilised to improve our understanding of the response of depositional elements to the evolution of salt diapirs. Conventional seismic interpretation, spectral decomposition, multi-attribute blending and iso-proportional slicing techniques have been applied to the seismic volume to identify and image discrete depositional elements within the Oligo-Miocene interval. This are then related to the dynamic or passive salt induced palaeo-topography, with the creation of models that can be utilised to enhance exploration efforts in subsalt hydrocarbon plays (e.g the Paleogene Wilcox Group, Gulf of Mexico) with poor geophysical imaging.

Black carbon measurements from field and lab-based biomass burning

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Black carbon (BC) aerosol plays an important role in global and regional climate, and has been described as the second strongest contributor to global warming (Ramanathan and Carmichael, 2008). Biomass burning accounts for a significant fraction (40%) of global BC emissions, both from wildfires and human activities such as slash-and-burn deforestation, crop-residue burning and prescribed fires used for land management. Trace gas and aerosol emission factors, including BC, change with different combustion conditions (e.g., Yokelson et al., 2003; McMeeking et al., 2009; Reid et al., 2005), and thus the amount of BC in smoke shows considerable variation. Further understanding of these areas will lead to improvements in the treatment of biomass burning BC in global climate models and more accurate predictions of its impacts on climate and visibility.

We investigated these issues using a combination of field- and laboratory-based measurements made with a Single Particle Soot Photometer (SP2) (Droplet Measurement Technologies, Boulder, Colorado). During the field study, the SP2 was mounted on the US Forest Service (USFS) Twin Otter aircraft and flown through smoke plumes from 6 prescribed fires in California in November 2009. Plumes were sampled on scales ranging from near-source to 60 km downwind.

The BC field measurements are compared with laboratory-based SP2 measurements of BC emitted by a series of burns conducted at the USFS Fire Sciences Laboratory in September/October 2009. Several of the fuels tested in the laboratory are representative of species found in the chaparral and montane regions examined in the aircraft-based study.

This work was supported by the US Dept. of Defence grant SI-1648, a Royal Society International Travel Grant and a UK Natural Environment Research Council Doctoral Training Grant.

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Identifying the optimal use of renewable power technologies via high-resolution, spatially-explicit modeling

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The cost-effectiveness of renewable power technologies depends on a range of socioeconomic, geophysical, and technical factors that vary over space and time. This spatiotemporal complexity makes it difficult to identify long-term strategies for exploiting and integrating available resources, especially when considering large areas over many years. Yet recognizing likely barriers or unimagined opportunities is critical to minimizing the cost of a large-scale transition to renewable energy and averting greenhouse gas emissions.

The recent development of high-resolution spatial datasets and low-cost “cloud computing” enable detailed modeling of renewable power deployment worldwide. By integrating information on terrain, the built environment, weather conditions, and diurnal variation in electricity markets, such modeling can help identify the optimal use of available technologies. Model outputs include the particular deployment patterns, technologies, and transmission infrastructure that minimize the cost achieving economic and environmental objectives. This information can inform energy subsidy strategies, research and development funding, and planning for transformational projects.

This ongoing work builds on previous research on utility-scale solar power modeling and will be part of a M.S. thesis to be completed next Spring as part of the MESPOM program supported by SEAES.

Sedimentary Characterisation and Depositional Mode of the Messak Fm, SW Libya

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The Late Jurassic-Early Cretaceous Messak Fm outcrops along the northern and western flanks of the Murzuq Basin of southwest Libya. The formation outcrops spectacularly along the Jebel Messak

Escarpment which extends for over 500km with an average exposure thickness of 250m. Little previous work has been carried out upon the Messak Fm. However, it has been considered to represent the deposits of a long lived braided fluvial system that dominated the North African margin for much of the Mesozoic era.

Here, we present the preliminary results collected over two field seasons in which 13 sections have been logged and correlated along a 100km transect on the western edge of escarpment. Two members are identified and represent a transgressive-regressive episode. The lower, overall transgressive, member displays a marked fining-up sequence from amalgamated sandstones bodies to isolated sandstone and heterolithic bodies to massive mudstone in the maximum flooding zone. The lower member is overlain by an overall regressive upper member. This member is dominated by amalgamated medium-coarse cross-bedded sandstone units with interbedded heterolithic packages.

This presentation will examine the key facies of the Messak Fm and identify the major facies associations. Through log correlation we illustrate facies variation both in proximal-distal and lateral trends. We present arguments for multiple phases of marine incursion into the Murzuq Basin during the Early Cretaceous, pushing back the known palaeocoastline by over 600km. Finally, we will discuss implications for palaeoenvironmental reconstruction and challenges this poses with regard to previous interpretations of the Messak Fm.

Poster Abstracts

Role and nature of organic matter in the mobilisation of arsenic in shallow reducing aquifers of Taiwan and Vietnam

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Exposure to high levels (>10 ppb) of arsenic (As) in drinking waters is affecting the health of millions of people and the death of thousands (Ravenscroft et al. 2009). The precise mechanism by which As is mobilized into the waters of shallow reducing aquifers is still a matter of debate. However, it is believed that microbes may play a key role in this processes through the reductive dissolution of As-bearing Fe(III) hydrated oxides and/or the reduction of sorbed As(V). The critical role of degradable organic matter (OM) in this process has recently been highlighted to be a major controlling factor driving As release in shallow reducing aquifers (Rowland et al. 2009).

Recent studies, in both Cambodia and West Bengal, revealed that the OM present at depth in these aquifers is likely derived from multiple sources including petroleum derived hydrocarbons naturally seeping into these shallow aquifers from depth (Rowland et al. 2006, 2007; van Dongen et al. 2008). However, these studies were only performed on a selected number of samples and it's presently unclear how common these OM contributions are to other As rich aquifers. In the present study, samples from two other As hotspots from south-western Taiwan (Yichu) and from Vietnam (Van Phuc) were analysed. GC-MS analyses showed, comparable to previous studies, OM contributions of both (immature) plant origin and (mature) petroleum origin at depth in these aquifer sediments. This suggests that potential OM sources, as suggested by van Dongen et al. (2008) for the aquifers in Cambodia and West Bengal, are more common in these types of aquifers.

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The involvement of Microorganisms in the formation of Ferromanganese Nodules

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Since their initial discovery during 1868, the formation mechanisms of ferromanganese nodules have been subjected to intense debate. Arguments focus on the relative roles of abiotic and biotic processes involved in accretion; abiotic mechanisms cited include hydrogenesis and diagenesis (Dymond et al. 1984) whereas biomineralisation is considered important by many, for instance in the formation of iron sulfide nodules (van Dongen et al. 2007). This study investigated the involvement of microorganisms in the formation of these nodules by searching for relevant biomarkers in nodules collected from the southwestern Indian Ocean using

techniques such as gas chromatography mass spectrometry (GC/MS), infra-red (IR) analysis and electron probe microanalysis (EPMA).

GC/MS analyses indicated that the organic matter (OM) present within the nodules was dominated by material of terrestrial origin (*n*-alkanoic acids, *n*-alkanols and specific sterols) and only a limited number of microbial specific biomarkers were detected. In addition, the presence of an unresolved complex mixture, *n*-alkanes with a low carbon preference index and hopanes dominated by the $\alpha\beta$ -configuration, suggested the presence of mature OM, comparable to that in nodules analysed from the gulf of Cadiz (González et al. 2009). Attenuated total reflection IR mapping, showed that the OM was entirely concentrated within the layers of concentric mineral banding and not in the nodules 'seed' nucleus. Mapping of the elemental distribution using EPMA indicated no correlation of organic and inorganic components. The combined results suggested that these nodules are most likely formed via an abiotic process and appear to be a sink for both terrestrial and mature OM in the deep ocean.

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The use of Fourier Transform Infrared spectroscopy techniques in palaeobiochemistry

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The study of chemistry in the fossil record is a comparatively young subject, particularly in vertebrates; however with increasingly adept and accurate technology and ever more complete and well preserved specimens available its pursuit is becoming more and more popular. Many studies have employed the use of techniques such as Gas Chromatography Mass Spectrometry (GCMS) in order to identify the chemical composition of fossil plants (Gupta et al. 2007), invertebrates (Stankiewicz et al. 1997) and vertebrates (Manning et al. 2009). Whilst a very effective and well honed technique it has the unfortunate consequence of being destructive. Many fossils are iconic and rare, and ironically the samples best suited for this type of analysis are generally the rarest and most precious, generally precluding their availability for destructive analysis. One potential answer to this conundrum comes from Fourier Transform Infrared spectroscopy (FTIR) which has been used in organic chemistry for many years. Its primary advantage over more traditional analytical methods being that it is non-destructive and therefore opens the door to the study of many more potential samples that previously would have been denied organic geochemical analysis. By using this technique major leaps forward can be made in understanding the palaeobiochemistry of extinct life.

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The impact of radiation fluxes on microbial cells

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Ionizing radiation leads to the production of significant quantities of reactive oxygen species and both oxidizing and reducing radicals, particularly in environments of relevance to nuclear waste storage facilities. These species have the potential to interact with a huge array of microbial bio-molecules which may ultimately lead to deleterious physical consequences. In contrast, high radiation fluxes have been shown to be tolerated by a few specialist micro-organisms with highly active DNA repair mechanisms such as *Deinococcus species*. Furthermore, exciting new data suggest that ionizing radiation can have unexpected beneficial impacts on microbes such as fungi, which may be able to convert ionising radiation into biochemical energy via pigments such as melanin. However, the mechanisms by which biological systems survive genetic and metabolic radical attack along with potential stimulation by ionizing radiation are poorly characterized. This research project will utilise highly focused metabolomic techniques to deliver fundamental physiological information on biochemical mechanisms that underpin cellular protection against radiation damage and novel energy metabolism. An initial phenotypic screen using Fourier transform infrared spectroscopy of cells exposed to a range of radiation doses will be utilised, followed by targeted mass spectrometry based methods.

Biogenic Magnetic Nanoparticles: Development and tailoring for potential applications

Byrne, J. M.

Magnetic nanoparticles have been shown to have enormous potential in many areas of research and technology including data storage, drug delivery, cancer therapy and environmental bioremediation. Small particle size and magnetic properties render them ideal candidates for such applications, however it is important to be able to manipulate these characteristics in order to tailor them to specific needs. A variety of different routes can be used to produce the particles, with the reduction of Fe(III) bearing minerals by anaerobic bacteria such as *Geobacter sulfurreducens* being an effective and environmentally friendly method of producing magnetite, as used in this research project. It has been shown that modifications, such as the inclusion of dopants, for example zinc or cobalt within the magnetite structure, and manipulation of other parameters enable the control of particle size and magnetic properties of the nanoscale biominerals.

Many different techniques have been used to analyse the particles such as Transmission electron microscopy (TEM) and X-ray diffraction, however it is only through X-ray absorption spectroscopy (XAS & XMCD) at synchrotron sources, and superconducting quantum interference device (SQUID) magnetometry that the source of magnetism within the particles can be fully explored. This work aims to describe the type of changes that occur in the samples of magnetite with the inclusion of dopants focusing on modifications of their physical and magnetic properties.

In-situ* and *ex-situ* measurement of greenhouse gas fluxes from upland peat*Do, P.D., Robinson C.H., Boulton S., Polya D.A. and van Dongen B.E.**

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Atmospheric carbon, specifically CO₂ and CH₄, is implicated in climate change. However, soil, particularly peat, is a much larger store of carbon. The amount of carbon in soils is being altered by changing land use and management (Bellamy et al., 2005), and these changes are particularly recognised in upland peat (Martin & Jeff, 2005). Carbon fluxes from peat may, therefore, be relevant to climate change.

At eroded and non-eroded sites in the Crowden Great Brook catchment (Peak District, UK), gaseous carbon fluxes have been quantified by *ex-situ* measurement and validated *in-situ* (measured at hourly intervals in boreholes screened at different depths). Peat from different depths was incubated under anaerobic conditions at 10 °C and CH₄ and CO₂ concentrations were measured periodically over 162 days.

The *in-situ* CH₄:CO₂ ratio was similar to that *ex-situ*, therefore validating the latter. Production of both gases was greater at the uneroded than the eroded site. The greatest production of both gases was in the upper layer of the uneroded site: 0.02 CH₄ and 0.071 CO₂ mol tonne⁻¹ day⁻¹. At the eroded site, CH₄ production was greatest in the lowest layer, 0.01, while CO₂ production was greatest in the upper layer 0.042 mol tonne⁻¹ day⁻¹.

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Landscape Response to Active Extensional Faulting and Multiple Local Base Levels: The Perachora Peninsula, Eastern Gulf of Corinth, Greece**Duffy, O. B^{1*}, S. H. Brocklehurst¹, R. L. Gawthorpe², E. Finch¹, M.R. Leeder³**

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We integrate digital topographic analysis, remote sensing and field observations of an active extensional terrain in the eastern Gulf of Corinth, to elucidate the controls upon spatial and temporal variations in transient landscape evolution. The ~130 km² Perachora Peninsula is characterised by a suite of E-W trending, mainly northward-dipping normal faults. Interplay between onshore and offshore normal faulting, ongoing regional uplift and eustasy has resulted in a series of reconfigured and diverted drainage networks, with sediment dispersal patterns characterised by trapped endorheic lakes.

Quantitative fluvial profile analysis was performed on a 20 m ground-truthed SPOT DEM, with the longitudinal profiles of 138 ephemeral bedrock streams extracted. Profiles were analysed to determine the size, elevation and distribution of significant long profile convexities (knickpoints) and to develop a map of normalised channel steepness. In addition, field mapping of faults, gorges, wind-gaps, abandoned landscapes, alluvial fans, drainage reversals and drainage capture was conducted to provide details on geomorphic variability across the area and to delimit non-equilibrated portions of the landscape. Using this evidence, along with observations from the planform drainage network, we classify a series of distinct geomorphic domains and deconvolve the key controls and processes which have resulted in such variability in landscape form.

The rich variability of controls across the area allows us to determine: i) the role of multiple base levels in controlling landscape evolution and sediment dispersal; ii) active processes in structural relay zones;

and iii) insights into the sequence of tectonic events. Our results emphasise how the ongoing evolution of an extensional fault terrain over time-scales of hundreds of thousands of years results in a complex drainage system modified by abandoned landscapes, internal drainage, and steep knickzones. In addition, we demonstrate how tectono-geomorphic observations from modern field analogues can provide a detailed framework which is applicable to the study of ancient rift systems.

The geomorphology of Antarctic submarine slopes

Gales, J.

The accelerating flows of ice streams around West Antarctica are today contributing to approximately 10% of the observed increase in global sea level (Rignot et al. 2008). Ice streams are responsible for up to 90% of all ice and sediment drained from the Antarctic ice sheet and therefore have a profound effect on sediment delivery to continental margins whilst also influencing ice sheet dynamics. Understanding the processes operating on Antarctic continental margins is essential for interpreting the depositional record and ice dynamic history which has the potential to be used for testing and refining numerical models that will predict Antarctic contributions to future sea-level rise.

Sedimentary deposits around Antarctica contain a record of varying ice-sheet extent, sub-glacial processes, past erosion and climate change. Slope processes modify this record through erosion, remobilisation and deposition. It is evident from multibeam swath bathymetry data that different morphological styles exist along the Antarctic continental margin. Quantitative methods are used to distinguish these morphological styles, with the aim of determining whether morphological styles relate to different processes on Antarctic submarine slopes. This will allow past routes of sediment delivery to be mapped, which in turn will help constrain where palaeo-ice sheets extended to the continental shelf edge, and permit interpretation of past subglacial processes and ice dynamic history from the depositional record. Knowledge of how the Antarctic ice sheets responded to past climate change is critical in understanding and predicting ice sheet sensitivity to future change.

Linking onshore and offshore erosion and sediment transport in the Ionian coastline of NE Sicily and SW Calabria, Italy

Goswami, R.

The Sicilian and Calabrian coasts either side of the Strait of Messina in southern Italy provide an opportunity to observe the response of subaerial drainage systems to variations in bedrock erodibility and uplift rate. Offshore processes include hyperpycnal currents derived from onshore drainages, as well as longitudinal flow along the Messina Channel. The narrow continental shelves allow a direct connection between these onshore and offshore processes.

NE Sicily and SW Calabria are mainly composed of granite, high-grade gneiss, limestone and meta-pelite. Published Late Pleistocene to Holocene uplift rates from bedrock terraces and erosional notches indicate that uplift rates increase away from the Strait, on both sides. Digital topographic analyses reveal that, on the Sicilian side, longitudinal channel profiles exhibit generally concave upward trends with many locally steep reaches (knickpoints). Many of the large scale knickpoints (150-200 m in height) occur at drainage areas below the transition from debris-flow dominated colluvial channels to stream-flow dominated fluvial channels. There is a positive but weak correlation between channel steepness and uplift rate. This correlation is strongest near the drainage divide, with a weaker correlation downstream, where a major shear zone generally reduces the bedrock resistance, irrespective of lithology. The distribution of landslides has been mapped on both sides of the Strait of Messina using aerial photography, revealing contrasting controls on landslide distribution. In Sicily, landslides are most frequent where uplift rates are most rapid and rainfall heaviest. The Calabrian landscape is less incised, so landslides are confined to valley sides, with low-relief interfluvies free of landslides.

Offshore, geomorphic features have been characterised from multi-beam bathymetric and Chirp data. The central feature is the Messina Channel, which runs north-south. Although the channel does not meander prominently, alterations of its course due to slumping and mass wasting are inferred from the arcuate surfaces bounding it. The Chirp data suggest undermining of the channel wall by sedimentary flows passing down the channel. The continental slopes are heavily gullied with prominent converging patterns of rills and gullies forming confluences at canyon heads. Our findings suggest that submarine channels associated with large, rapidly-uplifting, landslide-prone rivers receive higher sediment fluxes, and are characterised by canyons with broad channels and graded longitudinal profiles. In contrast, submarine channels that lie offshore small rivers (nearer the Strait) are characterised by low relief channels with steep gradients. The combination of multi-beam bathymetry and Chirp data allows us to evaluate the interaction between active tectonics, large currents descending the Messina Canyon, and sediments derived from the Sicilian and Calabrian coasts in shaping the evolving morphology of the Ionian Sea floor.

Determination of the evidence for Thermochemical Sulphate Reduction in the Miskar Field, Offshore Tunisia.

Hirani, J.

The Miskar Field, offshore Tunisia produces gas from the Turonian R1 Inferior carbonate reservoir that containing large volumes of H₂S that appear to increase with depth. The source of the H₂S may be a function of Thermochemical Sulphate Reduction (TSR). TSR involves the redox reaction between sulphate (anhydrite) and petroleum fluids at elevated temperatures (80-100°C < T < 150-200°C), producing H₂S which also generates hydrogen ions i.e. acid, resulting in the dissolution of carbonate host rocks (late stage corrosion). Other products of TSR include anhydrite replacive milky calcite, saddle dolomite, metal sulphides, bitumen, elemental sulphur and water. The R1 Inferior carbonates comprise of a coarsening, shallowing upwards succession, deposited within a transitional outer ramp to backshoal (salina/sabkha) setting. Detailed petrographical analysis of the reservoir interval has identified early dolomitisation that has locally improved reservoir quality, with no evidence of TSR saddle dolomite present. The main calcite cement phases present include an isopachous fringing cement, interpreted to have formed within a marine diagenetic environment. Coarse sparry calcite cements are opaque in core specimen and display internal zonation under cathodoluminescence, with no evidence of typical TSR milky calcites present. These cements are thought to have formed in an early burial diagenetic environment. The majority of the anhydrite present does not show evidence of replacement by TSR carbonates. Although pyrite is present throughout the reservoir interval, and there is evidence of late stage corrosion occurring, these are not convincingly TSR related. Based on petrographical analysis, there is no conclusive evidence for TSR occurrence. Burial history curves indicate a maximum present day temperature of approximately 189°C, at 3800 m burial depth. Even though these are ideal conditions for TSR to occur, the base R1 Inferior reservoir has not been within the TSR threshold for a significant amount of time for TSR occur. The main reactant, anhydrite, is present in relatively minor quantities within the reservoir for the redox reaction between the sulphate and hydrocarbons to occur at a feasible rate. The lack of anhydrite may therefore be a limiting factor, which effectively 'chokes' the TSR reaction from occurring.

Bioremediation of plutonium contaminated land

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The release of radionuclides from anthropogenic sources is of great scientific and public concern. The biogeochemical behaviour of Pu in contaminated soil was investigated in this study as microbial processes have the potential to mobilise Pu via the reduction of Pu(IV) to the potentially more mobile Pu(III). Microcosms containing Pu contaminated soil from an industrial site were constructed and the native bacterial community stimulated using glucose. Both fermentation and anaerobic respiration processes were stimulated in the microcosms and monitored over 118 days. A shift in the 16S rRNA gene profile was observed, with the dominant group changing from acidobacteria at time zero to betaproteobacteria at day 45. Clostridia, which are known fermentors and have been reported to facilitate the reduction of Pu(IV) to Pu(III) were not detected at time zero, but increased to 19% of the genetic profile by day 45. Despite the biogeochemical changes in the microcosms, negligible Pu was released into porewaters. This information is important for developing remediation options for Pu-contaminated soils, which may include managing legacy Pu in situ but not mobilisation via the stimulation of metal-reducing bacteria in situ.

Airborne measurements of organic and inorganic acids by chemical ionization mass spectrometry

Le Breton, M.

Atmospheric organic and inorganic acids were measured by chemical ionization mass spectrometry (CIMS) on the FAAM Bae-147 aircraft over the UK during July 2010. The I⁻ chemistry was used for ionization of the acids with detection limits in the ppt range and at a time resolution of less than 1 second. Distinct plumes of the carboxylic acids and nitric acid were found downwind of heavy industrial areas such as London and Tyneside, correlating well with increased NO_x and CO concentrations. The acids were anti-correlated with ozone for most of the measurement campaign, although some plumes did correlate with ozone. This will be investigated and could be a sign of different sources. Back trajectory modelling is being used to examine the possible organic acid sources using the meteorological conditions. Seasonal variations will be investigated by comparing observations made in December 2009 and July 2010. Lower concentrations are expected in the winter months as the main removal process of these gases is thought to be through wet deposition. Comparison of day and night time observations will also allow the investigation of effects of photochemistry on the acids. Vertical profiles of the gases are also to be presented.

Seismic Geomorphology of Plio-Quaternary Deposits offshore Angola

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A regionally extensive three-dimensional (3D) seismic dataset from the continental margin in deepwater offshore Angola has been utilized to analyse the seismic stratigraphy and geomorphology of Plio-Quaternary deposits from a 8,000 km² portion of the Lower Congo Basin. Our study area lies in the translational domain within this salt influenced passive margin, with extensive deposition of salt during the Aptian. The Plio- Quaternary stratigraphic succession has been sub-divided into 3 seismic units S1, S2 and S3. A Laterally extensive Mass Transport Deposit (MTD's) occurs within unit S1 and shows evidence of incision into the underlying Miocene deposits. After deposition of the basal unit S1, fold belt degradation resulted in the emplacement of frontally emergent mass transport deposits which are displaced for relatively short distances, and show marked topographic relief relative to the coeval undisturbed strata within the sequence.

Populations of normal faults (predominantly polygonal in plan view) occur within unit S2, and are stratigraphically confined to this interval, suggesting the sediments are mud dominated. Subtle variations

of palaeo-stress conditions induced by salt diapiric movement affect the alignment of the faults, resulting in both uni-axial and multi-axial extension. Deposition of regionally extensive multi-layered MTD's also occurs within this interval, with evidence of palaeo-pockmarks suggesting possible venting of hydrocarbons during this period. Sediment routing is influenced by a series of Cretaceous faults which detach off the Aptian salt, and propagate upwards through the stratigraphy into the Miocene interval. Subsidence on these faults, coupled with the bathymetric relief of the MTD's, and differential compaction of sediments above the mass wasting deposits in sequence S1 exerts a strong control on subsequent gravity flows and alter the continually evolving slope topography. Pronounced halokinetic activity within the study area is observed by the marked onlap of sediments within unit S3 onto growing limbs of salt cored fold-belts. This study discusses the evolution of the mapped elements within the Plio-Pleistocene succession, and implications for the viability of this interval as a regional seal for the prolific Miocene interval.

Diagenesis, sediment mobilization and fluid flow Controls: Implications for Oligocene-Miocene sediment deformation

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The study area (11,000 km²) is within the prolific Mesozoic hydrocarbon province in the northern North Sea. The dataset (courtesy of PGS Ltd) shows widespread occurrence of polygonal faulting, a potential opal A/CT diagenetic reflection, jack-up structures, fluid conduits and sand injectites. The aim of this study is to determine how different seismic facies relate to the distribution of the sediment mounds and how their evolution relate to other fluid-flow expressions, and also evaluate a possible link with diagenetic reaction front and polygonal faulting.

A significant inversion of the North Viking Graben at about the end of the Oligocene led to the uplift of the western half of the graben and the sagging of the mud-rich basinal part. Diagenetic alteration intensified in the sagged area (of pervasive polygonal faulting) and likely increased the accommodation space. This area also embraces the largest of the sediment mound structures. The timing of the mound formation is significant to constraining gas migration in the northern North Sea. The post-unconformity deposits of Utsira and lower Pliocene clinoform wedges show characteristic deformation above the mounds and were studied to determine the relative timing of the event. The mounds have previously been attributed to mud diapirism. However, the adjacent areas do not show apparent thinning indicative of substantial mass flow. We attribute the mounds to sand mobilization and focused fluid flow.

This study shows that the Oligocene – Miocene succession in the Northern North Sea has undergone widespread deformation which has been influenced fluid migration in the area.

Putting the sub-surface into the cloud

Rasheed, M.

Subsurface datasets, whether raw data, derived attributes or model runs, are stored in multiple locations throughout E&P organizations and are often duplicated and of variable vintage. The process of loading and managing the data relies heavily on people and time. In addition to this the fact that the data is stored on multiple databases and in different formats requires much reworking of information and an inability to see the larger data picture or combine data from across operations and disciplines.

One powerful solution is to use existing cloud computing technologies to allow collaboration and interoperability but this requires data integration, data management and computational performance to be successful. We suggest a common denominator that solves all these challenges. To date, most solutions have been focused on application integration or very domain-specific solutions, which have resulted in

massive data variety. This implies that no solution is viable until it has migration plans and compatibility with existing multi-variations. To move towards a homogenous environment, a methodology and framework is required that is auditable and has metadata built in.

The key features of any solution would require:

A data structure that promotes the implementation of efficient algorithms: this requires a data structure that can be changed or derived to enhance the performance and usage of data. It becomes essential that subtype polymorphism is achievable by the super data type.

A scalable data management system: most of the existing systems (designed for humans) works fine with small or medium size data but processing a large data set requires changes to the main procedure to accommodate. Small and medium data sets are good for basic analysis for individuals. Expanding to the complete set for an organization, it is essential that a data management system can not only scale work done by individuals but also for the organization.

Data relationships stored with actual data: Information can be retrieved until data cannot be linked to make interpretation. These relationship building is more a process but a vital need to bring meaning to the data. This is not an essential but proves to make data usage more productive.

Computational analysis attached to the data: Major slowness arises from data transfers that need to be carried out on specific machines. To completely eradicate this it would bring computational power directly to bear in the workflow.

Open-source data structure: Allowing everyone to contribute and utilize subtype polymorphism is essential to create reusable subtypes and algorithms. Openness is crucial to better data stewardship through time, communication and collaboration.

To meet this demanding need, the common denominator is a data structure which is referred as Spatial Registered Data Structure (SRDS). This article explains how the various challenges can be solved using this open source structure and how appropriate technology is utilized.

Numerical modelling of climatically-driven drainage capture and sediment flux, South Island, New Zealand

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River systems in central South Island, New Zealand are subject not only to the typical effects of glacial advances and retreats, but also an additional complication as ice crosses fluvial drainage divides, resulting in changes in discharge and sediment flux. Drainage capture occurred between the adjacent Rakaia, Ashburton and Rangitata basins during the Last Glacial Maximum (LGM, 24-18 ka). Transfluent ice flowed across drainage divides against the topographic gradient and reshaped the fluvial drainage network, causing the Ashburton basin to double in effective drainage area at the expense of its neighbours during the LGM. Drainage capture occurred at multiple locations within the study area and the relative timing of capture events is crucial to understanding the effect of climate on fluvial processes.

We use a 2-D energy, mass balance and ice flow model to understand climatically-driven changes in the drainage basins. We have adapted the model for use in the Southern Hemisphere and quantified monthly precipitation in terms of precipitation phase, volume and spatial distribution. Temperature-elevation relationships are derived from published lapse rates for New Zealand, and the CliFlo database provided other modern climate information such as wind speed and humidity values. Albedo values have also proved to be an important control on mass balance. Modelled climate change is driven by changing temperature, assuming minimal changes in the distribution of precipitation. We can reproduce modern and published LGM ice extents, and determine ice extent and dynamics at regular temperature intervals between these extremes. This allows us to quantify fluxes for each river under different climate conditions and to constrain the timing and duration of drainage capture events. Results indicate that drainage capture occurs during cooling of 3-4°C relative to modern conditions, equivalent to the LGM.

3D Seismic Characterization of Mud Volcanoes from the Deepwater Niger Delta

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Mud volcanoes are widespread in deepwater settings with their emplacement contributing to the tectono-sedimentary evolution of continental slopes. An understanding of their nature and formation mechanisms provides vital information about their expressions and impact on subsurface conditions and geological processes. Utilizing offshore 3D seismic data from Niger delta, the structural and morphological elements of deepwater mud volcanoes have been described. The features were recognized on seismic sections as chimneys of chaotic seismic reflections and data wipe-out.

A cluster of mud volcanoes, about 2.5km across, consisting of circular depressions and highs, bounded by inward dipping caldera faults, were imaged from the upper slope setting of the Niger delta. Active mud volcanoes with positive topographic relief of about 125m were imaged. Probable gas migration paths are indicated by high amplitude anomalies on volcano flanks. Caldera collapse faults bounding earlier mud volcanoes acted as vents during reactivation stages and resulted in the cluster of mud volcanoes with a common inverted-funnel-shaped root-zone up to 3.5 km across. Stacking mud cones defined by an array of crestal high amplitude anomalies give an apparent Christmas-tree configuration.

The mud volcanoes are located over shale diapirs and are associated with several active outlets within a large circular caldera. The presence of seabed mud cones suggest that their eruption was mainly through the ductile flow of deeper sourced muddy materials. Their occurrence has implications for slope stability and geomorphology as well as drilling uncertainties during E & P operations.