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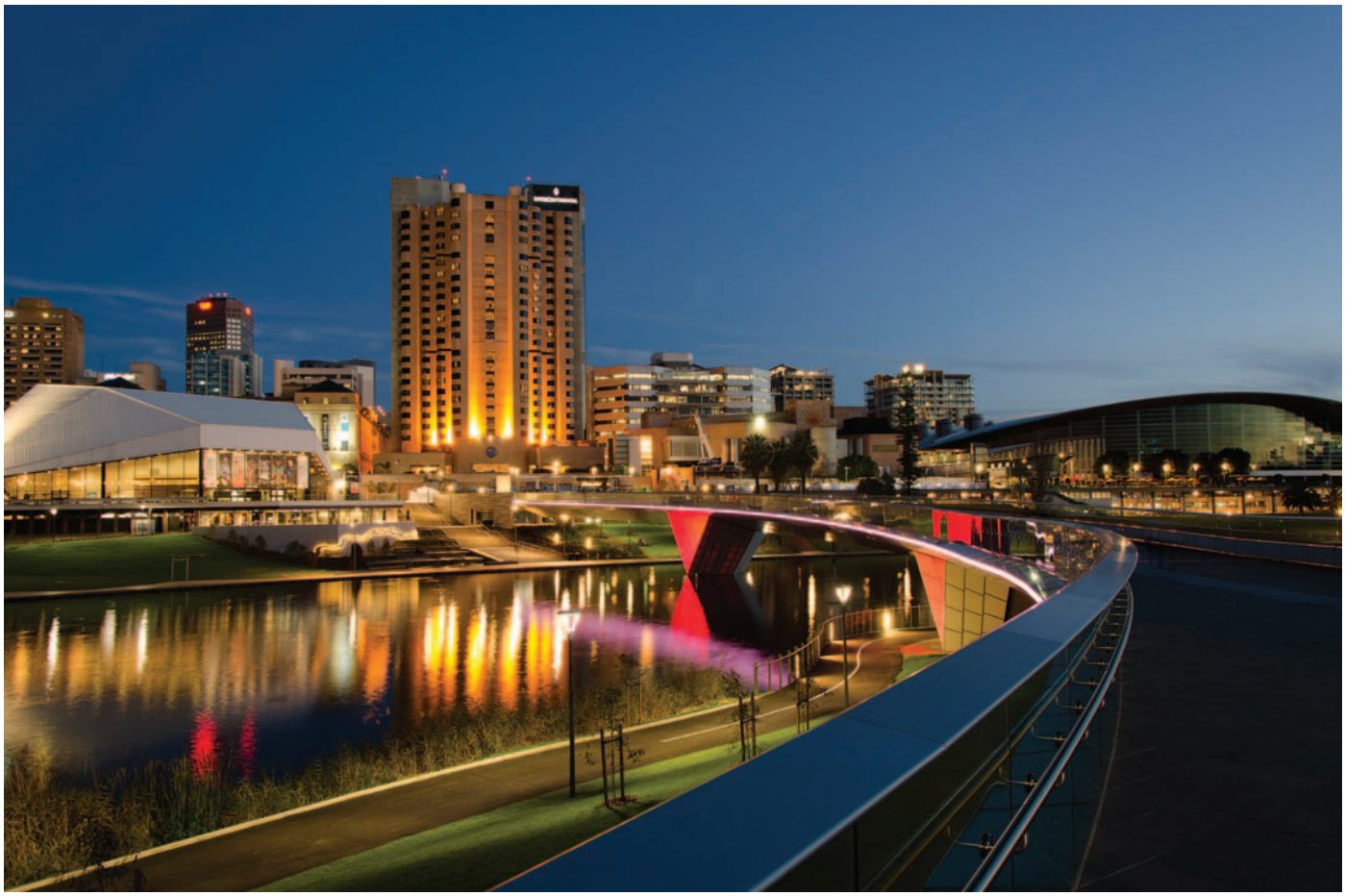
SECTION 4
POSTER ABSTRACTS



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1320–1345

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Posters – Minerals

ESTIMATING COVER THICKNESS USING SEISMIC REFRACTION IN THE SOUTHERN THOMSON OROGEN – AN UNCOVER APPLICATION

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The Southern Thomson Project was established to develop a better understanding of the geology and mineral potential of the southern Thomson Orogen. One way in which the Southern Thomson Project is improving this understanding is through the collection of seismic refraction data at 16 greenfields sites to assess the cover thickness (i.e. the amount of regolith and sedimentary basin cover overlying the basement geology). Seismic refraction data were collected using a standard linear array with 48 geophones and a 40 kg propelled weight drop as the energy source. An estimate of the cover thickness was produced from the refraction data using the time-term inversion method. This resulted in the creation of a three-layer model for each site, which accounts for the layers associated with the regolith, sedimentary basin cover and the basement geology.

GRAVITY GRADIENT DATA FILTERING USING TRANSLATION INVARIANT WAVELET

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Full tensor gradient (FTG) data is highly useful in hydrocarbon exploration and the detection of some geological targets with small size as its higher detailed information abundance and finer resolution. At the same time, there are some high-frequency Gaussian white noise mixed in the target signal and which has closer frequency range than the conventional gravity data. Thus, one key step before inversion is to remove as much Gaussian white noise as possible and reserve the subtle details. For this pre-processing step, several effective methods have been used, including low-pass filters, least square fitting methods based on Laplace equation and wavelet filtering methods. In this paper, we would utilize the translation invariant wavelet for the reason that it can suppress Gaussian white noise through multi-resolution analysis and at the same time can avoid pseudo-Gibbs phenomenon. The other point different from wavelet method used before is that we applied a mixed threshold constructed according to the curve of both soft threshold and hard threshold. Compared to soft and hard threshold, mixed threshold can keep more details and remove more noise respectively in terms of the energy distribution of signal and noise. Then we process wavelet coefficients with mixed threshold and do inverse transform to recover the data. The results demonstrate that translation invariant wavelet can not only remove the major part of Gaussian white noise, but also reserves high-frequency detailed information of FTG data. Obviously, translation invariant wavelet with mixed thresholding has preferable application effect in filtering FTG data.

ON THE VARIATIONS OF CRUSTAL DENSITY BEFORE THE WENCHUAN MS8.0 EARTHQUAKE

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Using 3D inversion method, we calculated and analysed the variations of crust density based on 13-issue repeated gravity observations from 1996 to 2007 in Chengdu Testing field, where is close to the Wenchuan earthquake epicenter. Finally, the following conclusions are obtained: 1) The deep crust density was unevenly changed before Wenchuan earthquake, including early accelerating change and smooth change in 1–2 years before earthquake. 2) The distribution of density was concentrated on the Longmenshan fault zone and its vicinity, and the density anomaly in deep is more significant than shallow.

INTEGRATED INTERPRETATION OF MAGNETOTELLURIC AND POTENTIAL FIELD DATA: ASSESSING THE NORTHEAST KIMBERLEY REGION

Mark Lindsay[1]*, Jessica Spratt*[2]*, Sandra A. Occhipinti*[1]*, Alan R.A. Aitken*[1]*, Michael Dentith*[1]**, Vaclav Metelka*[1]*, Julie Hollis*[3] *and Ian Tyler*[4]
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An integrated interpretation of potential field and magnetotelluric (MT) data was performed in the east Kimberley, northern Western Australia Structural interpretation of potential field data was constrained by geological field observations, petrophysics, remote-sensing and an understanding of the tectonic history of the region. Forward modelling of the potential field data located along the same survey traverse as the magnetotelluric data allowed comparison between the two datasets to assess complementarity of images and assist interpretation. Interpreted features include the presence of large-scale structures and associated electrical anomalies that indicate the presence of mineralisation deep in the crust, and guide prediction of mineralisation at or near the surface. The King River Fault is revealed to be a crustal-scale, west-dipping structure, which footwall bounds the western side of a large resistive body. A conductive anomaly is also located on the hanging wall of the King River Fault. A number of scenarios are discussed to the source of conductivity, including the presence of sulphides, saline water and graphite. Our assessment suggests that graphitic rocks, most likely with some sulphide content, contribute to the strength of this anomaly, and highlights the known potential of the east Kimberley to host graphite deposits. The conductive anomaly has a spatial and geometric correlation to Speewah Dome, a known prospective region. The depth of the conductor (c. 5km) precludes mining, but does indicate King River Fault is likely to form a mineralising conduit, and may contribute to possible Pb-Zn mineralisation where the fault reaches the surface.

DETERMINATION OF FORMATION DENSITY THROUGH RC RODS IN IRON ORE ENVIRONMENTS

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Logging through drill rods and casing is a well-known challenge in the coal, oil and gas industries, and several techniques have been developed to obtain open-hole values using open-hole tools in cased-hole (C-thru). Due to the differences between conventional open-hole and iron ore environments and practices, simply applying the same methods can result in spurious data and unreliable findings.

A revised tool design together with an improvement upon the standard oil and gas technique through single wall rods was required to ensure accurate results. Development of an appropriate compensation algorithm and response through Reverse Circulation (RC) rods was determined where multiple walls of steel and gaps of fluid and air separate the tool from the target formation.

TOWARD 3D STRUCTURAL CONSTRAINTS FROM MAGNETIC MODELS: AN EXAMPLE FROM THE MONTRESOR BELT, NUNAVUT, CANADA

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New geophysical and geological results shed light on the tectonic history of the Montresor belt, located on the Rae craton of northern Canada – an Archean terrane that has been reworked by four Proterozoic orogenies. In this contribution we use forward modelling of high-resolution aeromagnetic data to explore the 3D geometry and structural history of the Montresor belt, part of the Rae cover sequence. Previously thought to be a simple syncline, our re-analysis of the aeromagnetic data has outlined a set of earlier structures that provide new insight on the deformation history of the belt. Five cross-sections model discrete magnetic-lithologic units truncated by a series of low-angle faults. Reconstruction of the magnetic map features and forward models reveals a pre-fold geometry analogous to foreland fold and thrust belts, produced by D1 deformation during the Trans-Hudson orogeny, bracketed by available geochronology between 1.94 and 1.864 Ga. The Montresor belt rocks have potential for a variety of mineral deposit types, including precious metals in hydrothermal settings, and are under study as part of the Geo-mapping for Energy and Minerals program in Canada.

EDGE DETECTION OF POTENTIAL FILED DATA USING CORRELATION COEFFICIENTS

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Edge detection is an essential task in the interpretation of potential field data. In this paper, we present a new method to delineate the edges of the sources, which is based on the windowed correlation coefficients of the average and the standard deviation of vertical derivatives. The zero value of the correlation coefficients is used to delineate the geological edges. This method can clearly give resolution of the edges of the deeper and shallower sources. The measure is initially applied on the synthetic gravity data. The test of theoretical models indicates that this method could detect the geological edges in different depths and the result is in accordance with model edges. Finally, this method is applied to gravity data from a portion of Vientiane Basin, Laos. As a result, the method can recognize geologic fractures more clearly. Moreover, it can recognize more geologic details when the window size is small and give superior results when the data are relatively smooth.

LITHOLOGICAL MAPPING VIA RANDOM FORESTS: INFORMATION ENTROPY AS A PROXY FOR INACCURACY

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Machine Learning Algorithms (MLA) can be an effective means of lithological classification. The Random Forests™ (RF) supervised classification approach allows prediction of lithology from disparate geophysical, geochemical and remote sensing data. In this study, we examine the relationship between prediction accuracy and information entropy (H). Data were processed in accordance with industry best practice and input selection was optimised using RF. Using a training set containing 1.4% of available pixels, we produced a classified lithology map with an overall accuracy of 76% with regards to mapped geology. In addition, we produced a class membership probability for each pixel, a precursor to defining the ultimate class designation at each pixel. H was calculated at each pixel from output class membership probabilities; and in this context provides a measure of the state of disorder for each. H was normalised with 0–1 representing the minimum to maximum possible H for each pixel.

H equal to 1 at a pixel represents an equal probability of all candidate classes occurring, whereas H equal to 0 describes a 100% probability of single class occurring. In this study, we demonstrate that there is a significant difference in the distribution of H between correctly and incorrectly classified pixels. The median H of incorrectly classified samples occurs above the 75% percentile of H for correctly classified samples. Conversely, both the mean and median H for correctly classified pixels occurs below the 25% percentile level for incorrectly classified samples.

This information can be used to determine the well-defined transition range in H, above which classification is likely to be inaccurate. Using this approach, a geoscientist can produce a lithological map, a quantifiable measure of uncertainty and a quantifiable transition range above which they are likely to encounter incorrect classification, avoiding wasted expense in targeting based on an incorrect model.

CHARACTERISING COVER AND EXPLORING UNDER COVER WITH AEM

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CGG, Australia

Characterisation of cover is an important aspect of understanding many geological systems. Through a better understanding of cover and improved sensitivity to deeper structures the footprint of mineral systems can be extracted. This is important in providing greater confidence to mineral explorers and will assist with further exploration success at depth. UNCOVER is a government initiative, focussed on improving the mineral

prospects of Australia through better exploration of the subsurface under cover. AEM is well placed in supporting this initiative, by providing a rapid and efficient way to undertake near surface geophysical exploration. To accurately characterise the subsurface, AEM systems must have both accuracy and precision which are achieved through robust calibration and low noise levels. Tempest has a long history of exploring cover and under cover. The characteristics of the system are tuned to provide a broad bandwidth which maximises its sensitivity and applicability. Years of development has led to significant improvements in signal-to-noise along with deployment of system variants and platform diversity, including High Moment Tempest which provides increased transmitter moment along with reduced noise levels leading to greater depth of penetration and sensitivity to low conductivity contrasts.

A NEW SOURCE PARAMETERS ESTIMATION METHOD OF AIRBORNE GRAVITY GRADIENT TENSOR DATA

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One of the important tasks of potential field interpretation is source parameters estimation of the geological structures, including the horizontal position and buried depth. A new method to interpret airborne gravity tensor data is proposed in this paper based on Normalized Downward Continuation (NDC) of the tensor data directional total horizontal derivatives. The NDC method was introduced for source depth estimation, which can be applied to analytical signal modulus and potential fields themselves. And the maxima of the NDC map mainly correspond to the centre location of the geologic source. We applied the NDC method to the directional total horizontal derivatives which can be used for delineating the sources' horizontal edges. The maximum values of the result indicate the source edges horizontal position and buried depth simultaneously. During the calculation, the iteration method of the downward continuation is used in the NDC calculation process to improve the stability. The new method was tested on synthetic models and obtained satisfactory results. Compared with previous work, this new approach has a better lateral resolution.

FIELD-DEPENDENT SUSCEPTIBILITY OF ROCKS AND ORES – IMPLICATIONS FOR MAGNETIC PETROPHYSICS AND MAGNETIC MODELLING

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It is usually assumed that the initial magnetisation curve for a rock, soil or ore sample is linear in the applied field, for fields much less than the coercivity of the magnetic minerals in the sample. This implies that the measured susceptibility, defined as the induced magnetisation divided by the inducing applied field, is independent of the field H that is used in the measurement and that the induced magnetisation of the rock unit in situ can be calculated, irrespective of the field used by the measuring instrument, by multiplying the measured susceptibility by the Earth's field at the location of the rock unit. A better approximation for many materials that contain ferromagnetic (sensu lato) minerals is a quadratic dependence of the weak-field magnetisation on the applied field, given by Rayleigh's Law, which yields a linear dependence of susceptibility on applied field. This field-dependent susceptibility is associated with hysteresis and a phase lag of magnetisation behind the applied field for AC measurements, which can masquerade as a phase lag produced by magnetic viscosity. Field-dependence of susceptibility is strongly affected by self-demagnetisation, so measurements of the Rayleigh coefficient η of strongly magnetic samples, as well as the initial susceptibility χ, must be corrected for self-demagnetisation in order to calculate intrinsic properties of the rock unit. Self-demagnetisation also largely explains why rocks containing low-Ti magnetite grains, which have high intrinsic susceptibility, exhibit only weak field-dependence of susceptibility, whereas rocks bearing titaniferous magnetite, monoclinic pyrrhotite or multidomain hematite exhibit relatively pronounced field-dependence of susceptibility. Under the conditions of the Néel approximation ($\eta H \ll \chi$), the Rayleigh laws are still obeyed even when self-demagnetisation is considered. However, considerable departures from the Rayleigh relations occur when $\eta H > \chi$. This paper examines implications of field-dependent susceptibility for measurements of susceptibility and its anisotropy, and methods for correcting calculations of induced magnetisation.

MAGNETIC SUSCEPTIBILITY OF EDMUND BASIN, CAPRICORN OROGEN, WA

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Magnetic anomalies appear to be related to base metal prospects in the Mesoproterozoic Edmund Basin of the Western Australian Capricorn Orogen, one of them being the cause of finding the Abra Pb-Cu-Zn deposit. Our results from Edmund and Collier lithostratigraphic units show that magnetic susceptibility of the older dolerites is less than that of the younger, and that weathering appears to decrease the magnetic susceptibility response at outcrops. Sedimentary rocks and Moorarie Supersuite monzogranite have lower magnetic susceptibility than the mafic intrusive rocks. Hydrothermal quartz and diorite related to Moorarie Supersuite have high susceptibility and either of these or both may relate to magnetic highs at locations of outcropping or nearly outcropping basement rocks. Hydrothermal alteration seems linked to higher susceptibilities, but additional sampling from fresh unaltered rock and hydrothermal alteration as well as petrographic studies to define the magnetic accessory minerals in Edmund and Collier Basin lithostratigraphic units are required to understand the link between unit mineralogy and magnetic properties.

USING REMOTE SENSING AND POTENTIAL FIELD DATA TO INTERPRET BASIN FILL COMPOSITIONAL VARIATIONS AND STRUCTURES

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Combined mapping of variations in sedimentary basin fill composition and a structural interpretation is a step towards defining significant crustal scale structures and developing tectonic models in basin dominated terranes. The Bresnahan Group, part of the siliclastic Bresnahan Basin in the Capricorn Orogen was deposited in one such region. New geophysical and

remote sensing datasets have been processed to interpret the basin composition and structure. Fieldwork to ground truth the interpretations, including mapping, petrophysical measurements and petrographic examination has also been completed. A northwest-trending fault in the eastern part of the Bresnahan Group has been identified as being in close proximity to compositional changes in basin fill observed on hyperspectral mineral maps. The structure has a similar orientation to a fault that cuts the older Hamersley Basin. A previously interpreted northeast-trending basin-controlling fault mapped in the west has observed differences in radiogenic components north to south in the Bresnahan Group that could reflect changes in basin fill composition. Although, the actual fault could not be mapped in any of the datasets. A west-trending fault in the north that bounds the group, is co-incident to a fault that is thought to control the deposition of the underlying Ashburton Basin, which might indicate a degree of depositional control on sedimentation by pre-existing structures. Faults mapped within the Bresnahan Group, mainly by Landsat 8 and hyperspectral datasets, appear to be mostly post basin fill deposition because of compositional offsets observed. Overall, mapping out compositional variations and structures has indicated regions of the basin fill that might have been fault controlled, that is a step towards defining crustal scale structures and tectonic models in the region.

LITHOSPHERIC THINNING BY MANTLE PLUMES

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Thermo-mechanical thinning of the lithosphere by mantle plumes is essential for intra-plate volcanism, the initiation of rifting, the evolution of Earth's lower continental crust and the genesis of metals, diamonds and hydrocarbons. To develop a new understanding of how a mantle plume thins the overlying lithosphere beneath moving plates, we use 2-D and 3-D numerical models based on a finite-element discretization on anisotropic adaptive meshes. Our models include Earth-like material properties for the upper mantle (e.g. temperature and viscosity contrasts, non-Newtonian rheology) discretised at a local mesh resolution that has previously been considered intractable. In our simulations, a plume is injected at the base of the model (670 km depth) with a prescribed mass flux that is consistent with surface observations of topographic swells: from 0.5 (e.g. Louisville, Bermuda, Darfur) to 7 Mg/s (Hawaii). We undertake a systematic numerical study, across a wide parameter space, to investigate the effect of plume buoyancy flux, plate velocity, rheology law and Rayleigh number on processes leading to a reduction of the depth of the Lithosphere Asthenosphere boundary (LAB), such as small-scale convection (SSC) ('dripping'), or delamination of the lower lithosphere.

INVERTING DYNAMIC ELASTIC MODULI OF A GRANULAR PACK TO GET SHEAR MODULUS OF THE GRAIN

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Elastic moduli of rocks derived from its powder is a new concept and can be applied in practical geophysics studies. To develop this concept, we make ultrasonic velocity measurement on granular packs of quartz sand. We calculate dynamic elastic moduli from that measurement and invert afterwards to find the shear modulus of quartz. The inversion technique follows Extended Walton Model that relies on the grain's contact surface condition between infinitely rough and perfectly smooth. We use different coordination numbers from previous studies (for different samples) in the process of forward modelling and inversion. Forward models have good match with the laboratory measurements both in bulk and shear moduli of the granular pack. Our overall inverted results for the shear modulus are stable and close to actual shear modulus of quartz. However, the coordination numbers that has better match in forward modelling a little bit overestimates shear modulus. On the contrary, the coordination numbers that predicts the higher effective moduli of the pack is giving closest result. As the experiment set up and procedure are simple and robust, this technique can be extended and run in very rigorous situation such as at hard rock drilling rig site to get the elastic properties of the penetrated rocks in real time, where the effective elastic moduli of a grain can be represented as a statistical averaging of elastic moduli of hard rock minerals. This information can be helpful for planning and monitoring the ongoing drilling procedure. It can also be a replacement of solid cores that are missing or damaged for elasticity study.

THE BARK WITHOUT A DOG – MAGNETIC ANOMALIES OVER HOLES IN A VOLCANIC SHEET IN THE GREATER MCARTHUR BASIN, NT

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[2]Northern Territory Geological Survey, Australia

Linear strings of circular negative magnetic anomalies in the greater McArthur Basin of the Northern Territory are interpreted as due to holes in an underlying sheet of Kalkarindji flood basalts. Individual anomaly inversion results provide an estimate of the diameter, depth to top, and depth extent of holes in the volcanic sheet. The effective magnetization of the hole is its contrast against the more strongly magnetised sheet. Estimated magnetization contrast values are mostly rotated from a direction antiparallel to the local geomagnetic field, which we interpret as due to the contribution of remanent magnetization within the sheet. We support interpretation of the anomalies as due to holes in the sheet by comparing them with the magnetic expression of distant sheet edges. The linear arrangement of the anomalies is believed to arise from fractures in the sheet, suggesting that the holes developed after the sheet was emplaced, most probably by local escape of fluids, which altered the sheet and destroyed its magnetization.

TOWARDS AN UNDERSTANDING OF THE EFFECTS OF ALTERATION ON THE PHYSICAL PROPERTIES OF MAFIC AND ULTRAMAFIC ROCKS

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New physical rock property data from the Plutonic Well Greenstone Belt are presented. P-wave velocity (Vp), magnetic susceptibility and density measurements have been taken from rare stratigraphically complete drill core. Preliminary results show that variations of physical rock property data are successful in resolving most lithologies. However, questions remain regarding the interpretation of physical property data

involving ultramafic and mafic rock, and, in particular, the effect of alteration.

Variable alteration is suggested to be the cause of the wide ranges within physical property data populations. This problem is not exclusive to the Plutonic Well Greenstone Belt, and is a common feature within many greenstone terranes. Geochemical and mineralogical data are also available from the study area and may allow a better understanding of the effects of common types of alteration (serpentinisation, talc-carbonate alteration) on the physical properties of mafic and ultramafic rocks from granitoid-greenstone terrains.

THE ELECTRICAL RESISTIVITY OF THE AUSTRALIAN LOWER CRUST

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The resistivity structure of the crust is broadly expected to be homogeneous, with highly resistive lower crustal rock overlain by more conductive rock in the upper crust. However, observed data shows that although the upper crust is typically resistive, the lower crust can be much more conductive. The presence of such high electrical conductivity in the lower crust is remarkable and suggests a substantial highly connected material, melt or fluid. Has the low resistivity structure been present since inception, or is it the result of a later overprinting event. The secondary objective to establish how such a low resistivity region can be preserved over such an extended time scale.

Data has been collated from magnetotelluric (MT), and geomagnetic depth sounding (GDS) surveys collected over the last thirty years. Three different methods have been used to model thousands of data points. A thin-sheet inversion of thousands of GDS data has been used to place constraints on the regional scale electrical conductance. Inversions of the MT data in both 2D and 3D have provided more detailed models of how the Moho is connected to the upper crust.

Strong correlations were observed between major tectonic domains (such as the Gawler Craton) and regions of high resistivity within the crust. The 2D profiles show broad regions of low resistivity at the boundary between the upper and lower crust (10–15 km depth), with low resistivity zones extending for tens of km. Above the boundary, the low resistivity regions transform in to narrow pathways penetrating through the resistive upper crust and the areas with the lowest resistivity were found to have a strong correlation with known major mineral provinces. This leads to the suggestion that crustal low resistivity anomalies are likely a product of fluxes of fluid and possibly melt from the upper mantle and lower crust.

ELECTRIC BIPOLE ANTENNA MODEL STUDY OF A BASIN SCALE FAULT SYSTEM

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The generation of electric fields with electric bipole transmitters are applicable at a wide range physical scales and for many subsurface exploration endeavors. Increase in transmitter power for a wide range of waveforms combined with receiver sensitivity has led to deeper exploration with electromagnetic methods. We investigate the optimal design of grounded bipole EM system for generation of electromagnetic fields over a basin-scale fault in Perth, W.A. The technical objective is to recover detailed electrical conductivity distribution proximal to and within a large fault system to depths of as much as 1000m below the surface. The ultimate geological imperative for the exercise is reveal possible change in solute concentration or hydraulic across these large fault systems. For example, imaging of the difference composition of fault core zone would be a valuable outcome. We investigate various combinations of receiving and transmitting antenna geometries in preparation for a field campaign intended to resolve electrical parameters and structures of this large fault system.

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EVALUATION OF EMPIRICAL RELATIONS BETWEEN STATIC AND DYNAMIC ELASTIC MODULUS

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The difference between static and dynamic Young's modulus has been considered by the researchers since a long time ago. In field experience, very often dynamic Young's modulus can be calculated using logging data, while core data for static experiments in the lab is scarce. On the other hand, geomechanical analyses are traditionally based on static data. Therefore, it would be essential for geomechanical studies to estimate static Young's modulus based on dynamic values.

A number of empirical equations have been suggested to estimate static Young's modulus based on dynamic Young's modulus. However, it is realized that validity of these relations is limited and local. In this paper, 11 suggested relations were evaluated against an experimental data set from different geographic locations. All the correlations predicted static values based on dynamic modulus and among 11 suggested relations, only one of them considered porosity as an important input parameter which had indirect effect on modulus values. The approach was accomplished for three sedimentary rock types and the results were found to be notably more accurate. Afterwards, a new approach was selected to predict static Young's modulus using porosity as one of the input parameters. Using previous suitable results in ceramics studies and modifying the results for rocks, the new correlation estimated better values with considerably lower over-estimation or under-estimation.

MAGNETOTELLURIC MODELLING: TOWARDS A 4-D INVERSION

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Recent work has shown the utility of magnetotellurics (MT) in monitoring dynamic processes, however current MT inversion

schemes are not optimised for time-variant resistivity models. In this study we investigate if we can improve inversion results by introducing a time axis into the model space, creating time-lapse (4-D) models. We outline an inversion methodology which is altered from the existing Occam inversion to accommodate temporal changes. Our inversion incorporates only one spatial dimension, however the method is extensible to 2-D and 3-D spatial models. We assess the effectiveness of our method compared to existing time-invariant inversion by comparing inversions of synthetic MT data with the two techniques. Motivated by methods in other geoelectrical techniques, we also compare regularisation schemes and assess their suitability for use with MT data. Based on the results of the study, our work aims to help establish an inversion scheme for MT monitoring data.

MAPPING SUB-SURFACE GEOLOGY FROM MAGNETIC DATA IN THE HIDES AREA, WESTERN PAPUAN FOLD BELT, PNG

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Horizon mapping using magnetic data was conducted over a part of the Western Papuan Fold Belt, in an area of rugged terrain, where the geological structures are of relatively low complexity. Energy spectral analysis was used to detect magnetic susceptibility contrasts that were laterally merged to form magnetic interfaces corresponding to horizons derived from seismic and well data.

Numerous magnetic interfaces were detected corresponding to: magnetic layers within the Darai Limestone, top of Ieru Formation, intra-Ieru and deeper intra-sedimentary boundaries. These mapped sedimentary surfaces form an anticlinal structure which plunges towards the south-east. A major thrust fault, mapped from magnetic data using automatic curve matching, truncates the anticline in the south-west. Sedimentary magnetic layers were mapped on both sides of this fault. The results obtained from the interpretation of the magnetic data are consistent with structures mapped from seismic and well data.

CHARACTERISING EXTRUSIVE AND INTRUSIVE MAGMATISM AT THE KIPPER FIELD, GIPPSLAND BASIN, USING 3D SEISMIC DATA

Fun Meeuws[1], *Peter Reynolds*[1]*, *Simon Holford*[1], *John Foden*[1] *and Nick Schofield*[2]
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Increased hydrocarbon exploration along rifted continental margins indicates the need of a better understanding of the impact and influence of igneous rocks on hydrocarbon systems as they are often present in these tectonic settings. The southern Australian margin contains several petroliferous sedimentary basins which contain Cretaceous-Cenozoic igneous rocks and is therefore an ideal study area to investigate both the positive and negative effects on hydrocarbon systems. In particular, the Kipper Field in the offshore Gippsland Basin forms an excellent example of a volcanic play, as it holds a 328 m gas column and 14 m oil leg sealed by a >100 m thick basaltic lava flow juxtaposed against a sealing fault. The basin also contains a number of cross-cutting and layer-parallel type intrusions, although their impact on the petroleum system is as-yet unclear. Seismic interpretation techniques such as spectral decomposition and opacity rendering combined with electrical log signatures allowed us to identify the lava flow and intrusions down dip from the fault. Whether this fault has acted as a conduit for the magma responsible for the lava flow is still unclear. Future work will aim to further delineate and constrain flow paths of the intrusive and extrusive rocks near the Kipper Field and their influence on the Kipper play. This study highlights the importance of volcanic rocks in hydrocarbon basins and the possible effect they can have on hydrocarbon systems.

TRUE-TRIAXIAL-CELL SET UP TO ESTIMATE THE STRESS INDUCED ANISOTROPY: UNIFORMITY STUDY

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The stress anisotropy in Polymethyl Methacrylate (PMMA) subjected to triaxial stress has been investigated using True Triaxial Cell. True Triaxial Cell with 4 sealed S wave transducers inside each actuators facilitates the wave velocities measurement in different set of stresses. 108 positions of measurements have been selected and comprehensive test sequences has been allocated. The experiment analysis results confirm that the wave velocities increasing by increasing the stress in all sequences on different rates. Moreover, this experiment shows the designed True Triaxial Cell operates symmetrically and the results in both sets of transducers show a good correlation to one another which confirms the uniformity of applied stresses.

PETROPHYSICAL CHARACTERIZATION OF GONDWANA SHALES OF SOUTH KARANPURA COAL FIELD, JHARKHAND, INDIA

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Sedimentary rocks such as shales are the most abundant sedimentary rocks in the earth's crust. Shales are characterized by preferred particle orientations of platy clay minerals, strong laminations and presence of fissility. In petroleum geology, organic shales behave as both source rocks as well as seal rocks that trap oil and gas. In seismic exploration, shales interface with other rocks to form good reflectors. As a result, seismic and petrophysical properties of shales and the relationships among these properties are important for both exploration and reservoir management. The Gondwana shale of South Karanpura coalfield, Eastern India of Barakar (lower Permian) and Barren-Measures (Middle Permian) formation, majorly characterized by non-marine sedimentary fill and narrow graben structures, are used for petrophysical characterization. Because of thermal maturity and high content of organic matter in shale rock, South Karanpura coalfield is considered as one of the potential shale gas field in Damodar Valley Basin and it is a part of the 'Gondwana' basins of Eastern India. This paper discusses various experimental techniques that are applied to shales to obtain velocity, elastic properties structure, minerals composition, texture/fabric and pore types. These techniques include ultrasonic acoustic measurements, X-ray diffraction (XRD), and scanning electron microscopy (SEM). The frequency values used for acoustic measurements are 54 KHz (P-wave) and

250 KHz (S-wave). The resolution of these imaging techniques varies from micrometres to angstroms and the resulting images generally reflect the composition, topography, or combination of both. The estimated P-wave velocity for Barren-Measures and Barakar formation varies from 1463–1890m/s and 2110–3947m/s, respectively while the Shear-wave velocity varies from 898m/s–1232m/s to 1306m/s–2515m/s respectively which suggest that formation is hard and compact in the latter case. XRD and SEM analysis reveals the presence of clay minerals and other minerals, organic matter, texture/topography and pore types in the shale rock sample. The clay minerals identified consist of Kaolinite, Illite while Quartz, Siderite, Muscovite, Orthoclase and Rutile comprises of non-clay minerals in the sample.

ACTIVE TECTONIC AND MECHANIC INTERACTION BETWEEN CUSIANA AND YOPAL FAULTS INTERPRETING SEISMIC AND TERRACES GEOMETRY

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Along the Colombian Llanos Foothills, different rock formations lie affected by tectonic movements, expressing geomorphological changes at the surface associated with subsurface geologic structures (anticlines and synclines). Some of them were created during the most recent tectonic movements throughout the last period of geological time. This evidence is plotted in the geological map of the area extended from the Colombian Eastern Cordillera to the Colombian Llanos Orientales basin (figure 1). There, folded and faulted Quaternary deposits can be observed. This is the case of the alluvial terraces in the study area (figure 1), which have been deformed due to the recent tectonic activity. Therefore, to test this theory, this study generates a three dimensional kinematic model based on serial balanced geological cross sections built by seismic, geological and well data. Hence, we can analyze the geometry of faults in the area (Cusiana and Yopal), with the geometry of the Alluvial Terraces deposited during the Late Pleistocene (0.2 Ma, ICP, (2009)). Consequently, it simulates the fault kinematics since the Quaternary Terraces deposition in order to quantify fault motion rates, thereby, assessing the age of faulting. Finally, in addition, this study, using PetroMod 1D models, appraises the age of the famous Colombian oil field called Cusiana. As a result, it demonstrates the continuous generation and migration of oil from the kitchen located at the Colombian Eastern Cordillera, to the Colombian Llanos Basin.

THE FACIES ARCHITECTURE OF SUBMARINE BASALTIC VOLCANOES AND THEIR EFFECTS ON FLUID FLOW

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Volcanic-affected hydrocarbon basins commonly contain a variety of intrusive and extrusive volcanic rocks. All extrusive facies are ultimately sourced from volcanoes. Importantly, volcanoes link the extrusive components to the underlying magmatic plumbing system; features which may act as subsurface conduits and baffles for fluid flow. Volcanoes also provide insights into the timing of both intrusive and extrusive activity, thus helping constrain hydrothermal and contact metamorphic processes associated with magma intrusion. However, in comparison to the intrusive components of volcanic systems, the criteria for recognising these important features in seismic data are less well known. In addition, the facies of which volcanoes are commonly composed are poorly characterised from well and seismic data.

In this study we use a combination of 3D seismic data, well data and field analogues to detail the architecture of submarine basaltic volcanoes constructed in the Bass Basin, offshore southern Australia. These volcanoes are Miocene in age and were emplaced in a thermally subsiding rift basin. Our studies indicate that the volcanoes are composed of volcaniclastic rock such as hyaloclastite and pyroclasts, produced during effusive activity and magma-water interaction. These facies present a range of drilling complications, and may act as either seals, reservoirs or migration pathways. After their eruption, the volcanoes were encased in a sequence of claystones, and continued to focus subsurface fluid flow and sediment recycling for 20 Myr after their extinction. We conclude that basaltic volcanoes are important components of volcanic-affected basins. This study can be used to help recognise basaltic volcanoes in other data sets, and provide insights into their impacts on petroleum system.

ANALYSIS OF GRAVITY-DRIVEN NORMAL FAULTS USING A 3D SEISMIC REFLECTION DATASET FROM THE PRESENT-DAY SHELF-EDGE BREAK OF THE OTWAY BASIN, AUSTRALIA

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The growth, interaction and controls of gravity-driven normal faults is somewhat understudied. Using three-dimensional (3D) and two-dimensional (2D) seismic reflection data, located at the present-day shelf-edge break and into the deepwater province of the Otway Basin, southern Australia, we aim to temporally and spatially constrain the development of a normal fault system and determine the controls on growth. The Otway Basin is a Late Jurassic to Cenozoic age, rift-to-passive margin basin. The seismic reflection data images a gravity-driven fault array, consisting of ten fault segments, striking NW-SE (128-308), located within Upper Cretaceous clastic sedimentary rock. We analyse the growth of a gravity-driven hard-linked fault assemblage interacting with basement normal faults. Our analysis shows that the fault assemblage is linked to major basement faults and displays Turonian-Santonian nucleation, continued growth until the latest-Maastrichtian and a maximum throw of 1.74 km. High variability of throw along-strike and down-dip of the fault assemblage indicates growth via lateral and vertical segment linkage. We interpret that the spatial and temporal evolution of the fault assemblage is the result of rifting basement fault control during Upper Cretaceous resumed crustal extension in the Otway Basin. The control of the rifting basement faults on these gravity-driven normal faults has implications towards the growth and petroleum prospectivity of gravity-driven normal faults on passive margins such as the Niger Delta and Gulf of Mexico, but also towards gravity-driven normal faults developed in supra-salt sedimentary rock in rift basins, such as the North Sea and Suez Rift.

THE APPLICATION OF SEISMIC INTERFEROMETRY IN OIL AND GAS GEOLOGICAL SURVEY ON THE PERIPHERY OF SONGLIAO BASIN

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Seismic data collected in volcanic rocks coverage area has weak energy and low signal to noise ratio. These characteristics cause severe problems for seismic exploration. Many geophysicists try to solve these problems and propose many methods. Some of them focus on the acquisition method to improve the signal to noise ratio of data in the step of data acquisition. The others focus on the processing method to improve the data .In this paper, we focus on the processing method and try to apply the seismic interferometry to volcanic rocks coverage collected on the periphery of Songliao Basin to improve the signal to noise ratio and the resolution.

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THREE-DIMENSIONAL INVERSION OF GREATEM DATA: APPLICATION TO GREATEM SURVEY DATA FROM KUJUKURI BEACH, JAPAN

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Studies have shown that Grounded Electrical-Source Airborne Transient ElectroMagnetics (GREATEM) is a promising method for resistivity structures investigating in coastal areas, in addition to inaccessible areas such as volcanoes, mountains and deep forest cover. To expand the application of the GREATEM system, a three-dimensional (3-D) resistivity model that considers large lateral resistivity variations is required. In this paper, we present a frequency- domain 3-D electromagnetic (EM) inversion approach that can be applied to time domain data from GREATEM. In the frequency-domain approach, TEM data were Fourier-transformed using a smooth-spectrum inversion method, and the recovered frequency response was then inverted. To deal with a huge number of grids and a wide range of frequencies in airborne datasets, a method for approximating sensitivities is introduced for efficient 3-D inversion. Approximate sensitivities are derived by replacing adjoint secondary electric fields with those computed in the previous iteration. These sensitivities can reduce the computation time without significant loss of accuracy. Firstly, we verified both of our forwarding and inversion solutions. We then applied this approach to the GREATEM survey data from Kujukuri beach, central Japan. The inverted results of the field data are well fit with the previous study results at Kujukuri area, suggesting the applicability of this inversion approach for constructing 3D resistivity models from the GREATEM field survey data in the future.

DELINEATION OF FAULT SYSTEMS ON LANGELAND, DENMARK BASED ON AEM DATA AND BOREHOLES

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In 1998 Denmark initiated a national groundwater mapping campaign in order to obtain knowledge of the aquifers with respect to their location, distribution, extension, interconnection and to acquire maps detailing groundwater vulnerability. The aim was to establish site-specific groundwater protection zones to prevent groundwater contamination from urban development and agricultural sources in agreement with The EU Water Framework Directive. The mapping campaign involved a dense data acquisition typically comprising boreholes, electromagnetic surveys – both airborne and land based and geoelectrical surveys. The data serve as basis for constructing 3D hydrogeological and groundwater models from which site-specific protection zones are establish. At present time dense geophysical mapping covers approximately 45% of Denmark.

Based on a dense Airborne ElectroMagnetic (AEM) survey in combination with boreholes, three fault systems in the northern part of the island of Langeland, Denmark are mapped. Two of the fault systems were unknown prior to the mapping campaign. The two unknown fault systems are interpreted as a normal fault and graben structures, respectively. The presence of the hanging-wall block in the fault systems can be observed in the AEM data as a low resistivity layer that clearly distinguish from the underlying and surrounding high resistivity fresh water saturated limestone (footwall block) and the overlying glacial clay till. Soil descriptions from a borehole confirm that the low resistivity layer can be correlated to Palaeocene clay deposits. The fault systems were most likely initiated in the early Neogene during the Alpine orogeny. The fault systems are observed to alter the hydrology significantly and are therefore important to map.

MAGNETIC SURVEY AROUND THE MANIFESTATION OF GEOTHERMAL PROSPECTS IN RABUNAN REGION, INDONESIA

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Rabunan region, Probolinggo is an area in Indonesia which has a geothermal prospects indicated by the manifestation of hotsprings. This area is near the foot of Mount Argopuro. Magnetic data acquisition has been conducted around the manifestation of the hot springs in the Rabunan area. The purpose of this magnetic measurement is to determine the subsurface structure that controls the manifestation of the hot springs. Data acquisition is collected on an area of 3 km × 2 km spacing 100 m. Data is processed by the IGRF correction and diurnal correction to obtain a 2D map of the total magnetic field anomalies. The reduction of the flat plane and upward continuation at altitude of 100 m to 400 m above reference sferoida is conducted to separate the local and regional anomaly. The result is reduced to pole, transformed to pseudo gravitation and obtained the horizontal gradient. Interpretation have been finished by analyzing the total magnetic that has been reduced to pole, also the result pseudo gravity transformation and contour of the horizontal gradient. Interpretation of result indicates

anomalous magnetic dipole of -1400 nT to +2000 nT extending from west to east. This anomaly is identified as a fault that resulted in the existence of the weak zone so easily intruded by the flow of hot water.

PROCESSING OF AIRBORNE GAMMA-RAY SPECTRA: EXTRACTING PHOTOPEAKS

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Receiving information from airborne gamma-ray spectra is based on the ability to estimate the photopeak areas in the regular spectra of natural and other sources. In the airborne gamma-ray spectrometry, extracting the photopeaks of radionuclides from regular one-second spectra is a complicated problem. In the region of higher energies, e.g., above 1.6 MeV, the difficulties are associated with low count rates, while in the region of lower energies, difficulties are due to a significant background level and its statistical noise. In this article a new procedure is proposed to process the measured spectra up to extracting evident photopeaks. The procedure consists of decreasing noises in energy channels along the flight lines, transforming spectra to equal resolution spectra, removing baselines from each spectrum, sharpening details, and transforming spectra back to original channel scale. The resulting spectra are better suited for examining and using the photopeaks. No assumptions regarding the number, positions and magnitudes of photopeaks are needed. Non-negativity of photopeak areas is ensured by the procedure. The proposed technique is likely to contribute to studies of environmental issues, soil characterization and other near surface geophysical methods.

PROCESSING OF AIRBORNE GAMMA-RAY SPECTROMETRY USING INVERSIONS

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Geophysicist, Canada

Standard processing of Airborne Gamma-Ray Spectrometry data generally gives good results when the geological situation is uniform and the conditions of measurements are quite constant within footprint area with possible exception of flight height variations in a small range. Any violation of these conditions leads to certain problems. In reality, violations such as large changes of flight height and/or rugged terrain are not that rare as well as sharp changes in composition of surface rocks. This article proposes an approach where the solutions of inverse problems are used for data processing. The approach is quite natural in the processing of field data measured along the flight lines: it explicitly takes into account one-dimensional models of survey and flight parameters – from topography to sources distribution on the surface. Also, it clearly demonstrates that the inverse problem of Airborne Gamma-Ray Spectrometry data does not have a unique solution. This feature can be used in accordance with the geological problem in hands because various formulations of inverse problems can lead to various geological solutions. The use of the approach is illustrated by several examples given for both flight lines and survey areas.

MAGNETOTELLURIC IMAGING OF A CARBONATITE TERRANE IN THE SOUTHEAST MOJAVE DESERT, CALIFORNIA AND NEVADA

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The southeast Mojave Desert hosts one of the world's largest rare earth element (REE) deposits at Mountain Pass, California. Although surface geology has been studied, a full understanding of the carbonatite and associated intrusive suite complex requires subsurface geophysical characterization. In this study, a combination of geophysical methods, including magnetotelluric (MT), magnetics, and gravity are used to create a two-dimensional (2D) geophysical model to a depth of about 10 km. An electrically conductive body is found 2–3 km below and west of the deposit that is associated with a magnetic high that could be connected to a deeper (10 km) conductive body related to possible intrusions or hydrothermal systems. The carbonatite body coincides with a steep magnetic gradient and a bench or terrace in the gravity data that may reflect relative lower-density intrusive rocks. Although carbonatite rocks are typically magnetic, the carbonatite rocks, associated intrusive suite, and host rocks in this area are essentially non-magnetic. Combined geophysical data indicate that the enriched REE deposit may be related to a regional extensive hydrothermal alteration event.

PERFORMANCE OF HANKEL TRANSFORM FILTERS FOR MARINE CONTROLLED-SOURCE ELECTROMAGNETIC SURVEYS: A COMPARATIVE STUDY

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For the numerical calculation of electromagnetic responses by an arbitrary source in a one-dimensional model, integral-equation based approaches can be the best method since they are semi-analytic and thus very fast and accurate. In the numerical computation of the integral-based approaches, digital linear filters (e.g., Anderson's filter, Kong's filter and Mizunaga's filter) play a key role. Using a closed-form solution of the Hankel transform in transverse magnetic mode for a homogeneous half-space model, we can assess the accuracy of digital linear filters for evaluating the Hankel transform. In this paper, we conduct comparative performance tests on the linear filter with known integral transforms. We examine three kinds of filters developed by Anderson, Kong and Mizunaga, which are known to be suitable for marine controlled-source electromagnetic (CSEM) applications. Kong's filters perform best in the three kinds of filters over a practical range of offset distances in marine CSEM surveys. While the relative error versus distance appears as a V-shaped curve in semi-log scale, Mizunaga's filters are the shortest in length and have a performance comparable to Kong's filters. Anderson's filters have a quite similar performance between the J_0 and J_1 filters, although these are somewhat inferior to Kong's and Mizunaga's filters when computing marine CSEM fields.

AN ANALYSIS OF MASW RESPONSES FOR URBAN GROUND SUBSIDENCE

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Ground subsidence occurred by sink-hole and cavities in the city has become a serious problem in Korea so these days geophysics survey study for the near-surface become active. Multichannel analysis of surface waves (MASW) is useful survey method to detect anomaly under the subsurface and characterize the structure of S wave velocity of the medium. In this study, we set subsurface seismic model with reference to the real coring data near the sink-hole outbreak point. To define elastic properties of the medium from the core data, we apply ground physics model (GPM) and use Gassman's equation, the typical model for GPM. For Gassman's equation input, we consider and assume rock properties as porosity and bulk modulus and so on. The algorithm for this study is time-domain 2D FDM elastic wave modelling algorithm which is based on staggered grid and it damp the reflected wave in the convolutional perfectly matched layer (CPML) zone. We carry out synthetic modelling experiments with the composited medium model and analyse the sensitivity of the underground cavity effect. To set variables of the cavity, we adjust the scale and the depth of the cavity. MASW modelling results show the effect of the cavity and we will study further for the synthetic experiments.

AN ANALYSIS OF CHANGES IN RESISTIVITY OF GENERAL RESERVOIR DAMS BASED ON 4D INVERSION OF TIME-LAPSE RESISTIVITY DATA

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There are many reservoir dams in the South Korea for the purpose of agriculture. It is necessary to monitor these agricultural facilities to prevent accidents such as water leakage in the deteriorating equipment in advance. Resistivity surveys are commonly applied to determining leakage of water under the dams. Resistivity monitoring had been conducted every six hours during September, 2015 at the Cheongcheon reservoir on the Chungcheongnam-do in the south-west of the South Korea. Prior to analysing this monitoring data, it is needed to pick specific section of the data having meaningful changes of resistivity structure. Forward modelling was performed to determine variations of resistivity based on the variations of characteristics under the dams, consequently selecting proper dataset and doing inversion well. To reflect various underground feature like distorted dam structure and determine exactly, I developed three-dimensional (3D) electrical-resistivity modelling algorithm, using finite element method (FEM) based on tetrahedron element. Also, I examined rate of resistivity variation on the crest of the dam according to the changes of properties of reservoir. On the basis of this rate, valuable monitoring data were chosen and used to do time-lapse resistivity inversion. We also improved three-dimensional inversion algorithm to 4D algorithm, adding time constraint section, considering the rate of changes as time passes by. From this method, we could evaluate conditions of reservoir dam and avoid damage of human life or property by dam collapse.

GEOSCIENCE AUSTRALIA'S GEOPHYSICAL NETWORK: CRITICAL INFRASTRUCTURE AND OBSERVED AND DERIVED DATA FOR EARTH MONITORING AND COMMUNITY SAFETY

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Geoscience Australia operates and maintains a state-of-the-art network of stations and sophisticated instrumentation that monitors natural and anthropogenic (human-made) hazards in Australia and around the globe through its Geophysical Networks.

Key responsibilities are to: operate and maintain the Australian National Seismograph Network (ANSN) and Urban Monitoring (UM) networks; operate and maintain Australian Comprehensive Nuclear-Test-Ban Treaty (CTBT) seismic, hydro-acoustic and infrasound technologies, as part of Australia's commitment to support monitoring of worldwide nuclear testing; operate and maintain a national network of geomagnetic observatories which form part of a global observatory network; provide technical expertise and advice to Geoscience Australia projects, such as the National Geospatial Reference Systems, Hazard and Risk Infrastructure and Applications, Regional Development, Vulnerability, Resilience and Mitigation and the JATWS (Joint Australian Tsunami Warning System); and, provide technical and operational support for significant Australian earthquake events and aftershock deployment studies.

Geophysical data archives are stored on-site and can be freely downloaded from GA or international data centres. Seismic data can be accessed at GA and Incorporated Research Institutions for Seismology (IRIS) and geomagnetic data at INTERMAGNET.

Seismic data from Geoscience Australia's Geophysical Networks feeds into important hazard maps including the probabilistic national earthquake hazard map and the probabilistic Tsunami hazard map. Geomagnetic data feeds into the International Geomagnetic Reference Field and has been used to develop the first 3-D conductivity map of Australia.

AEROMAGNETIC COMPENSATION WITH PARTIAL LEAST SQUARE REGRESSION

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Magnetic exploration plays a significant role in regional geological investigation and detection of underground geological bodies with magnetic anomaly. At the moment, aeromagnetic survey is widely applied for its high efficiency, low cost and less subject to terrain restrict. Magnetic compensation is a key step in pre-processing survey data and several methods have been used. In this paper, we would use partial least square method to complete aeromagnetic compensation. Partial least square regression is frequently used to find the fundamental relations between two matrices. It combines linear regression analysis, canonical correlation analysis and principal components analysis. It can be applied into data with multicollinearity among independent variables and the number of variables is larger than

that of observations. Before compensation, we should have several pre-processing steps such as parallax correction, diurnal variations correction, geomagnetic field correction and high-frequency noise removal. This will provide us magnetic data with higher quality and make compensation process more accurate. We set synthetic aeromagnetic data with interference of aircraft's maneuvers and used partial least square method to do compensation. From the results of simulation, we can see that the interference signal is reduced to a low degree and satisfied compensation effect is obtained. Partial least square regression is a stable and effective method in the application of aeromagnetic compensation.

COMPARING TEST LINE INVERSION RESULTS FROM DIFFERENT HELICOPTERBORNE TRANSIENT INSTRUMENTS WITH REGARD TO HYDROGEOLOGICAL MAPPING

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The selection of an appropriate instrument for the data collection is one of the most important issues to address in survey design. Both theoretical analyses of the resolution capabilities of the candidate systems and field tests should be part of a selection process. It is also quite clear that any comparison must be performed based on the specific criteria of the survey. In this presentation we will concentrate on the field test aspects of the system selection process and compare the results of inverting data from three different helicopterborne systems: the VTEM system, the SkyTEM312 system, and the SkyTEM312FAST, that were flown over the same test lines. The bench marks of the comparison were mainly the near-surface resolution capabilities, both vertically and horizontally, and the resolution at depth. The results of our study show that in certain parts of the test lines both SkyTEM systems have a better near-surface vertical and horizontal resolution than the VTEM system, but that in other parts of the test lines differences are small. The depth penetration seems to be approximately the same for all three systems. The differences between the SkyTem312 and the SkyTem312FAST are almost imperceptible.

ELECTROKINETIC MONITORING GROUNDWATER FLOW IN FRACTURED ROCK MEDIA

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When investigating an anthropogenic fluid migration event within a given hydrogeological setting, information relating to hydraulic transmissivity is typically evaluated using a set of observation wells. Due to high production costs observation wells are often scant in numbers; additionally their intrusive nature bares further disturbances to natural aquifer conditions. Now more than ever, there is an indisputable need for low-cost, non-intrusive and reliable geophysical methods sensitive to these groundwater flows.

Ground water flows are known to generate electrokinetic signals that can be measured passively at the ground surface, and these 'self-potential' signals generated can be used to measure and estimate patterns of groundwater flow.

Two pump programs were conducted in fractured rock aquifer systems in the Adelaide Hills Region, South Australia. The predominant purpose of these programs was to quantitatively investigate the self-potential responses of these systems, this included gathering of complimentary geophysical data to support conclusions.

WIRELINE LOGGING: COST EFFECTIVE METHODS FOR NEW WATER BORE CERTIFICATION AND OLD LEAKY BORE REHABILITATION ASSESSMENT

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Water bores in Australia are important capital assets used for local town water supply, agricultural stock supply and irrigation or simply as an indicator of the region's aquifer health. Water bore construction methods used in previous decades has led to a pervasive problem of surface leakage and/or sub surface leakage and aquifer contamination particularly in relation to the Great Artesian Basin. Wireline logging methods are available to assess if a new water bore meets current design requirements to prevent leakage/contamination issues (hence certification) or to assess the current internal and 'in situ' condition of old water bores. Knowledge of the current 'in situ' condition of the water bore will be able to direct a rehabilitation workover programme. Methods range from a simple 3 arm caliper for internal casing inspection and full wave sonic logging is assess the presence/absence of cement in the annulus of the casing through to high resolution acoustic (multi-fingered caliper) and optical imaging of the internal casing. Methods are discussed and examples provided.