fault running on the western edge of two basins named Melandro and Pergola. The fault is composed by two main NNW-trending, ENE- dipping segments, showing an en-echelon pattern. The fault affects recent soft sediments, producing scarps up to 10 m high. Evidence for Late Pleistocene-Holocene tectonic activity along the trace were also observed at several outcrops and quarries, such as tilted and deformed colluvial and alluvial deposits. Radiocarbon dating from deformed sediments revealed a faulting age of at least 12 ka old. The far- and near- field data analysis and interpretations lead to consider this fault as a potential large earthquake source in this area.

T51E MCC: Level 1 Friday 0830h

Ground and Space Methods for Monitoring EM Preearthquake Phenomena I Posters *(joint with GP, S, SA, SM, MR)*

Presiding: **S Pulinets,** Universidad Nacional Autónoma de México**; M Parrot,** Laboratoire de Physique et Chimie de l'Environnement, CNRS, Universit dOrlans

T51E-0200 0830h POSTER

STIMULATED IR EMISSION FROM THE SURFACE OF ROCKS DURING DEFORMATION

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Studying the IR emission from rocks placed under stress may lead to a better understanding of the reported pre-earthquake "thermal anomalies", observed in mid-IR satellite images. Large blocks of granite and labradorite (45 x 30 x 7 cm3) were loaded in their center between two vertically oriented pistons (11.25 cm diameter). Smaller blocks of the same rocks plus gabbro (about 10 x 10 x 7 cm3) were loaded uniformly over their entire cross sections. We used a SATEC press (250 tons) and a BOMEN FT-IR spectrometer (3.3-14 micron), equipped with two black body sources (one at ambient temperature and another controlled at a higher temperature) for calibration. At 1 m from the samples, the spot size on the surface analyzed was about 5 cm in diameter. The blocks were loaded at a constant rate until failure. Typical runs lasted for 10-15 min. We monitored the IR emission from the front faces, which were either rough saw-cut or irregular broken. In the case of the large blocks the emitting surfaces were 20-25 cm from where the rocks were loaded. In the case of the smaller blocks the emitting surfaces were part of the rock volume that experienced increasing levels of stress and, at higher loads, underwent cracking and occasional spallation. We observed distinct changes in the IR emission spectra during press. The changes were specific of the rock and the loading geometry. They include a band at 11.7 micron, the position of which agrees with that of vibrationally excited O-O bonds, predicted to form when positive hole charge carriers, activated in the inner rock volume under stress, recombine at the rock surface.

T51E-0201 0830h POSTER

Charge Releasing of Charge Trapping Centers on Milled Quartz Grains

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Milling treatment makes quartz grains with amorphous and/or disturbed surface layers that acquires many E' centers and is often called the surface disordered layer. We measured thermoluminescence (TL) from milled quartz grains of different sizes with and without surface disordered layers. Here, TL phenomenon from quartz is caused by recombination of thermally stimulated electrons and Al-hole centers. The TL intensities per unit mass of both grains with and without the surface disordered layers decreased with decreasing grain diameter. It is due to loss of photons through reflection on grain surfaces. In addition, the TL intensity of grains with the layers decreased more rapidly than that without the layers. This indicates deformation and/or breakage of Al-hole centers in the surface disordered layers. Broken Al-hole centers release holes, while newly formed E' centers release electrons. These holes and electrons are disturbed in surface disordered layers during the milling procedure. These charges form surface electrification on grains and generate even TL. Faulting similarly forms the surface disordered layers along fault surfaces and in the gouge. Therefore, the charge releasing of charge trapping centers may be widely related to generation of electromagnetic phenomena accompanied with earthquakes.

T51E-0202 0830h POSTER

An Electrochemical Model for the Inception and Prediction of Earthquakes

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Much has been said and written about increased pore pressures prior to earthquake events. I will present a model that shows how the pore pressure in rocks increases catastrophically due to simple electrochemical principles. The model is applicable to all rocks under stress in contact with aqueous pore fluids. Its simplicity probably means that the mechanism is ubiquitous in the crust. Additionally, this new model of the earthquake source suggests that significant electrical signals will be created in the hypocenter region.

T51E-0203 0830h POSTER

In Search of Correlations between Geoelectrical Signals and Earthquakes in a Seismic Active Area of Southern Italy

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The aim of this work is to investigate the possible correlation between electrical anomalous patterns and incoming earthquakes in a seismic active area of Southern Apennine chain (Italy). In this research field, the greatest problem is the sporadically monitoring activities in time and space. A very weak point is also the current approach to time series analysis that makes no use of robust statistical methods to discriminate extreme events from random noise. Further, the lack of objective criteria to assess the precursory character of the geophysical anomalous signals makes the short-term predictions based on them poorly reliable. Altogether these shortages concur to explain the low scientific consensus placed so far on the claimed correlation between the observed geophysical anomalies and the occurrence of earthquakes. Taking into account these considerations, in this paper we analyse the self-potential time series coming from a new geophysical monitoring network installed in a seismic active area of the Southern Apennine chain (Southern Italy). All the remote stations (Tramutola, Tito, Giuliano, Marsico Nuovo and Laterza) are equipped with multi-electrode array able to detect the time fluctuations of self-potential along two directions, N-S and E-W. The monitoring strategy combines new technologies for data acquisition with advanced statistical packages for the identification of the extreme events in geophysical time series. During the last years a very large data-base of self-potential time series has been organized and it is actually available to assess robust statistical methodologies to identify extreme events. Firstly, we have investigated the inner dynamical structure the self-potential time series and we have filtered the effects induced by climatological parameters (temperature, rainfall, etc.). In a second step, we propose robust statistical methods to pick out extreme events from background electrical noise. Finally, we compare the extreme events identified in the self-potential time series and the earthquakes sequences recorded during the past 5 years (1997-2002) in the investigated area. The results allow us to obtain only in few cases a significant correlation between sequence of extreme events in electrical signals and incoming earthquakes, the measuring period is not sufficient to perform an high number of statistical checks. However the time dynamics of self-potential signals seem to be correlate with the fluctuations of seismic cycle over long time periods.

T51E-0204 0830h POSTER

Observations of Seismoeletric Signals Induced by a Hydro-fracturing Experiment in a Deep Geothermal Reservoir

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During a hydro-fracturing experiment at the Soultz-sous-Forêts Hot Dry Rock site, more than 100,000 microseismic events of magnitude greater than -2.0 were induced by the continuous injection of 30,000 m^3 of fresh water at 5 km depth. At the same time, we carried out monitoring of surface electric fields at a sampling rate of 2 kHz with two pairs of unpolarizable electrodes. After removal of the man-made noise, we observed strong electric field perturbations associated to the 48 microseismic events of magnitude greater than 1.8. Their maximum amplitude is 20 mV for the largest event (M = 2.7) while the background electrical noise is roughly 70 mV. The start of these electric perturbations coincides with the P-arrival time of the seismic waves at a depth of 1.5 km i.e. roughly half a second before the surface arrival time and their duration is about one second. As the sediments - granite interface is located at the same depth, the source of these electromagnetic signals could be an electroseismic conversion at this high acoustic impedance contrast. Moreover, a detailed analysis of the electric waveform reveals that several electric phases are arriving on the surface after the first pulse which may be caused by electroseismic conversions within the sediment layers. We did not however observe any electric field perturbations prior to rupture and the alleged first pulse associated with piezoelectric effect. It seems therefore that the prevailing effect when monitoring high-frequency ($\geq$ 1 Hz) synearthquake EM phenomena is seismoelectric.

T51E-0205 0830h POSTER

Pre-earthquake Electromagnetic Waves Propagation from the Underground Seismic Source to the Earth's Surface

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A static and quasi-static model is proposed for describing the characteristics and the propagation of pre-electromagnetic waves from the seismic focal zone to the Earth's surface and the near-Earth space.
Such waves are supposed to be generated by changes in the state of stress in the hypocentral focal volume during the earthquake preparation.
In formulating the model, the realistic case of pre-electromagnetic waves propagating in a stratified lithosphere with different values of electrical conductivity has been taken into account.
Different elementary (dipolar) and real (volumetric) sources as well as the presence of a vertical fault have also been considered.
The electric and magnetic fields are determined by the model at any lithospheric layer and at the Earth's surface.

T51E-0206 0830h POSTER

Ultra Sensitive Monitoring of the Geomagnetic Field Combined with Radon Emanation as a Tool for Studying Earthquake Related Phenomena

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An ultra sensitive magnetic gradiometric system and a very sensitive, continuous radon monitoring system are located with an existing seismic array, at the Amram Geophysical Observatory near Eilat, Israel. The purpose of setting these independent technologies together was to assess their applicability as a combined tool for studying earthquake related phenomena in the Dead Sea Rift (DSR) - a geodynamically active region (seismogenic). The magnetic system consists of three GEM Systems SuperGrad© magnetometers, spaced several tens of meters apart, having a sensitivity of 0.05 pT/$\sqrt{Hz}$, bandwidth ranging from DC to 10 Hz and featuring very high long-term stability. Several months of on-site operation shows that the magnetic gradiometric system demonstrates: a) a new capability of ultra-high precise geomagnetic field observations at sub-pT resolution; b) enables the suppression of diurnal variations and pulsations, thus enhancing the resolution of residual shallow crustal contributions; c) the registration bandwidth provides an opportunity to analyze field variation in a wide frequency domain, which was not attainable so far. The initiative of including radon monitoring is based on the combination of: a) large multi-day temporal radon variations are recorded at the Amram site; b) part of the variation is correlated to radon signatures at other locations in the same tectonic segment; c) some of the signals are similar to the multi-day signals, from another part of the DSR, which are significantly related to weak earthquakes in the DSR (Geology, v. 31, 505-508). The operated radon system consists of alpha and gamma ray detectors, integrating at a rate of 15 minutes and having a sensitivity of below 0.1 pCi/l in the geogas. The combined geophysical system is in continuous operation since 2002. It is expected that joint analysis of long-term multi-sensor data series will reveal subtle geophysical signals that precede or follow earthquakes in the region.

URL: http://www.gemsys.ca

T51E-0207 0830h POSTER

Seismo-Ionospheric Precursors

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Large earthquakes are often preceded or accompanied by signals of a different nature: electric, electromagnetic, or luminous, although seismic waves are the most obvious manifestation. Recently, seismo-ionospheric phenomena have received considerable discussions. To investigate possible seismo-ionospheric precursors, we statistically examine the relationship between electron density variations at the ionospheric F2 peak observed by a local ionosonde and 184 earthquakes with magnitude 5.0 or larger, which occurred in 170 days during 1994 1999 in the Taiwan area. Results demonstrate that the electron density abnormally decreases during the afternoon period, 1200 1800 LT, within 5 days before the earthquakes. The odds of the earthquakes with the precursor increasing in the earthquake magnitude but decreasing in the range between the epicenter and the ionosonde confirm the existence of an imminent seismo-ionospheric precursor.

T51E-0208 0830h POSTER

Long-term monitoring of electromagnetic signals along the San Andreas Fault

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There have been frequent reports of anomalous electromagnetic (EM) signals (or changes in ground resistivity) preceding seismic activity. Although there are a number of physical mechanisms which might plausibly explain such EM-seismic phenomena, observations often seem inconsistent (e.g., precursors are reported to be primarily electrical in some cases, but in others are primarily magnetic) or difficult to reproduce (the phenomenon appears to occur in some special locations or circumstances, but not in others). As a result, the very idea that tectonic activity might have a measurable EM signature is justifiably regarded with skepticism by many scientists. One major problem with many previous reports of EM precursory phenomena has been the lack of redundant measurements which would allow signals to be corroborated and separated from natural magnetotelluric (MT) and cultural sources of EM noise. In an effort to address some of these issues systematically, EM monitoring arrays have been established near the Parkfield segment of the San Andreas Fault. Here we will present results from an array of 2-3 magnetotelluric instruments which has been occupied for much of the past 7 years, with sites near Hollister and Parkfield, CA. Each site is instrumented with an EMI MT-1 system, consisting of three orthogonal induction coil magnetometers, 2-4 orthogonal dipoles to measure induced electric field variations, and Quanterra data loggers digitizing at 40 Hz. With multiple sites it is in principal possible to remove the relatively large scale external MT signals, increasing sensitivity to more localized signals that might be associated with tectonic activity. In the simplest approach, the horizontal magnetic fields at a reference site are used to estimate the MT signal at the local site. We compare several variants on this basic idea, including time and frequency domain approaches, and approaches based on multivariate statistical methods. We find that large scale cultural noise from the San Francisco Bay Area (mostly due to DC trains) complicates residual estimation significantly. During the period that these arrays have been occupied, we have not yet detected any pattern of anomalous signals that is obviously associated with small earthquakes in the Parkfield or Hollister areas.

T51E-0209 0830h POSTER

Pre Earthquake Phenomena in Phase Velocities and Gradients of ULF Geomagnetic Disturbances

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Tree high-sensitive three-component torsion magnetometers MVC-2DS were operating in Japan before and during a seismic active period started 26.06.2000. A seismic active region was situated to the southeast from Izu peninsula. The strongest seismic shock with magnitude MS=6.4 had taken place 01.07.2000 under a sea bottom at a distance 85 km from the magnetic stations. The magnetometers were installed at the Izu peninsula in tops of a triangle at a distance 4-6 km from each other. This configuration of the magnetic stations allows determining of gradient and phase velocity vectors along the earth's surface using a phase-gradient method. The vectors of the gradient are usually directed to a source of the ULF EM waves, the vectors of the phase velocity - from the source. A time evolution of the phase velocity and gradient values of the pulsations with periods T=2-512 s (data were preliminary filtered by narrow pass-band filters) was investigated before and during the seismic active period (from 1.02 to 25.07.2000). An increasing of the phase velocity and gradient values was observed 1.5 months before first seismic foreshock. The greatest values in Z component were reached close to the moment of the EQ. The increasing of the phase velocity values was observed only in direction from the future seismic activity region. There was no change of the phase velocities in the opposite direction. A sharp increasing of the gradients was distinctly seen 2-3 days before the seismic shocks with Ms>6. The effect was most clearly observed in the short-period pulsations in the total horizontal component. A new direction of the gradient vectors in the total horizontal component aroused 2-3 weeks before the seismic activity beginning - just the direction to the future seismic activity region. The phase velocity vectors shown a new direction (just the direction from the future seismic activity region) in the total horizontal component the same 2-3 weeks before the seismic activity start. The phase velocity and gradient vectors in Z component were mostly connected with the seawater induction currents ("sea coast" effect) and only during the seismic active period the vector directions were connected with ULF EM sources situated in the seismic active region. A comparison of the ULF magnetic field variations at the Kakioka magnetic station, located 200 km to the northwest from the magnetic stations, with the gradient values at the Izu peninsula shows a low correlation between a magnetic activity and the time evolution of the magnetic pulsation gradients.We suppose that the gradients and phase velocities features observed before the seismic activity start is probably connected with an arising of a local geoelectric anomaly connected with the future seismic region. The increasing of the gradients just before the strong seismic shocks is probably connected with the ULF EM emissions exited in the seismic activity region situated in the Earth's crust.

T51E-0210 0830h POSTER

Early Warning of Coastal Earthquakes Using Land, Ocean and Atmospheric Parameters

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Three Indian coastal earthquakes (Gujarat, Pondicherry and Andaman) have occurred near the western and eastern coasts of India. These earthquakes are known as intraplate earthquakes which occurred far from the plate boundaries. The physics of such earthquakes are still a mystery to the scientific community. These earthquakes at times have proved to be disastrous e.g. 20000 people were killed in the Gujarat earthquake of January 26, 2001. In the present paper, detailed analysis of remote sensing data has been carried out of various land, ocean and atmospheric parameters prior and after the earthquake. The IRS P4 OCM data have shown significant changes in chlorophyll concentration. The MODIS data from these earthquakes have shown significant changes of the land infrared thermal temperature. The surface latent heat flux retrieved from the NOAA satellites over the epicentral region of these earthquakes show anomalous increase prior to the main earthquake. Various parameters deduced from various satellites data have been analysed statistically and also using signal - noise decomposition of time series using the

continuous wavelet transform. The detailed analysis of these parameters shows strong interaction between land-ocean-atmosphere prior to the earthquake. Such interaction shows anomalous behavior of land, ocean and atmospheric parameters that can be used in the early warning of impending coastal earthquakes.

T51F MCC: Level 1 Friday 0830h

Lithospheric Structure and Dynamics I Posters *(joint with S)*

Presiding: **B Guest,** University of California, Los Angeles**; K Mutnuri,** Rice University

T51F-0211 0830h POSTER

Crustal and Upper Mantle Structure of the Taupo Volcanic Zone, North Island, New Zealand.

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The Taupo Volcanic Zone (TVZ) is a major Pliocene-Quaternary NNE-SSW orientated,volcanotectonic complex, about 250 km long and up to 60 km wide in the central North Island of New Zealand. The TVZ is one of the largest and most frequently active rhyolitic magmatic systems on Earth, characterised by intense shallow seismic activity, high natural heat flow (some 12-20 times the continental norm) and active NW-SE extension. To the north of the TVZ, subduction of the Pacific Plate beneath the oceanic lithosphere of the Australian Plate is accompanied by a region of back-arc extension (the Havre Trough). The TVZ marks the southern continuation of this back-arc extension into continental lithosphere.The TVZ therefore represents an ideal opportunity to study the onset of back-arc spreading onshore. Here we present forward and inverse models of the crustal structure beneath the TVZ. These models incorporate both active and passive source data acquired from the NIGHT (North Island GeopHysical Transect) project. Common to both models is a 2-3km deep basin of low velocity sediments which we interpret to be ignimbrite deposits. Typical basement velocities of ∼6km/s are observed beneath and to either side of the TVZ, where they correlate well with mapped outcrops of basement rocks. Velocities of around 7.3 km/s are observed at depths greater than 16 km beneath the TVZ. Such velocities may be interpreted as anomalously low velocity upper manlte or heavly intruded lower crust. Having constrained the crustal structure we then use earthquake events from the subducting Pacific Plate to yield information on the velocity structure of the upper mantle beneath the TVZ. NIGHT Working Group A. Harrison, J. Haines, R. White (University of Cambridge,United Kingdom); S. Henrys, S. Bannister, I. Pecher, F. Davey (Inst. Geological and Nuclear Sciences, Lower Hutt, New Zealand); T. Stern, W. Stratford (Victoria University of Wellington, New Zealand); H. Shimamura, Y. Nishimura, and A. Yamada (Hokkaido University, Sapporo, Japan).

T51F-0212 0830h POSTER

Strong decrease in ultrasonic Vp in lower crustal rocks at high temperature

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In order to determine temperature derivatives of P-wave velocities (Vp) at pressure-temperature conditions of island arc lower crust, we measured Vp in various lower crustal rocks from exposed crustal section of Kohistan arc at temperature up to 1000 °C at pressure 1.0 GPa. The rock sample is embedded in a cylinder of pressure transmitting material (talc). Pt buffer rod is used to isolate the piezo-electric transducer from the high-temperature condition. Travel times of P-wave through the rock sample were determined with the pulse reflection technique. Sample length at experimental conditions was estimated with adiabatic bulk modulus and thermal expansion coefficient of rock samples studied. The uncertainties of Vp are ± 0.3 %. Kohistan arc lower crust is mainly composed of gabbronorite, wehrlite (Chilas complex), amphibolite, tonalite (Kamila amphibolite), pyroxene granulite, garnet granulite, garnet pyroxenite, websterite, and dunite (Jijal complex). Vp measurements were performed for 6 rock samples at 100 °C intervals up to 1000 °C. Ultrasonic determinations of Vp in the Kohistan lower crustal rocks show nonlinear temperature dependence. With increasing temperature, Vp values decrease slightly at lower temperature conditions, and decrease rapidly at higher temperature conditions. Cusp on the Vp - temperature profiles was identified for all samples. Cusp locates at various temperatures (300-800 °C) depending the rock sample measured. The temperature derivative above the cusp temperature is 1.8 - 5.8 times higher than the temperature derivative below the cusp temperature. Vp value is 7.0 km/s at 800 °C and 1 GPa for the gabbronorite, 7.6 km/s at 800 °C for the wehrlite, 7.2 km/s at 900 °C for the garnet granulite, 7.5 km/s at 900 °C for the garnet pyroxenite, 7.2 km/s at 900 °C for the websterite, and 8.0 km/s at 900 °C for the duntie.

T51F-0213 0830h POSTER

Elastic Thickness of the lithosphere below the Tehuantepec ridge

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7 shipborne bathymetry and free-air gravity profiles, crossing the Tehuantepec ridge and fracture zone (TR), have been used to estimate the elastic thickness (Te) of the oceanic lithosphere, by the means of the admittance technique. The age of the oceanic lithosphere and the bathymetry in the vicinity of the TR change abruptly from the NW to SE. The assessment of the age of the lithosphere at the time of bathymetric loading of the TR can be deduced from the analysis of the experimental admittance and the elastic thickness Te. We have computed the admittance, which is interpreted in terms of isotropic elastic plate thickness. A model with a Te of 10±5 km fits well the observed admittance. The shape of the admittance (low values at low wave-numbers) suggests that TR is isostatically compensated. Using a diagram of the Te versus the age for a cut-off temperature of 450°C, the age of 15±10 Ma was obtained for the oceanic lithosphere at the time of TR onset.

T51F-0214 0830h POSTER

Structural and Stratigraphic Correlations Between the Conjugate mid-Norway and NE Greenland Continental Margins

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Late Mesozoic-Cenozoic tectono-stratigraphic correlations between the conjugate mid-Norway and NE Greenland continental margins are provided based on the recently refined structural and stratigraphic framework off mid-Norway, new early opening plate reconstructions between Jan Mayen and Senja fracture zones, and a regional grid of seismic reflection profiles off NE Greenland. The Norwegian margin exhibits a distinct along-strike margin segmentation governed by across-margin transfer systems. In particular, the Bivrost Fracture Zone and its landward prolongations are well-defined features on the conjugate margins representing a first-order, across-margin tectono-magmatic boundary of prolonged structural inheritance. Regional transects across both margins reveal important vertical and lateral variations in crustal configuration and composition resulting from a complex history of rifting prior to and during the last Late Cretaceous-Early Tertiary rift episode leading to breakup and volcanic margin formation. Although the composite Late Jurassic-earliest Cretaceous rifting is the dominant tectonic episode we also observe structural and stratigraphic relations that indicate an Aptian-?Albian rift phase, probably coeval with similar events elsewhere on the NE Atlantic margins. Late Cretaceous rifting, with onset in middle Campanian time, is characterized by low-angle detachment faulting, culminating with regional uplift, intrusive igneous activity and subsequent erosion towards the end of the Paleocene. Thick seaward dipping reflector sequences manifest massive eruptions of lavas during breakup at the Paleocene-Eocene transition. The post-breakup passive margin development is characterized by the transport and deposition of large amounts of sediments in response to margin subsidence and continental uplift, particularly during two distinct phases of outbuilding in Oligocene and Plio-Pleistocene times. Of special interest are a number of mid-Cenozoic intrabasin inversion features recognized both off Norway and off Greenland, revealing a regional compressive regime.

T51F-0215 0830h POSTER

Bivrost Transfer System: A Primary Cross-margin Tectono-magmatic Feature on the Norwegian-Greenland Margin

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The Norway-East Greenland conjugate margin exhibits distinct along-strike segmentation. The Jan Mayen and Senja fracture zones and their landward prolongations represent first-order features. In between, we identify several second- and third-order features. Of these, the Bivrost transfer system is the most prominent. Off Norway, it separates two different physiographic provinces, i.e. the Vøring and Lofoten-Vesterålen margins. Structural studies, analysis of potential field images on the conjugate margins, and plate reconstructions to early Tertiary opening suggest a landward prolongation of the Bivrost Fracture Zone on both margins. The prolongations appear as low-relief Late Jurassic-Early Cretaceous accommodation zones, reactivated during Late Cretaceous-Paleocene rifting. We recognize a difference in trend, and possibly in polarity, of the relative motion between the older transfer zone and the younger fracture zone. The more northerly sinistral relative motion along the fracture zone suggests two different stress regimes, however the older feature may have determined the initial location of the fracture zone. Pre-opening structural spatial relations may imply sinistral offsets also along the continental prolongations. Furthermore, we observe a northward decrease in thickness and volume of the high-velocity lower crust, interpreted as related to magmatic underplating, across the Bivrost Fracture Zone. Other changes north of the fracture zone include: breakup lavas over most of the continental slope, a reduction in the intensity of sill intrusions, and a change in style of the seaward dipping seismic reflector images to less prominent and shallower features without the typical, deep wedge-like pattern observed to the south. We interpret breakup occurring in different crustal configurations: in the south along the western flank of the deep Cretaceous Vøring Basin, and in the north along a deep-rooted detachment fault in relatively thick crust on the eastern basin flank. These settings have governed the asymmetric distribution of breakup magmatism and the construction of marginal highs.

T51F-0216 0830h POSTER

Extent of Continental Crust Thickening Derived From Gravity Profile Leading From Aden Towards the Dhala Plateau in the Yemen Trap Series

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Gravity profile trends NNW from Aden and terminates at the Dhala plateau formed by Tertiary volcanics often referred to as the Yemen Trap Series. The length of profile is 120 km. Profile consists of 366 gravity stations with average distance of 300 m between stations.

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