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Satellite radar interferometer observations reveal widespread and continuous surface deformation on the western Galapagos Islands of Isabela and Fernandina during the period 1992-2001. All seven major volcanoes, save one, showed sigificant signs of activity although only two eruptions occurred during the observation period. These basaltic shield volcanoes are characterized by large summit calderas and a lack of rift zones. The radar images show caldera-centered uplift at four of the volcanoes: Wolf, Darwin, Alcedo, and Sierra Negra. The uplift rates are variable over time with a maximum of 90 cm/year at Sierra Negra volcano during 1997-1998. The total uplift of Sierra Negra volcano from 1992-2001 is about 3 m. Cerro Azul and Fernandina volcanoes erupted during the observation period and show evidence of inflation, co-eruptive deflation and shallow dike intrusion. No deformation is observed at Ecuador volcano; it is also the only volcano here that has not erupted during historical time. Although the distance between adjacent volcanoes on Fernandina and Isabela is only 30-40 km, this pattern of simultaneous uplift at many neighboring volcanoes is not typical of other ridge-hotspot systems. For example, in Iceland only one volcano is generally active at any given time.

The variable and varied deformation patterns seen in the high-resolution radar deformation maps show that several different subsurface magma flow patterns occur in the Galapagos. Increasing pressure in a single magma reservoir, as described by a point source (Mogi) model embedded in an elastic half-space, fairly accurately reflect observed inflation at Wolf, Darwin, Cerro Azul and Fernandina. The resulting source depth is 5 km at Cerro Azul but 2-3 km at the other volcanoes, or only 1-2 km below sea level. Fernandina, however, also shows a significant pattern from a shallow dike intrusion associated with a flank eruption in 1995. Sierra Negra exhibits both spatially and temporally variable uplift that can be modeled by a shallow inflating sill during 1992-1997 and 1998-1998. Inflation during 1997-98, however, was accompanied by trap-door faulting on a steeply dipping fracture system within the caldera. Field observations in 2001 support our earlier interpretation of the InSAR data that up to 1 m of faulting occurred. Repeated trapdoor faulting over geological time has formed an arcuate intra-caldera ridge within Sierra Negra and may have acted to relax stresses above the magma chamber, inhibiting summit eruptions.

T42B-0942 1330h POSTER

Consistent Melt Production From a Weak but Stable Galapagos Plume; Inferences From Fernandina Volcano

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Homogenous and evolved lavas from Fernandina Volcano, located at the leading edge of the Galapagos mantle plume, place constraints on plume thermal and material transport processes. Analysis of over 100 samples, selected for geographic, age, and petrographic variability, show that Fernandina, a 1476 m high, 32 by 24 km shield volcano with a highly active 850 km-deep caldera has erupted remarkably monotonous lavas over its subaerial history. These samples, including examples from all of the last 13 known historic eruptions (1958-1995), are notable for their accumulated plagioclase phenocrysts, nearly constant composition [La/Sm(N) of 1.4-1.7 and Pb207/204 of 15.52-15.57], and consistently evolved nature (MgO of 5.6-6.7% for fine-grained, non-cumulate samples). Inferred eruption temperatures cover a narrow range of about 1100 to 1140°C. Microprobe analysis of over 40 samples shows extensive evidence for active mixing in the shallow magmatic system, yet no evidence exists for shallow Fernandina melts with Mg# higher than 0.62 or temperatures hotter than about 1160-1180°C. Picritic lavas recently dredged from Fernandina's offshore NW rift are also of an evolved composition (D. Geist, pers. comm., 2001). They complement the subaerially-erupted plagioclase-rich lavas in indicating that active crystallization processes are occurring within a dynamic shallow magmatic system, with accumulation of unerupted olivine on the central magma chamber floor and plagioclase accumulation by flotation in the more evolved, erupted lavas. Caldera depth has fluctuated at least 800m in its history (implying dramatic changes in central magma chamber geometry); the thermal and chemical stability of this volcano is remarkable given the dynamism of its central, shallow magmatic system. As Fernandina's subaerial volume is about 170 km3, estimates of eruption rate (including those of Rowland, 1996) indicate that stability must have been maintained for at least 4-10 thousand years. During this time (within the timeframe of plume melt extraction and transportation estimates, e.g. Sims et al, 1999), melting in this demonstrably complex plume (Harpp and White, 2001) must have been relatively constant in terms of both source composition and source melting amount, thereby leading to consistent volcano melt supply. In addition, significant and consistent heat loss during lithosphere transport must have occurred to prevent primitive parental melts from entering the shallow Fernandina magmatic system, implying that deeper crustal storage and associated crystallization has been involved.

T42C MC: Hall D Thursday 1330h

Hotspot-Ridge Interactions III *(joint with OS, S, V)*

Presiding: **A Briais,** CNRS**; A H Barclay,** University of Washington

T42C-0943 1330h POSTER

Dynamical Models of Melt Migration and Crust Formation in a Plume Beneath a MOR

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The evolution of a mantle plume ascending through the upper mantle beneath a spreading mid-oceanic ridge and the generation and migration of melt is modelled for the case of temperature-dependent mantle viscosity. The interactions between melt generation and mantle convection are taken into account considering the effect of latent heat on temperature, the density reduction in the melting mantle due to depletion and melt retention of the matrix and the effect of transitions of Al-bearing phases on melt production and temperature. The migration of melt is modelled explicitly as porous flow in a deformable matrix, taking into account its buoyancy and dynamical forces from matrix-melt interaction.

The models, which differ in plume excess temperature, viscosity and threshold value for melt extraction/retention, result in a wide range of amounts of produced melt and crustal thickness for both normal crust and hotspot crust. The crustal thickness is quite sensitive to variations in threshold porosity; it seems that low porosity values are more likely to match observations at real oceanic crust. In the modelling of melt segregation, it is important to take into account the compressibility of the melt, because it controls the segregation velocity and thus also has influence on the porosity and crustal thickness.

T42C-0944 1330h POSTER

Experimental Constraints on the Tholeiitic-Alkalic Transition in Kerguelen Archipelago Basalts

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The Kerguelen Archipelago is the emergent part of the 19-20 km thick Northern Kerguelen Plateau (NKP), which is located on the nearly stationary Antarctic plate. The NKP began to form at ~40 Ma, when the Southeast Indian Ridge and the Kerguelen mantle plume were coincident, and since 40 Ma, the ridge has moved to the north relative to the NKP. Lava compositions range from tholeiitic at Site 1140 (34 Ma) on the northern edge of the NKP, to transitional for the 26-29 Ma flood basalts on the archipelago, to alkaline for the youngest (24-25 Ma) volumetrically important lava sequences on the archipelago.

Primary variations in the alkalinity of basaltic magmas are considered to result from changes in the extents of partial melting or through the effects of clinopyroxene (cpx) fractionation. The presence of rounded, high-Al cpx phenocrysts in the mildly alkalic lavas of the 24 Ma Mont Crozier section on the Kerguelen Archipelago is suggestive of a high-pressure crystallization environment. We performed a series of equilibrium crystallization experiments on a powder of natural basalt from Mont Crozier (dry and slightly hydrous, 1.2 wt% H_2O) both at relatively high (0.4 to 1.4 GPa, piston cylinder) and low (<0.1 MPa, vacuum furnace) pressures to test the fractionation effect of cpx on alkalinity changes.

The observed geochemical trends for the experimental glasses show that hydrous, high-pressure (0.9 GPa), high-Al (8-10 wt% Al_2O_3) cpx-only fractionation produces nearly all of the required geochemical trends, especially Al-enrichment, observed in the Crozier lavas. Cpx-only fractionation, however, does not significantly increase alkalinity at these pressures. Major alkalinity changes must then reflect decreasing extents of melting, or deeper melting, within the Kerguelen mantle plume. The tholeiitic-alkalic transition on the Kerguelen Archipelago is related to progressive deepening of the lithosphere-asthenosphere limit (lowering melting) and of the crust-mantle interface (site of high-pressure cpx fractionation) with time as it moved from a ridge-centered position to an intraplate setting.

T42C-0945 1330h POSTER

Influence of the Reunion/Rodrigues Hotspot on the Structure of the Central Indian Ridge Near 19°S

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We present an analysis of multibeam bathymetry, backscatter imagery, and gravity data collected during the Magofond2 and Gimnaut cruises, and of satellite-derived gravity anomalies, on the flanks of the Central Indian Ridge (CIR). The bathymetry data reveal that the CIR axis near 19°S is about 1000 m shallower than normal, slow-spreading ridge axes. In this area, the ridge flanks display low-relief abyssal hills, up to 100 km long, which are similar to those observed on intermediate-spreading centers. The traces of the axial discontinuities in the ridge section between 18°30'S and 20°S are marked by series of low-relief bathymetric saddles, contrasting with the deep basins marking the ridge offsets farther south. Bathymetric highs are observed on the eastern flank of the ridge near the center of two segments at 19°10'S and 19°30'S. The Mantle Bouguer Anomaly map shows two small-amplitude, negative anomalies associated with the two bathymetric highs, superimposed on a broader regional negative anomaly, centered on the ridge segment at 19°30'S. The pattern is asymmetric, displaying more negative values on the west flank, towards a group of small off-axis, elongated ridges. The residual mantle Bouguer anomaly displays a similar pattern. The negative anomalies are suggestive of thicker crust and/or hotter mantle beneath the ridge axis and the western ridge flank. The low-relief bathymetry between 18°30'S and 20°S, the asymmetry of the gravity anomalies, and the good correlation between both the regional and more localized MBA lows and the off-axis volcanic ridges suggest an influence of the Reunion hotspot on accretion processes and volcanic construction near the CIR axis. The thermal influence appears to spread over a large area, certainly due to the large distance of about 1000 km between the ridge and the hotspot. The contrast between the low-relief bathymetry between 18°30'S and 20°S and the high reliefs observed farther south coincides with a contrast in roughness in the free-air gravity anomaly maps derived from satellite altimetry data.

T42C-0946 1330h POSTER

Geodynamic and Seismic Modeling of the MELT region of the East Pacific Rise: An Example of Plate Scale Hotspot-Ridge Interaction

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The Mantle Electromagnetic and Tomography (MELT) experiment demonstrated that the asymmetry observed in bathymetry and mantle Bouguer anomaly profiles across the southern East Pacific Rise (SEPR) was also present in the upper-mantle seismic and electromagnetic structures. This asymmetry is, in part, a result of greater concentrations of melt in the mantle to the west of the spreading center. Several explanations of these anomalies invoke local effects beneath the ridge, such as asymmetric flow passively driven by coupling to the faster moving Pacific plate; an off-axis center of dynamic upwelling; or anomalous melting of an embedded compositional heterogeneity. Alternatively, the asymmetries in near ridge structure may result from asthenospheric return flow from the hotspots of the South Pacific Superswell. Each of these explanations implies distinct differences in either the pattern of mantle flow or the region of melt production, which in turn depend on the assumed mantle rheology, temperature distribution, or melting relation. The goal of the present study is to determine the boundary conditions and constitutive relations of geodynamic models that are consistent with the available seismic and underway geophysical data.

We calculate numerical models for plate-driven upwelling and adiabatic melting for a range of pressure- and temperature-dependent mantle viscosities and linear dry and wet melting solidi. For each model, the flow-induced seismic anisotropy structure is estimated. For a given anisotropic velocity structure, we calculate the split times of vertically propagating S waves and we use anisotropic seismic tomography (with the anisotropy fixed) to find the isotropic P and S wave velocity anomalies that best fit the MELT delay times. Each geodynamic model, or set of initial conditions, can therefore be assessed on the basis of its fit to the observed split and delay times, and by this approach we limit the set of acceptable geodynamic models to those that are consistent with the seismic observations. We also use this method to explore the effects of critical assumptions, such as the maximum depth of flow-induced seismic anisotropy, the extent of melt retention in the mantle, and the effects of mantle temperature and melt fraction on seismic velocities. Our approach to geodynamic seismic tomography eliminates models that do not include a component of asthenospheric return flow from the west of the SEPR.

T42C-0947 1330h POSTER

Electrical 2D Section of a Continental Break-up Region, Gulf of Aden - Results From the ANC Cruise

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Seafloor magnetotelluric (MT) array study was conducted in the western part of Sheba Ridge, Gulf of Aden. Five ocean bottom electromagnetometers were deployed along a 200 km long profile perpendicular to a mature ridge segment over the continental break-up region. All these instruments were successfully recovered during the Aden New Century Cruise (ANCC).

Temporal EM variations were measured for about three weeks at a sampling rate of 0.1 Hz in order to delineate the electrical structure beneath the continental break-up region. The magnetic and electric resolutions were 10 pT and 60 nV/m, respectively.

The time- and tilt-corrected EM time series were processed by the robust remote reference method (Chave et al., 1987) to yield MT impedance tensors at each site for 12 periods ranging from 480s to 40960s. The MT tensors were then rotated toward a direction perpendicular to the mean geological strike of the ridge segment (N27E). The ridge-parallel and ridge-perpendicular components of the tensors were used as TM and TE modes in subsequent two-dimensional (2D) MT inversions (Uchida, 1993) using Akaike's Bayesian Information Criterion (ABIC).

A joint 2D ABIC inversion using both modes and incorporating the 2D bathymetry along the profile yielded a model that showed a shallow conductor in the south of the ridge crest centered at a depth of approximately 30 km. The joint model also implies the presence of deeper (>125 km) conductor in the northern side.

The bathymetry and the mantle bougurer anomly across the ridge segment are known to show asymmetry (Leroy et al., 2000). Volcanic seamounts seem to be abundant in the south of the ridge crest and the mean depth close to each margin is deeper in the north. The mantle bouguer anomaly extends more in the south-southwest direction as well. These features can be explained by the presence of shallow conductor in the south. It is possible that a hot melt body in the southern conductor supports the relatively intensive volcanic activity and the shallower depth in the south of the ridge crest, which resulted in the wider mantle bouguer anomaly in the south.

T42C-0948 1330h POSTER

Topographic Expression of the Gulf of Aden Spreading System and its Tectonics: Hotspots-Ridge Interaction in Gulf of Aden

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Gulf of Aden is a young ocean basin formed by the rifting of Arabia away from Somalia (NE Africa). The Arabian plate moves away from Africa in a NE direction, at a rate of about 2 cm/yr. The rifting started from Early Miocene. After the, the Gulf of Aden spreding system is propagating westward into the Arabia-Africa continent (Manighetti et al., 1997). It reached the Afar hotspot area about 10 Ma (Manighetti et al., 1998). The spreading system continues to interact with the hotspot up to the present. Tamsett and Searle (1988) exposed that strike of segmentations of the spreading center in Gulf of Aden is NW-SE, although the trend of the spreading system is ENE. Their survey showed the general topographic features of the spreading system, but more detailed survey is necessary to reveal the tectonics of the Gulf of Aden, especially hotspot-ridge interaction.

The bathymetric survey by the SEA BEAM 2120 multi-narrow beam echo sounders aboard the R/V Hakuho-maru was carried out along the spreading system of the Gulf of Aden between 45°30′E and 50°20′E from December 2000 to January 2001. The interval of the track lines is 4-6 km. The trend of the track lines is N70°E. Geomagnetic and gravity fields were measured during the bathymetric.

The topographic expression of the spreading centers east of N46°20′E is an axial rift valley offset by transform faults similar to that observed at slow spreading centers. The trend of the axial rift valley is N65°W. The offset of the spreading centers increases in length to the east as Tamsett and Searle (1988) indicated. The axial rift valley west of N46°20′E, which has an east-west direction, is not offset by any prominent transform faults. N65°W trending en-echelon basins are situated in the rift valley similar to that of the western Gulf of Aden spreading system (Dauteuil, et al. 2001).

T42C-0949 1330h POSTER

Pilot Study of the Tjörnes Fracture Zone, offshore Northern Iceland, using High–Resolution Multichannel Seismic Reflection Profiling and CHIRP Sonar

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In July, 2001 we conducted a high–resolution geophysical survey of the Tjörnes Fracture Zone (TFZ), offshore Northern Iceland, using two high–resolution seismic profiling systems – a SUBSCAN Chirp/Side Scan Sonar and a portable High–Resolution Multichannel Seismic System. This was the first time these two systems had been used together and this nested approach proved to be very successful. Our principal scientific objectives were: (1) to define the current location and history of strike–slip movement along the offshore portion of the Húsavík –Flatey (HFF) fault; and (2) to estimate the amount of extension across the Eyjafjardaráll graben (the southern extension of the Kolbeinsey Ridge), Skjálfandi Bay, and Öxarfjördur basin in order to determine how strain has been accommodated in the TFZ over the past 6 Ma. Within the glacially–eroded and sediment–filled graben on the N–Iceland shelf, the Chirp typically penetrated up to 30–40 m subbottom; HiRes MCS data was able to extend this stratigraphy to 300–500 m depth. The uppermost Holocene section was characterized by a 10–25 m thick transparent layer of silts and muds overlying a highly reflective, jökulhlaup–derived, turbidite sequence 5–10 m thick of late glacial or early post–glacial age inferred to be deposited by jökulhaups, which buries an older reflective surface interpreted as glacial diamictites. Several thin, high–amplitude reflectors occurring within the transparent layer may represent tephra layers identified in nearby cores . The thickest 'transparent' Holocene section is in the Öxarfjördur basin with a progressively thinner Holocene section in the Skjálfandi and Eyjafjardaráll basins. Numerous faults were mapped in both the MCS and Chirp data, some of which extend to the seafloor, suggesting these graben are actively extending. The HFF is marked by a prominent 10–15 m high, south facing scarp between Flatey Island and ∼17°36'W where it intersects a N–S trending basement ridge. East of this point the HFF fault appears to step to the north, where its expression is much more subdued. We were unable to find the offshore extension expression of the faults that have been mapped on–land into the town of Húsavík. Side scan sonar data collected along the HHF west of 17°36'W show numerous, lineated shallow depressions in the surficial sediments on the upthrown block near the fault which may be caused by focused fluid expulsion along the fault.

T42C-0950 1330h POSTER

Sediment Thickness and Regional Variations of Basement Depth in the North Atlantic

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We present a compilation of sediment thicknesses in the North Atlantic within the region of 35-65 N and 0-65 W. A digital grid with resolution similar to ETOPO5 bathymetry was produced by digitization and careful combination of previous hand-contoured maps. This grid details a wide variety of sediment deposits from thick terrigenous margin basins to regions of localized sediment accumulation within the deep ocean. We combined this with a digital grid of seafloor depth and calculated depth-to-basement including local isostatic adjustment of the sediment load. Finally, basement depth anomalies were calculated relative to predictions from lithospheric thermal models, using ages constrained by magnetic anomaly identifications. Comparison of depth-anomaly patterns were made in reconstructions at selected magnetic isochrons. Important features of these maps are: (1) The northern area is dominated by elevated basement caused by excess heat and volcanism from the Iceland plume. The volcanic margins of East Greenland and Hatton-Rockall are well defined. Elevated regions reach to Charlie-Gibbs FZ, including an extended zone of high basement south of Greenland. South of the FZ, conjugate basement rises (E.&W. Thulean Rises) occur between chrons 21-25 and appear to be linked to the same activity. Systematic variations occur with time, with highest basement on the margins and along the Reykjanes Ridge separating zones of deeper basement between chrons 13-21. (2) More normal basement depth in the central Labrador Sea is bounded by highs to the north (Davis Strait) and to the south. Thus volcanic effects of the Iceland plume seem to be linked to the shift of sea-floor spreading away from the Labrador Sea towards the North Atlantic between Greenland and Europe. (3) In the southern region, basement depths are generally normal to slightly elevated, except for the Azores hot spot and a localized set of conjugate highs that extend across ∼44 N from the Newfoundland through Milne seamounts in the west to the Azores-Biscay Rise in the east. (4) A prominent asymmetry in basement depth exists between the

conjugate Newfoundland and the > 1 km deeper Iberia abyssal margin.

T42C-0951 1330h POSTER

Post-Glacial Eruptive History of the Western Volcanic Zone, Iceland

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We have mapped and extensively sampled all the post-glacial eruptive sequences along approximately 170 km of the Western Volcanic Zone (WVZ) of Iceland. New ^{14}C charcoal ages and tephrachronology constrain the timing of eruptive activity. During post-glacial time (last ∼12,000 yrs) the WVZ has erupted at least 42 times. There is no apparent systematic relationship between eruption location and age, but both eruption frequency and total erupted volume have decreased with time. At least 25 eruptions (58%) are older than ∼9000 yrs. In the last 4500 years the WVZ has erupted only five times, the last time in 1000 A.D. Eruptive activity along the WVZ occurred as two types: (1) Only seven units were clearly produced by fissure eruptions; (2) At least 32 units (>80%) are monogenetic, central vent eruptions, comprising both low effusion rate pahoehoe lava shields (21 units), and tephra cones dominated by aa to transitional lava flows (11 units). The largest erupted volumes are associated with lava shields formed from long-lived eruptions. The total erupted volume of lava in post-glacial time along the WVZ is >90 km^3. Individual eruptions vary from about 0.01 km^3 to more than 15 km^3. Nearly 65% of the total post-glacial erupted volume was produced prior to 9000 yrs ago; about 14% was erupted in the last 4500 years. Chemical evidence suggests that average extent of partial melting may have decreased for at least part of post-glacial time. These results generally support a model of enhanced melt production immediately following glacial unloading, followed by subsequent relaxation. The average volume of individual eruptions for all 42 identified units is about 2.2 km^3, but the median is 0.175 km^3; these values increase to 2.8 and ∼1 when 10 small units of the Grimsnes field on the SE periphery of the WVZ are excluded. There are few good correlations between chemical composition and location within the WVZ, except for incompatible element-enrichment in Grimsnes lavas, restriction of high-MgO picritic shields to the far south, and a tendency for incompatible element depletion to the north. In general, chemical variations within the WVZ are dominated by temporal rather than by spatial variability.

T42C-0952 1330h POSTER

The Iceland Deep Drilling Project (IDDP): Obtaining Supercritical Geothermal Fluid from Hot Spot-Ridge Interaction.

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The Iceland Deep Drilling Project (IDDP) plans to drill one or more boreholes deep enough to penetrate into the supercritical zones believed to be present beneath three currently exploited geothermal systems in oceanic ridge-type spreading centers in Iceland. The main aim is to produce much higher enthalpy fluids for power production than are currently being utilized. The IDDP is being funded by Deep Vision, a consortium of Icelandic energy companies. A feasibility study is currently under-way and is examining three candidate sites as well as the economics and engineering issues of drilling to greater depths and higher temperatures. Responding to the invitation of Deep Vision, a meeting funded by the International Scientific Continental Drilling Program (ICDP), was held in Reykjavik in June 2001, to help define the tasks for the feasibility study and to begin planning a scientific program to take advantage of the IDDP boreholes. A Science Applications Group of Advisors (SAGA) with both Icelandic and international membership has been formed to formulate and oversee these activities. An IDDP-ICDP science workshop on the IDDP will be held in Reykjavik in March 2002 with 50-75 participants to formulate a drilling and science plan. A second workshop is being considered for 2003 and drilling is expected to take place in 2004.

Iceland is a particularly favorable location for research on very high enthalpy geothermal fluids and it is hoped that such fluids can be produced at high flow rates. In Iceland the repeated seismicity and volcanic activity in the rift environments above the hot spot create high permeability and high temperatures at drillable depths. Temperatures greater than 300°C are commonly encountered in wells drilled to depths of 2 km in high-temperature geothermal fields in Iceland. The likely existence of permeable regions in brittle basaltic rock at supercritical temperatures at still greater depths beneath the candidate geothermal fields is inferred from the distribution of hypocentral depths of seismic activity that continues to below about 5 km depth. These circumstances are the product of the special geological environment of Iceland, a coincidence of a mantle plume with the divergent plate boundary at the Mid-Atlantic Ridge. Thus the IDDP offers the international geoscience community a unique opportunity: (a)to investigate the magmatic and fluid circulation character of the Mid-Atlantic Ridge (on land) in relation to the hot spot, and (b)to study and sample fluids at supercritical conditions which resemble black smoker marine hydrothermal systems. These aspects of high-temperature hydrothermal systems have rarely been available for direct observation. International science and engineering participation is welcomed in the (IDDP).

URL: http://www.os.is/IDDP/

T42C-0953 1330h POSTER

Reconciling the Misfit Between the Yellowstone Plume Trace and Global Plate Motion Models: Channelized and Pancake Plume Flow on Basal Lithospheric Topography

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Age-progrssive rhyolitic volcanism from the Owyhee Plateau along the Snake River Plain to the Yellowstone Plateau is widely interpreted as reflecting the motion of the North American plate over a mantle plume. The strongest line of evidence against this interpretation is the misfit between the length of the interpreted plume trace and the length predicted by global plate motion models. As generally represented, the plume trace extends 700 km from the 16.1 Ma McDermitt Caldera to the caldera of the 0.6 Ma Lava Creek Tuff at Yellowstone. Global plate motion models predict a plume trace of 190-340 km in 16 m.y. Extension immediately south of the Snake River Plain has been estimated at 20%, well short of the >100% required to reconcile the misfit. Also complicating the plume interpretation is the position of the feeder dikes of the Columbia River basalts (CRB), widely interpreted as the result of emplacement of the head of the Yellowstone plume, >300 km north of the interpreted plume trace at 16 Ma.

Both of these problems can be reconciled by considering the complex results of interaction of a mantle plume with basal lithospheric topography. The predicted position of the plume at 16 Ma, based on plate motion models plus extension, was near the southern end of the Snake River Plain, under thick Precambrian lithosphere. Thinner lithosphere occurred 150 to 200 km west of this point at the boundary with Paleozoic and Mesozoic accreted terranes. The CRB, Steens Basalts (SB), and Northern Nevada Rift (NNR) basalts were erupted through the accreted terranes west of this boundary beginning about 16.5 Ma. Two processes could link this basaltic volcanism to the plume: (1) assuming the plume head was >600 km in diameter, some plume head material would have risen to shallow depths and undergone decompression melting under CRB and SB dikes and the NNR; and (2) flow of plume head and conduit-fed material up a basal lithospheric gradient from under the cratonic lithosphere toward the accreted terranes would have produced more decompression melts. The latter process is analogous to plume flow toward mid-ocean ridges. Two modes of flow have been evaluated in considering plume-ridge interactions, channelized and pancake flow, with geodynamic models favoring the latter. I suggest that both types of flow occurred in the Yellowstone system in the Miocene. The western Snake River Plain graben connects the projected position of the Yellowstone plume at 17 Ma to the CRB dike swarms. I propose that the development of the western Snake River Plain graben reflects weakening of the lithosphere by channelized sublithospheric plume flow. Further evidence for this process is the observation that CRB lavas became more isotopically evolved over time, consistent with thermomechanical erosion of the Precambrian lithosphere in which the channel was developed. In contrast, the region connecting the projected position of the Yellowstone plume to the SB dikes and the NNR lacks subsequent focussed deformation and is characterized by widespread Miocene caldera systems (including the western 300 km of the canonical plume trace). These characteristics are more consistent with pancake flow. Only after the craton margin was far enough from the plume, at about 10 Ma, did the Yellowstone plume begin to leave a simple plume trace. That channelized plume flow dominated over pancake flow in this setting (CRB volume >3x SB volume) probably reflects greater irregularity in the sublithospheric topography under continents than ocean basins.

T42C-0954 1330h POSTER

Fine-Scale Volcano-Tectonic Patterns Along the Hotspot and Non-Hotspot Influenced Fastest Spreading Parts of the East Pacific Rise, and Their Relation to Hydrothermal Activity

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A broad Easter mantle plume appears to be having a major long-term effect on the evolution of the giant duelling propagator system between the Easter and Juan Fernandez microplates. It is driving long-term propagation of the West ridge of this system toward the south, although there are occasional episodes of duelling propagation of the East ridge towards the north. The West ridge segment nearest the hotspot is the most highly inflated segment and contains several intense hydrothermal vent areas, although the East ridge segment farthest from the hotspot has a higher percentage of axis with active hydrothermal activity. DSL-120 sidescan sonar and bathymetry data collected along the EPR segment axes between the Easter and Juan Fernandez microplates have been compiled into a Quicktime movie. This presentation method provides a fast overview of an immense amount of data, and facilitates comparisons between the hotspot influenced and non-hotspot influenced segments, as well as correlations between the structural data and hydrothermal patterns, with implications for hydrothermal prospecting along mid-ocean ridges. For example, in addition to strong correlations with axial inflation and spreading rate, hydrothermal activity frequently correlates with areas of recent voluminous low-backscatter flows pouring out of axial fissures. Hydrothermal activity shows good correlation with presence of axial summit collapse structures, but not with the presence of an axial summit graben (sensu strictu). Although on a million year timescale the hotspot influence on the West ridge has a dominant effect on the tectonic evolution of this area, on the shorter timescales governing hydrothermal activity the hotspot influence is much less important than individual magmatic inflation events along individual ridge segments.

T42D MC: Hall D Thursday 1330h

Nankai Seismogenic Zone: Thermal Structure, Earthquakes, Seismic Reflection, and Marine Geophysics

(joint with OS, S)

Presiding: **S Gulick,** Univ. Texas**; K Obana,** JAMSTEC

T42D-0955 1330h POSTER

Micro-seismicity off Cape Muroto Along the Nankai Trough Seismogenic Zone Detected by a Series of OBS Observations

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