T12C-0489 1330h POSTER

Preliminary Report Of Paleoseismological Study On The Kuromatsunai Lowland Fault Zone, Southwest Hokkaido, Northern Japan.

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The Kuromatsunai lowland fault zone in southwest Hokkaido is one of the major active faults in Japan. This 30-km-long and 5-km-wide fault zone consists of many N-S-trending, several-km-long thrust faults, which are closely related to the folding structure of the thick sediments of late Miocene to early Pleistocene age. The folding structure has been formed by E-W compression due to the plate convergence after E-W extension related to the opening of the Japan Sea. However, there is no historical document that recorded large earthquakes in this area. To reveal the recent activity of the Kuromatsunai lowland fault zone, we conducted paleoseismological study including trenching and coring in the northern and southern parts of the fault zone. A trench on the Shirozumi fault, one of the main fault strands in the northern part, exposed a nearly horizontal, sharp contact between an eastward-dipping silt bed of 45,000 years BP and an overlying weathered aeolian volcanic ash layer. It is not clear, however, whether the contact is a low-angle fault of tectonic origin or a slip surface of landslide origin. Another trench on a dissected flexural scarp of the Oshamanbe fault in the southern part exposed the unconformity between an eastward-dipping silt layer of 45,000 to 50,000 years BP and an overlying gravel layer of 4,000 to 9,000 years BP. Liquefaction traces were also found in the gravel layer. The coring survey near the trench site shows that the vertical displacement of the silt layer attains about 10 m. We are planning to conduct seismic reflection survey to image the subsurface structure of this fault zone.

T12D MCC: Level 1 Monday 1330h

Observational and Theoretical Insights Into the Structure and Dynamics of Mid-Ocean Ridges II Posters *(joint with V)*

Presiding: **J Escartin,** Laboratoire de Geosciences Marines (IPGP/CNRS)**; O Engen,** University of Oslo

T12D-0490 1330h POSTER

Deep Crustal Structure of Fast-Spreading Crust Near Hess Deep

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We present the results of a wide-angle seismic survey conducted near Hess Deep in the equatorial East Pacific. Hess Deep is a rift velley in 1 Ma crust formed at the fast-spreading East Pacific Rise (EPR). Rifting is characterized by north/south extension and the westward propagating Cocos-Nazca spreading center. Geologic investigations of the northern wall of the valley using deep-sea submersibles have mapped the lithologic boundaries exposed here. The experiment took place on top the northern wall of the rift valley and consisted of three scarp parallel lines of ocean bottom seismograph (OBS) receivers. The instruments were separated by 7.5 km on two of the lines and 3.5 km on the third. We used two-dimensional ray-tracing to constrain velocity structure in the region and then made comparisons with the geologic structure observed by the submersible teams. For each profile we present a four layer crustal velocity model consisting of layer 2A (2.85-3.15 km/s), 2B (5.1-6.7 km/s), layer 3 (6.35-7.35 km/s) and mantle (8.0 km/s). It has been suggested that the seismic layer 2/3 boundary may correspond to the lithologic contact between dikes and gabbros. However, the velocity structure closest to the fault scarp indicates seismic boundary 2/3 is nearly 1 km below the observed dike/gabbro layer. Overall, the seismic boundaries of the two lines further from the scarp are very similar, but the line closest the scarp presents a slower than expected velocity at the top of layer 3 (6.25-6.35 km/s). The average crustal thickness in the region is 5.9 km.

T12D-0491 1330h POSTER

Off-axis seismicity along the Mid-Atlantic Ridge at 12°-14°N and the North America - South America -Africa triple junction

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Seismicity along the MAR, monitored with the Autonomous Underwater Hydrophone (AUH) array, shows an anomalous band of events 70 km west of the axis (5.5 My-old crust), and between 11.9 and 14.2°N. Available focal mechanisms from teleseismic events along the off-axis band show extension directions consistent with North American-South American relative plate motion as predicted by the REVEL plate model. Near the north end of this band events trend towards the axis, and in proximity to the axial seismic gap at14°N. This gap coincides with the shallow and robust 14°N segment, which is also associated with a prominent *hotspot* geochemical anomaly. Axial focal mechanisms are consistent with spreading of the African (AF) and the NA or SA plates. We propose that the off-axis seismicity could be caused by an active westward jump and the formation of an incipient ridge, or by the presence of a microplate bounded by the axial and off-axis seismicity. Multibeam data show sediment ponds among irregular faults scarps locally covered by massifs that may correspond to recent volcanic edifices. This area also shows higher acoustic backscatter than nearby sedimented terrain. Additional data (magnetics, seafloor samples and direct observations is required to determine if there is recent volcanic activity associated with the intraplate seismicity. We speculate that the triple junction between the AF, NA and SA plates is close to the 14°N seismic gap, and is responsible for the large rotation of stress in the area recorded by the teleseismic events. We cannot constrain the position of the NA-SA plate boundary extending west towards the Caribbean subduction zone. If this boundary were continuous, we expect it to initiate at the southern end of the off-axis seismicity band, coinciding approximately with the trace of the Marathon FZ. Alternatively, the plate boundary may be diffuse along the corridor defined by the Fifteen-Twenty and the Marathon FZs, with the possible presence of a microplate at the axis.

T12D-0492 1330h POSTER

Crustal Structure of the Northern and Southern Jan Mayen Ridge Segments, Norwegian Sea, Based on Ocean Bottom Seismometer Data.

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The Jan Mayen Ridge (JMR) is a submarine ridge trending south from the volcanic Jan Mayen island in the Norwegian Sea, towards Iceland. In the north, it is a distinct, single ridge, but in the south it is divided into several smaller ridges. JMR is interpreted as a micro-continent, being part of Greenland during the volcanically active rifting off Norway in the latest Paleocene. In the late Oligocene, JMR was rifted off Greenland when seafloor spreading shifted from the now extinct Aegir Ridge, to the presently active Kolbeinsey Ridge. The southern termination of the micro-continent is uncertain, though it may extend into the Icelandic shelf. Earlier studies of the northern ridge found extrusive volcanism, and an asymmetrical crustal root, displaced to the east. Two OBS profiles were shot across the northern and southern part in year 2000. The northern (∼ 69°N) terminates in the Jan Mayen Fracture Zone, and the southern (∼ 66.5°N) crosses the Aegir Ridge. The vertical and horizontal components were modeled by ray-tracing into two-dimensional velocity transects. In the north, a maximum crustal thickness of 16 km was found in a narrow root below the eastern part of the ridge. The P-wave velocity at the bottom of the eastern part of the root (7-7.2 km/s) indicates igneous rocks, while the western part (6.8 km/s) is typical for continental rocks, with a 40 km wide transition zone between. The supposed extrusive basalts do not stand out in the data, but may have a low velocity contrast to underlying pre-breakup sedimentary strata. The top oceanic basement is very rough near the Jan Mayen Fracture Zone, with upper basement P-wave velocity of 3.5-4 km/s. A slight increase in the Vp/Vs ratios indicates an increase in fracturing of the deep crust here. Adjacent to the JMR, the top oceanic basement becomes very smooth, and the velocity increases to 5.5 km/s. Average oceanic crustal thickness is 5.3 km. For the southern profile, the average thickness is 5.2 km around the Aegir Ridge. West of that, the crustal thickness increases smoothly to 12 km over a ∼90 km distance, and the crust appears to be of mafic, igneous composition. This is similar to the thick oceanic crust created immediately after continental breakup on the complementary Moere Margin in Norway. West of that region, a crustal root with a relief of up to 3.5 km is associated with a mid-crustal region (5-12 km depth) having a slight drop in P-wave velocity (-0.4 km/s), and Vp/Vs ratios (-0.03), is interpreted as a continental fragment. Towards the Iceland shelf, the results indicate a predominantly mafic igneous crust, with a Moho depth oscillating around 16 km. Relief to the Moho surface and mid-crustal velocity layers indicate that smaller continental fragments may be embedded in the igneous crust also here.

T12D-0493 1330h POSTER

A Wide-Angle Survey of the Mid-Atlantic Ridge at 5° South

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Slow spreading mid-ocean ridges are characterized by along-axis segmentation where crustal composition and structure varies significantly within a segment and across transform faults and other ridge axis discontinuities. In 2000, the GERSHWIN experiment investigated two spreading segments adjacent to the 5°S transform fault. A set of intersecting wide-angle profiles were acquired running both parallel and perpendicular to the median valley and extending from the center of one segment across the transform well into the next segment. The lines focused on a number of topographic features (median valley, inside corner high, outside corner, transform fault) in order to resolve related velocity variations inside the crust and the uppermost mantle. This ridge transform intersection is unusual in that the inside corner high south of the 5°S fracture zone has been split by a change in location of active seafloor spreading resulting in an outside corner massif and the absence of a volcanic ridge in the northernmost part of the median valley. For assessing velocity models we chose a combination of forward modeling and first-arrival tomographic inversion. For profiles with sufficient Moho reflections a joint refraction and reflection travel-time tomography was used. Energy propagation varies strongly but in most cases reaches for more than 40km, sometimes up to 90km. Modeling results show a velocity structure which differs significantly from normal oceanic crustal structure. In the median valley of the southern segment models show an unusual thin crust of about 4km thickness (shallowing towards the transform fault in the north) underlain by a low velocity upper mantle (Vp∼7.5km/s). North of the fracture zone, median valley seafloor depths show a bathymetric high near the middle of the segment. Here, velocities reach up to 7.5km/s within depths of 6.5-7.5km below seafloor (starting with beneath seafloor velocities of about 3km/s). In contrast, velocity depth profiles in the region of the inside corner high and the outside corner massif in the southern segment show either very

high near surface velocities (>6.0km/s) or very high velocity gradients causing crustal velocities to reach up to 6.5km/s within the first 1000m below seafloor. Below, velocities increase steadily up to between 7.5-7.8km/s at 4.0 to 6.0km depth below seafloor. By assuming that velocities of 7.5km/s are indicative for the upper mantle, models suggest crustal thicknesses of 4.0-5.0km at the eastern flank of the inside corner high and 4.5-5.5km at the outside corner.

URL: http://geomar.de/projekte/gershwin/

T12D-0494 1330h POSTER

Detailed sub-surface structure of Atlantis Bank as derived from in-situ observation and seafloor gravimetry

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Atlantis Bank was precisely surveyed by manned submersibles and ROV's since 1998 after the results from ODP Leg176 was compiled. In addition to the in-situ observation and rock sampling, seafloor gravimetry was carried out during the two cruises by Submersible SHINKAI6500 by use of gravity meters for on-land surveys. The observed gravity data were reduced into the free air anomaly on the sea surface and then Bouguer anomaly was calculated by 3-D terrain correction in order to estimate the average density of the basement rock underneath each gravity station. The result was compiled with the observed geological features, collected rock samples and precise seafloor topography obtained by the same cruises in order to describe the precise sub-surface structure and faulting of the bank. The average density of the basement rocks on the western slope of the bank was estimated as 3.0 g/cc in the lower part, 3.8 g/cc in the middle part and 3.1 g/cc in the upper part, corresponding to the collected mantle peridotite, oxide Fe-Ti gabbro and peridotite/oxide olivine gabbro, respectively. Results from swath bathymetry shows detachment faults sub-parallel to the ridge axis. The dive tracks which crossed these detachment faults showed an exposure of mantle peridotite above gabbro, as expected by the distribution of the low-angle normal faults. Considering also the seafloor observation and collected rock samples along the dive tracks nearby, the area is characterised by detachment of thin lower crust - mantle peridotite assemblage along the detachment faults. Seafloor gravimetry was also carried out on the eastern slope of Atlantis Bank. Average density of basement rock was estimated as 3.1 g/cc in the lower part and 2.6 g/cc in the middle part. The difference in estimated bedrock density is corresponding to the difference in seafloor observation: huge blocks of gabbroic massifs in the lower part and a steed escarpment covered with fault gauge in the middle part. The collected rock samples were mylonatised gabbros along the whole track.

URL: http://www.nme.co.jp

T12D-0495 1330h POSTER

Late Mesozoic-Cenozoic Evolution of the NE Atlantic Region and Links to the Arctic

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Detailed studies of the continental margins off Norway, Greenland and the Barents Sea have revealed a series of Late Mesozoic-Cenozoic rift phases reflecting the main plate tectonic episodes in the North Atlantic-Arctic breakup of Pangea. Each rift phase is related to the northward propagation of North Atlantic sea floor spreading, which finally reached the incipient Norwegian-Greenland Sea in early Tertiary times, but they are also linked to important tectonic events in the Arctic. Late Jurassic-Early Cretaceous rifting was a dominant, composite tectonic episode which gave rise to prominent NE-trending structures in the NE Atlantic. Following rifting, a wide region subsided and was covered by thick Cretaceous strata. Aptian-?Albian rifting is documented locally off Mid-Norway, onshore East Greenland and in the SW Barents Sea. A Large Igneous Province developed in the Arctic during Early Cretaceous breakup of the Amerasia Basin and formation of the Alpha Ridge, and gave rise to widespread magmatism in the northern Barents Sea. We propose that the SW Barents Sea rift may have a component trending northwards east of Svalbard, but this may be masked to some extent by the extensive magmatism which caused regional uplift instead of subsidence. A distinct Late Cretaceous rift event, with onset in middle Campanian, is documented on the conjugate mid-Norway and East Greenland continental margins, and is characterised by large-scale normal faulting and locally by low-angle detachment faulting within thick Cretaceous strata. The Late Cretaceous rifting between Norway and Greenland was taken up within the De Geer Zone by down-faulting in a pull-apart setting. The rifting culminated in crustal breakup and accretion of oceanic crust near the Paleocene-Eocene transition, accompanied by large-scale igneous activity associated with the North Atlantic Large Igneous Province. Passive rifted margins developed off mid-Norway and central East Greenland, and along the northern Barents Sea during opening of the Norwegian-Greenland Sea and Eurasia Basin, respectively. The western Barents Sea-Svalbard and NE Greenland margins developed as predominantly sheared margins. There is a well-defined along-strike margin segmentation and the various segments are characterized by distinct crustal properties, structural and magmatic styles, and post-opening history of vertical motion. The continent-ocean transition is confined within a narrow zone at the sheared margin segments, but is more obscure and partly masked by volcanics at the rifted margin segments. Following breakup, the subsiding margins experienced modest sedimentation until the late Pliocene when large wedges of glacial sediments prograded into the deep ocean from uplifted areas along the continental margins.

T12D-0496 1330h POSTER

Mid-Atlantic Ridge 29^{o}N: New Insights on Ridge-Axis Faulting From High-Resolution, Deep-Towed Swath Bathymetry

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The deep-towed vehicle TOBI carries 30 kHz side-scan sonar giving 6 m resolution over a 6 km swath. A phase measuring swath bathymetry system was added in 1998. The first deployment was over the Mid-Atlantic Ridge axis at 29^{o}N, as part of a comprehensive study of the Broken Spur spreading segment. The system, still undergoing development, achieved partial success. We recorded and have processed two adjacent swathes of data across the ridge axis, extending 35 km either side of the axis (approximately to crustal age 2.7 Ma). The phase signals were rather noisy, but usable data were recovered in swaths up to 1.2 km wide on either side, though over significant areas coverage was much worse. Best coverage was obtained over seafloor depths greater than 3000m, especially the median valley floor, possibly because lack of sediment there provides the strongest acoustic contrast. Post-processing included conversion of acoustic phase to depth, with corrections for varying vehicle attitude. Careful analysis reveals some residual noise that seems to correlate with vehicle motion, suggesting sub-optimum calibration of its attitude sensors, and in places clear artefacts trend parallel to track or to iso-phase lines. Nevertheless we were able to grid the data with an interval of 10m following filtering. The results have been compared to both bathymetry from the ship-mounted, 12 kHz Simrad EM-12 and to the TOBI side-scan data. We were able to grid the Simrad data to 50 m horizontal resolution. Seafloor fault scarps can be reliably resolved in Simrad data where apparent seafloor gradients are greater than about 20-30^o and scarp heights are greater than several tens of metres. Many of the smaller fault scarps have apparent gradients of less than 25^o and hardly ever more than 35^o, often making it difficult to distinguish them from steep volcanic slopes. On larger scarps, slopes up to 55^o and rarely 65^o can be seen. Scarps less than 50 m wide are not resolved. By contrast, TOBI reliably resolves scarps down to 10 m wide, and shows that even these have slopes of at least 30^o, with slopes up to 50^o being common and maximum slopes reaching more than 60^o. Major escarpments can sometimes be resolved into bundles of smaller faults. Faults are thus imaged with comparable resolution to the TOBI side-scan, but with the addition of quantitative depth information. This has important consequences for estimates of tectonic extension. While we have relatively little coverage of the axial neovolcanic zone, volcanic forms are well resolved at the 10 m grid interval, showing the typical hummocky terrain revealed with high-resolution side-scan, as well as larger mounds and cones.

T12D-0497 1330h POSTER

Crustal Structure of the Northern Juan de Fuca Plate From Marine Seismic Refraction and Gravity Data

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A seismic refraction experiment was conducted in 1980 as part of the Vancouver Island Seismic Project (VISP80). Profile VISP II was positioned to provide insight into the structure of the oceanic crust on the northernmost part of Juan de Fuca plate. The refraction data were recorded on three ocean bottom seismometers (OBSs) deployed at the ends and middle of a 110 km line oriented parallel to the deformation front of the Cascadia Subduction Zone. An airgun source at 0.5 km spacing and explosive charges at ∼ 2.5 km spacings were fired into the OBSs. Direct, converted and reflected phases are observed from vertical and horizontal component geophones. A velocity model is constructed using forward ray trace modeling and synthetic seismograms are produced from this model for comparison with the recorded seismogram sections. Travel time picks for the Pn phase indicate significantly different lower crustal velocity structure toward either end of the profile. The Pn phase picks are modeled by a pronounced increase in igneous crustal thickness of the Juan de Fuca plate, from ∼ 7 km at the southern part of the model to ∼ 10 km at the northern part. A complementary 2.5-D gravity model is produced. Densities for this model are derived from the velocity model using a general relation between P-wave velocity and density for typical oceanic crust. The gravity anomaly calculated from the model of thick crust is not replicated in the free-air gravity field. The P-wave velocities and densities required to match the gravity data may be explained by serpentinization of the uppermost mantle.

T12D-0498 1330h POSTER

Opening of the Arctic-North Atlantic Gateway

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The ∼150 km wide Fram Strait between Svalbard and Greenland is the only deep-water connection between the Arctic and the world oceans. It is essential for the thermohaline 'engine' of the North Atlantic circulation system, pulling warm surface water north along the European coasts while returning cold, saline bottom water from the Arctic. Moreover, it contains a series of short, ultra-slow spreading segments and right-lateral transform faults, connecting the Gakkel Ridge to the rest of the Mid-Atlantic Ridge system. While the ridges to the north and south started spreading near the Paleocene-Eocene transition (∼55 Ma), the plate boundary between Svalbard and Greenland underwent shear and a transpressive orogeny. Only after the earliest Oligocene (∼33 Ma), when the Greenland plate became attached to North America and the rotation pole moved, the entire plate boundary became divergent. However, the final opening of the Fram Strait gateway was delayed for several reasons: First, basement terraces on the western Svalbard margin were down-faulted post-Eocene, witnessing a pre-breakup crustal thinning period that may have lasted for 15-20 m.y. Second, transform segments formed continental bridges for several m.y. after breakup on the ridge segments; the deep-water passage was not established before continental outliers were separated by young oceanic crust across all transform faults. Third, the Hovgaard microcontinent, which was split off the western Barents Sea-Svalbard margin, may have restricted water circulation for some time. By integrating gravity, bathymetry, magnetic and reflection seismic data we locate the positions of present and extinct spreading axes, as well as the continent-ocean transition (COT) on the Svalbard side. The COT correlates with a steep gradient in the Bouguer gravity anomaly, which is taken as a proxy COT on the sparsely surveyed Greenland side. By testing different rotation poles we arrive at a regionally consistent plate kinematic model from breakup to present. The model shows that deep-water conditions in the Fram Strait could not possibly occur before Late Miocene to Early Pliocene times (9.5-4.5 Ma). If so, the far-field sedimentary record needs to be re-examined

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for independent corroboration of a young, major, deep-water gateway through the Fram Strait.

T12D-0499 1330h POSTER

Axial Seamount crustal structure inferred from gravity modeling and seismic constraints

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Axial seamount is a young and active volcano, located at the intersection of the intermediate spreading rate Juan de Fuca Ridge and the Cobb hot spot (46N, 130W). Similar to the adjacent mid-ocean ridge, intermittent lava flows at Axial have built a volcanic edifice. Likewise, rifting has occurred at Axial's summit caldera. The caldera walls of Axial Seamount and the axial valley walls on the Juan de Fuca Ridge are of similar vertical extent. However, Axial stands 700 m higher than the rest of the nearby Juan de Fuca Ridge. This paper presents results from a recent gravity survey and modeling of Axial Seamount's crustal structure. In general, the narrower a feature, the more a traditional slab approximation underestimates bulk density. Initial density determinations of Axial and other seamounts have been low and then refined (e.g. Hildebrand, et al., 1990). A usual practice is to assume some higher density, such as a standard density of 2670 kg/m^3 and then model features of interest, such as density excesses or deficiencies. Taking topographic effects into consideration, this paper presents a new method of modeling bulk density and application of the method to Axial. Using constraints on crustal density from seismic velocity (West et al., 2001) and new gravity data, this paper presents a model of low bulk density crust. Combining geophysical information from gravity and seismic surveys, results of gravity modeling are presented here, which place new constraints on upper crust porosity and seamount evolution.

T12D-0500 1330h POSTER

Hydrothermal circulation and subsidence of ocean basins : a case study from the South-East Indian Ocean

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The South-East Indian Ridge (SEIR) flanks between 105°E and 130°E are characterized by anomalously low subsidence rates, less than about 280 m/sqrt(Ma) [Hayes and Kane, JGR, 1994]. While individual estimates of the upper mantle temperature variations below the SEIR axis may vary significantly from one study to the other, all geophysical (axial morphology, seismology and geoid) and geochemical (major and trace elements systematics) evidence is compatible with variations of less than about 100°C. Such a temperature anomaly is not sufficient to fully explain the observed anomalously low subsidence rates, using the present available models for the thermal evolution of the lithosphere. Ad hoc explanations, such as, for instance, variations in mantle thermal parameters cannot be readily rejected, but are not completely satisfactory because they cannot be supported by direct estimates. In contrast, of direct evidence is the lack of sedimentation that characterizes the flanks of the SEIR and the fact, recognized from heat flow data, that in absence of sediment cover, seawater penetrates into the ocean crust and plays a key role in the mechanisms of heat transfer through the seafloor. Although it is now widely accepted that seawater may penetrate massively into poorly sedimented off-axis crust, the contribution of water circulation to the seafloor subsidence rate has only been considered so far near crestal areas, but not at the scale of tens of millions years. We thus propose a simple model which assumes, at first approximation, that seawater penetrates into highly permeable off-axis crust to a depth H below the seafloor and maintains the temperature equal to Tc at that depth (Note : H may depend on age crust). Assuming that hydrothermal circulation is active over large periods (of tens of Ma, for instance), the subsidence rate is controlled by Tm-Tc. The model thus predicts that variations in the hydrothermal regime, by affecting Tc, may affect the subsidence rate. Estimates for the best fitting values of Tc and H are proposed and discussed. Agreement with re-assessed subsidence estimates a posteriori supports the model hypothesis, suggesting that in absence of sedimentation sealing the upper crust, anomalously low temperatures could be forced for tens of millions of years, down to the base of the layer penetrated by the diffusive seawater circulation.

T12D-0501 1330h POSTER

Micro-earthquake seismicity of the Mid-Atlantic ridge at 5°S: a different style of tectonic extension

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Based on an ocean-bottom micro-earthquake survey of the Mid-Atlantic ridge just south of the 5°S transform fault/fracture zone, we find seismic activity to be concentrated within the western half of the median valley. The median valley seismic zone is bounded in along-axis direction by the transform faults to the north, and the tip of the axial volcanic ridge to the south. A few scattered events occurred within the inside corner high, on the transform fault, and in the western side wall close to the segment center. Earthquakes reach a maximum depth of 8 km below the median valley floor and appear to be predominantly in the mantle although a few crustal earthquakes also occurred. The presence of earthquakes in the mantle indicates it is not extensively serpentinized. We infer the median valley seismic activity to arise from slip on two parallel low-angle normal faults which dip from the inside corner toward the spreading axis.

T12D-0502 1330h POSTER

Upper Crustal Variations due to Mantle Temperature Variations Along the Southeast Indian Ridge

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A systematic variation in axial morphology and axial depth is observed along the Southeast Indian Ridge (SEIR) with distance away from the Australian Antarctic Discordance, an area of cold mantle downwelling. Since spreading rate and mantle geochemistry appear constant nearly along this portion of the SEIR, variations are attributed to a gradient in mantle temperature. We carried out a multichannel seismic (MCS) survey on the SEIR to determine the effect of changes in mantle temperature on melt supply and crustal structure. The MCS reflection data was collected along six segments, showing a range of axial morphology. The MCS data demonstrate a systematic variation in upper crustal structure. Segment P1 (101°E) is characterized by a well developed axial high. It shows an axial magma chamber under ~60% of the axis at an average depth of 680 ms twtt (~1800 m) and average layer 2a thickness of 270 ms twtt (~325 m). Segment P2 (102°E) is characterized by a poorly developed axial high. Axial magma chambers are found underneath ~40% of the axis, at an average depth of 1000 ms twtt (~2200 m) and an average layer 2a thickness of 400 ms twtt (~ 475 m). Segment P3 (105°E) shows a transition along the segment from an axial high in the west to an axial valley in the east. The axial high portion of the segment has an axial magma chamber (AMC) under almost the entire section located at an average depth of 975 ms twtt (~2000 m), and an average layer 2a thickness of 350 ms twtt (~420 m). The transitional part of the segment again has an axial magma chamber found almost along the entire section, located at a deeper average depth of 1000 ms twtt (~2200 m), and an average layer 2a thickness of 400 ms twtt (~ 475 m). The axial valley part of the segment has no magma chambers, and an average layer 2a thickness of 750 ms twtt (~890 m). Segment S1 (110°E), characterized by an axial valley, shows only a few scattered deep AMC reflections located at an average depth of 1200 ms twtt (~2250 m), and highly variable average layer 2a thickness of 600 ms twtt (~900 m). This section of the SEIR is characterized by a clear relationship between axial morphology, depth to the AMC and thickness of layer 2a along this section of the SEIR. Although axial morphology changes progressively along the axis, AMC extent and layer 2a thickness show abrupt changes along the axis. Magma chambers are commonly observed under axial high segments. As the axial high becomes less developed, AMC reflections become deeper but are still imaged over significant parts of the segment. An axial magma chamber is rarely observed at segments with an axial valley. Layer 2a thickness roughly doubles with the transition from an axial high to an axial valley.

T12D-0503 1330h POSTER

The Terceira Rift as Hyper-Slow, Hotspot-Dominated Oblique Spreading Axis: A Comparison With Other Slow-Spreading Plate Boundaries

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We suggest the 550km long Terceira Rift (Azores Plateau) is the world's slowest-spreading (hyper-slow, 4mm/a plate separation; 2.3-3.8mm/a perpendicular to oblique axial segments) organized accreting plate boundary. In its slightly sinuous (ca. 300km radius of curvature) axial trace, its oblique spreading angles (ca. 40°-65°), and in frequency and first motions of earthquakes, the TR resembles better-known ultra- or super- slow spreading ridges (e.g., Gakkel and Southwest Indian ridges). Interpreted simply as volcanically unfilled rift valley segments, the inter-island basins (e.g., the 3200m deep Hirondelle Basin) are slightly wider (30-60 km), but not significantly deeper (1000-2200 m) than the Mid-Atlantic Ridge median valley (20-28mm/a; 10°N-53°N). However, along-axis segmentation wavelengths (ca. 100km) are double those along the central MAR, but make TR comparable to the ultra-slow (15-16 mm/a) Southwest Indian and Gakkel (7-13 mm/a) ridges. If this segmentation wavelength reflects Rayleigh-Taylor instabilities, the viscosity contrast between the overlying axial lithosphere and the partial melt zones is about an order of magnitude greater at ca. 4-16 mm/a than at 20-30 mm/a. The Terceira Rift differs dramatically from ultra-slow ridges only in the large amplitude of along-strike topography (2000-4000m; 4200m totalvariation) owing perhaps to a copious melt flux from the Azores hotspot, combined with a spreading-rate-determined greater axial flexural strength and plate thickness, and slower export of volcanics from the rift axis. The probable TR youth (ca. 1 Ma, requiring less than 4km new oceanic crust) indicates lack of steady-state spreading conditions, which may explain the published gravity evidence against TR spreading. Absolute plate motions support the creation of the Azores Plateau by successive NE jumps of the rift axis to maintain its position over a fixed hotspot.

T12E MCC: 3007 Monday 1340h

Seismotectonics of the Eastern San Francisco Bay Area II *(joint with G, S)*

Presiding: **D E Moore,** U.S. Geological Survey**;** **D A Ponce,** U.S. Geological Survey

T12E-01 1345h

Pliocene Reorganization of Hayward-Calaveras Fault Junction, San Francisco Bay Region, California, USA

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Paleogeographic reconstruction of the East Bay Fault System has revealed that about 100 km of post 12 Ma offset was passed onto the Hayward Fault from faults to the south (Graymer and others, 2002). This relation is reflected in the present day by transfer of 9 mm/yr of fault slip from the central Calaveras Fault to the Hayward Fault (Working Group on California Earthquake Probabilities, 2003). The surface manifestation of the connection between the two faults is a zone