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By far the largest number of secondary hotspots (cf. Courtillet et al., 2003) can be found in the "South Pacific Thermal and Isotopic Anomaly" (SOPITA) or "Superswell" region. Its Cretaceous counterpart is preserved in a large range of seamounts and guyots found in the "West Pacific Seamount Province" (WPSP). The seamounts in these regions display very distinct and long-lived isotopic signatures (Staudigel et al., 1991; Koppers et al., 2003) that can be used to combine source region chemistry and seamount geochronology to map out mantle melting anomalies over geological time. These mappings may resolve many important questions regarding the stationary character, continuity and longevity of the melting anomalies in the South Pacific mantle and its secondary hotspots. Of all secondary hotspots that are currently active in the SOPITA we could identify only two hotspots that appear to be long-lived and that have Cretaceous counterparts in the WPSP. Plate reconstructions show that the "HIMU-type" Southern Wake seamounts may have originated from the Mangaia-Rurutu "hotline" in the Cook-Austral Islands, whereas the "EMI-type" Magellan seamounts may have originated from the Rarotonga hotspot. All other hotspots in the SOPITA and WPSP are short-lived (or intermittently active) as evidenced by the presence of numerous seamount trail "segments" representing no more than 10-40 Myr of volcanism. Our observations violate one or more assumptions of the classical Wilson-Morgan hotspot hypothesis: (1) none of the South Pacific hotspots are continuously active, (2) most are short-lived, (3) some show evidence of hotspot motion, and (4) most of them have poor linear age progressions, if any at all. On top of this we have evidence for volcanism along "hotlines" and the "superposition" of hotspots. The simple and elegant "hotspot" model, therefore, seems insufficient to explain the age distribution and source region characteristics of intra-plate volcanoes in the South Pacific. This has lead to new models that retain the concept of mantle plumes, but these lack both simplicity and predictive power. New models that call on "extension" are indeed simple and they may explain most characteristics of Earth's intra-plate volcanism, but they also have limited predictive power, making it more difficult to test for their validity. We argue that we require a combination of processes: one that forces regional magmatism from a large-scale source of buoyancy from below (like the rise of plumelets shooting off the top of a superplume) and one process that acts from above, as intra-plate extension opens up pathways that allow the lithosphere to be penetrated by magma.

V21B-05 0905h

Geochemical constraints on melting proccess in the GLIMPSE region

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The GLIMPSE region, where there are cross grain gravity lineaments, has abundant volcanism that permits tests of melting conditions and mantle sources associated with these important off-axis features. The Sojourn and Brown Ridges are extensive linear features, subparrallel to one another and perpendicular to the East Pacific Rise (EPR), which lies to the east. The Brown Ridge lies further to the east of Sojourn, ending ~60 km or less from the EPR. South of the two ridges, Hotu and Matua are central complexes punctuated by dozens of smaller cones. Fresh lava flows with no topographic expression also cover portions of the sea floor in the general area. The recent flows on flat lying terrain include a flow northwest of the Sojourn Ridge, arguing for recent volcanism in the west as well as in the east. Samples from two cruises show that compositions range from highly depleted to strongly enriched. Sojourn Ridge samples show a general increase in enrichment with increasing distance from the EPR. On the Brown Ridge sporadic spikes of enrichment with no systematic geographic distribution occur and are associated with limited isotopic variations that are similar to those observed on the EPR, suggesting very recent enrichment and depletion events near the spreading axis. In contrast Hotu and Matua samples largely consist of incompatible element enriched lavas with isotopic compositions similar to Easter Island. Evidence for recent volcanism is found throughout the region. In the west, SiO_2 contents are significantly lower, reflecting higher pressures of formation and therefore little lithospheric thinning in the west. On the Brown Ridge in the east, recent volcanism also is apparent, but low SiO_2 contents are not observed reflecting younger and thinner lithosphere.

V21B-06 0920h

Origin of Cross-Grain Gravity Lineations and Intraplate Volcanic Ridges: Constraints and Ideas From the GLIMPSE Experiment

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Three hypotheses have been advanced in the literature for the origin of cross-grain gravity lineations and associated volcanic ridges in the Pacific: small-scale convective rolls aligned by asthenospheric shear in the direction of absolute plate motion; lithospheric boudinage or cracking by remotely applied stresses; and mini-plumes or hotspots. Inspired by the compositional anomalies and age progression along the Pukapuka ridge, we have suggested a fourth possibility; that the volcanic ridge and seamount chains are associated with rapid transport of volatile-rich, low viscosity mantle in the asthenosphere back toward the East Pacific Rise. The GLIMPSE experiment was designed to provide constraints on these conceptual models by measuring crustal thickness variations, seismic velocity anomalies in the underlying mantle, density anomalies as revealed through bathymetry and gravity, variations in mantle composition and the depth and degree of melting as indicated by major and trace elements and isotopic composition of the melt products, thickness of the brittle lithosphere shown by depth extent of microearthquakes, and age progression of volcanism. The study area west of the East Pacific Rise and just south of the Garrett fracture zone includes the Hotu-Matua volcanic complex, which has recent volcanic activity distributed over a region about 60 km across and 200 km long, and the Sojourn/Brown ridges, which are the largest and most continuous of these intraplate volcanic ridges. A year-long deployment of ocean-bottom seismometers, extensive underway geophysical surveying and dredging and geochemical analysis of basalts indicates that there are distinct differences between the processes of formation of the Hotu/Matua and Sojourn/Brown chains. Our current interpretation is that, rather than the gravity lineations beginning to form in seafloor 4-5 Ma old, they die out as the East Pacific Rise spreading center is approached.

V21B-07 0940h

Lithospheric and Melt Anomaly Control of Foundation Chain Volcanism

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The Foundation Chain is a small chain of seamounts and volcanic ridges extending northwestward from the Pacific-Antarctic spreading ridge. $^{40}Ar/^{39}Ar$ age data show linear migration of volcanism along-chain at a rate of 91±2mm/yr for the past 22 Myr (O'Connor et al., 1998). The case history of the Foundation Chain is notable because it is a rare example of a hotspot melting anomaly that has been traversed by a fossil microplate and is now being encroached by the active Pacific-Antarctic spreading ridge. Prior to the Selkirk Microplate encountering the melt anomaly the Foundation Chain formed as broad elongate zones of scattered, synchronous volcanism cross-cutting the overall NW-SE trend of the chain (O'Connor et al., 2002). But once the significantly older microplate began capping the melt anomaly about 14 Myr ago, the chain narrowed abruptly into a single line of discrete seamounts, only broadening again about 5 Myr ago when sufficiently young lithosphere again started drifting over the melting anomaly. Measured ages show a dominant trend of coeval, yet structurally disconnected, segments of Foundation Chain VERs developing in a series of en echelon, elongate 'zones' of coeval volcanism cross-cutting the overall NW-SE seamount trend (O'Connor et al., 2001). These elongate zones developed at intervals of approximately 1 Myr while maintaining a basically steady-state orientation and size as the Pacific-Antarctic spreading ridge migrated closer to the melt anomaly. Although VER development was controlled in part by local factors (e.g. location of nearest spreading ridge segment, lithospheric thickness and stress), long-lived attributes of the Foundation melt anomaly (e.g. size, orientation, periodicity) must have played a pivotal role. Foundation volcanism can be suppressed across elongate melt 'zones' if the capping tectonic plate is too thick for melts to penetrate to the surface (O'Connor et al., 2001, 2002). The lack of a seamount chain connecting the Foundation and the Austral volcanoes can be similarly explained, thus extending the age of the Foundation melting anomaly back to at least 34 Myr ago (McNutt et al., 1997). While lithospheric architecture controls if and where Foundation volcanism occurs (e.g., chain broadening and narrowing), it cannot explain the origin of the underlying long-lived melting anomaly. The timing and distribution of Foundation Chain volcanism requires a long-lived process that creates broad melting anomalies of fundamentally constant size and orientation under a moving Pacific lithosphere with an apparent periodicity of about once per Myr (O'Connor et al., 2001, 2002). Thus, the Foundation Chain is a product of lithospheric architecture and a first-order mantle process controlling the existence and behavior of an underlying long-lived melt anomaly.

V21C MCC: Level 1 Tuesday 0830h

Volcanic Emissions to the Troposphere: Posters II *(joint with A, B)*

Presiding: **F M Schwandner,** Institute of Mineralogy and Petrography**; D L Lopez,** Ohio University

V21C-0522 0830h POSTER

Acid Loading of Soils by Magmatic CO_2 at Mammoth Mountain, California

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Areas of tree kill appeared in the early 1990's after a shallow intrusion of magma under the south flank of Mammoth Mountain, California. Subsequent field measurements have revealed high concentrations of soil CO_2 in these areas, the locations of which are controlled by faults and fractures that serve as conduits for magmatic CO_2 streaming to the surface from depth. Detailed surveys at the largest of these tree-kill areas, Horseshoe Lake, about 14 ha in size, have consistently shown soil CO_2 concentrations that range up to 90% or greater in the shallow soil layers. Continuous soil CO_2 monitoring stations established in 1995 at Horseshoe Lake reveal a pattern of both short-term and seasonal variations in magmatic CO_2. Because the pressure of CO_2 is externally fixed by CO_2 streaming to the surface, carbonic acid activity is constrained by open-system buffering of magmatic CO_2. Eight years of intensive soil CO_2 monitoring have documented a consistent pattern whereby pH values as low as 4 can be achieved in the soil solution during spring melting of the winter snow pack. Coupled with the seasonal drop in pH, aluminum, which can also be toxic to forest ecosystems, is released from soils in those areas with the highest CO_2 concentrations. After more than a decade of exposure to elevated levels of CO_2 and repeated cycles of acid loading, along with nearly complete tree and vegetation mortality and the release of Al^{3+}, the soils at Horseshoe Lake and the other areas of tree kill may not recover their ability to sustain any significant level of forest production for several years, even if the CO_2 degassing should stop immediately. The level of in-situ acid loading by magmatic CO_2 in the tree kill areas around Mammoth Mountain rivals that of the better known process of rain-out of acid gases from volcanic plumes in the troposphere.

V21C-0523 0830h POSTER

Two Decades of Degassing at Kilauea Volcano, Hawaii: Perspectives on Island Impacts

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The ongoing eruption of Kilauea provides an opportunity to examine how volcanic emissions impact the natural and human environment of the island of

Hawai'i. Kilauea has released $\sim$ 13 megatons of SO_2 gas into the troposphere since the current eruption began in 1983, more than any single anthropogenic source in the U.S. During prevailing trade wind conditions, measurements of SO_2 gas, aerosol mass, and aerosol acidity downwind of Kilauea document the conversion of SO_2 to acid aerosol as the plume propagates to the leeward side of the island. Lidar measurements suggest a gas-to-particle conversion rate ($t_{1/2}$) of 6 hours. When trade winds are disrupted, ambient SO_2 and particle measurements in Hawai'i Volcanoes National Park have shown episodes of particle concentrations of $\sim$ 100 $\mu g/m^3$ and SO_2 concentrations in excess of 4000 ppb. Federal health standards and WHO guidelines for SO_2 have been exceeded repeatedly at this near-source location. Documented effects from volcanic emissions on the island of Hawai'i include the rapid corrosion of metal objects, degradation of domestic water quality, agricultural crop damage, and adverse impacts on human respiratory and pulmonary function. Other impacts may include decreases in local rainfall and increased mortality of asthmatics. For the period 1986 to 1993, after the eruption became continuous, deaths from asthma on the island of Hawai'i increased by a factor of ten. Three current health studies seek to investigate the relationship between exposure to volcanic pollution and health effects. In addition to measuring gas and particle exposures, these studies examine lung development in children around the island, disease prevalence in adults residing in communities downwind of volcanic degassing sources, and acute effects in asthmatic children and healthy children and adults. In the absence of conclusive evidence linking exposure and health effects, the USGS, in collaboration with the National Park Service, has developed a real-time advisory for heavily visited park areas known to exceed U.S. Air Quality Standards. This color-coded system informs and advises park visitors and employees when ambient SO_2 concentrations exceed predetermined levels.

V21C-0524 0830h POSTER

Impacts of Tropospheric Plumes From Icelandic Fissure Eruptions on the UK

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A tropospheric plume from a large basaltic fissure eruption similar to the 934 AD Eldgja or 1783 AD Laki Craters eruptions would be expected to contain acid gases and aerosols including SO_2, H_2SO_4, HCl and HF. High concentrations of these materials pose a hazard to human health and the environment. Reports from Europe during the early months of the 1783/4 Laki Craters eruption suggest that the region was affected by atmospheric pollution resulting from the presence of the eruption plume in the troposphere. We present results from an analysis of English historical mortality data, which show that an unusual and large increase in mortality during August and September 1783 can, in part, be linked to tropospheric pollution from the Laki Craters eruption. We find that a decrease in winter temperature in 1783/4, believed to have been caused by stratospheric volcanic pollution, also resulted in an increase in mortality. Our analysis of the English historical data suggests that elderly people were particularly badly effected by the eruption-induced tropospheric pollution. This finding has important implications for the health of regional populations following future eruptions of this type. To determine the potential impacts of a similar eruption on public health in the UK in a modern day situation, we have modelled the transport of a hypothetical plume from an Icelandic fissure eruption. Here, we present preliminary results from modelling using the UK Meteorological Office's NAME model. Meteorological data from 2002 and 2003 have been used to assess the probability of a tropospheric plume passing over the UK and Europe under modern day weather conditions and to examine whether there are particularly favourable conditions for such an event. Concentration ranges of some typical volcanic atmospheric pollutants that might be expected in the surface boundary layer are given and suggestions are made as to what impacts such occurrences might have on public health.

V21C-0525 0830h POSTER

Heavy Metal Concentrations in Soils Downwind from Masaya Volcano (Nicaragua)

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Quiescently degassing volcanoes can significantly contribute to the global emission of heavy metals. In turn, substantial deposition of metals onto soils may result, possibly increasing the risk of phytotoxicity. In contrast to anthropogenic sources, the environmental impacts of airborne volcanic heavy metals and their accumulation in soils are poorly studied. Along with the degassing of S, Cl and F, Masaya volcano, Nicaragua, is also a strong source of heavy metals. Recent estimates indicate emission rates of e.g., 62 t As yr^{-1}, 133 t Zn yr^{-1} and 306 t Cu yr^{-1} (Moune, 2002). Here, we report on the effects of heavy metal depositions on the total contents of As, Cr, Ni, Cu, Bi, Zn, Se, and Co in two groups of soils located 5 km and 15 km downwind from the volcano. These soils correspond to young Vitric Andosols and more weathered Eutric Andosols, respectively. As and Se were measured by Inductively Coupled Plasma-Atomic Emission Spectrometry after soil digestion in a trace metal unit, and Cr, Ni, Cu, Co, Bi and Zn were determined after alkaline fusion in Li-metaborate/Li-tetraborate. Results suggest that prolonged metal inputs in the vicinity of Masaya volcano have significantly increased the As, Se and Zn contents of the soils. For these elements, concentrations are about 3-5 times those measured in the parent rock materials. However, maximum concentrations in soils (i.e., 5.4 mg As kg^{-1}, 183 mg Zn kg^{-1} and 0.9 mg Se kg^{-1}) never exceed critical concentration levels as defined for cultivated soils in the UK (10, 300 and 3 mg kg^{-1} for As, Zn and Se, respectively). We did not detect significant enrichments in Cr, Ni, Cu, Bi, and Co. The relatively low accumulation of metals in the Masaya Andosols contrasts with the high retention of volcanic F and S inputs (Delmelle et al., 2003). Since Andosols typically show a high affinity for heavy metals, which can be bound to organic matter as well as to oxides, oxyhydroxide and allophane minerals present in these soils, rapid leaching of the metal inputs through the soil profiles is considered unlikely. Instead, metals in the plume may have been deposited during the first seconds of transport in the atmosphere, rapidly depleting the plume in these elements. Thus, in the case of plume emitted in the boundary layer, the volcanic contribution of metals to the atmosphere may be significantly lower than that extrapolated from emission rates measured at the source. Further studies are needed to better assess heavy metal deposition and the biogeochemical cycle of these compounds in volcanic environments.

V21C-0526 0830h POSTER

Widespread Sulfate ^{17}O Anomaly in Cenozoic Ash Beds in North America High Plains: What Could be the Cause(s)?

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Volcanically emitted sulfur gases are ultimately oxidized to sulfate and fall back to the surface of Earth. The oxygen and sulfur isotope compositions of sulfate, particularly the ^{17}O anomaly, provide direct clues to specific oxidation pathways. Atmospheric oxidation of reduced sulfur gases involving oxidants such as O_3 and H_2O_2 are likely the sources of the ^{17}O-anomalous sulfate. We report a widespread oxygen-17 anomaly for water- and acid-leached sulfate in Cenozoic (33 to 7 million years ago) ash beds in the northern High Plains, a signal not found in freshly collected ashes from recent eruptions around the world. These data suggest that the anomalous sulfate was not carried by ash-falls. Similar magnitude of sulfate ^{17}O anomalies in rock records has so far only been found in hyperarid deserts on Earth (e.g., the Antarctica Dry Valleys and the Atacama Desert), where extreme dry climate and long-term stable surfaces have facilitated the accumulation of atmospheric sulfate for up to millions of years. The northern High Plains of North America, however, has been mostly in a semi-arid climate and its sediments are characterized by fluvial, aolian, and playa deposits. Our extensive survey shows that sulfates of non-atmospheric origins have no ^{17}O anomaly. Sulfate from playa settings in arid and semi-arid regions do not have ^{17}O anomaly or have smaller anomaly than that from the surrounding surfaces, which is in contrast to the observation for many of the ash beds in the northern High Plains. The ash beds in the Atacama Desert and in the Antarctica Dry Valleys do have a significant amount of anomalous sulfate in them. However, the sedimentary features (e.g., the presence of desert pavement), isotopic data and their patterns, and sulfate concentrations in these ash beds do not fit those of the Cenozoic ash beds in the High Plains that contain ^{17}O-anomalous sulfate. A stratospheric origin for a large quantity of anomalous sulfate in ash beds seems difficult because of the lack of a viable transport and deposition mechanism. In light of these constraints, extreme dry-fog (sulfate haze) events resulting from the tropospheric oxidation of volcanic sulfur gases might provide the best explanation for the anomalous sulfates in the ancient ash beds in the northern High Plains.

URL: http://www.geol.lsu.edu/bao/

V21C-0527 0830h POSTER

Global Climate Change Resulting From Voluminous Intrusive Basaltic Volcanism in Sedimentary Basins: the Methane Production Potential

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Large igneous provinces are often temporarily associated with global warming and mass extinction events, for instance (1) the Siberian Traps and the Permian-Triassic boundary, (2) the Karoo igneous event and the Early Toacian anoxic event, (3) the Deccan Traps and the Cretaceous-Tertiary boundary, and (4) the North Atlantic Volcanic Province (NAVP) and the initial Eocene thermal maximum (IETM). We propose a new theory for linking the volcanic and global warming events where the magma emplacement environment is a crucial parameter. Our theory is that massive production and release of isotopically light carbon gasses in metamorphic aureoles surrounding magmatic sill intrusions in organic-rich sedimentary basins may trigger global climate change. The greenhouse gasses have to be produced and released in a short time (about 10^4 years) to be able to explain large global warming events. The intrusion of magma into an organic-rich sedimentary basin may increase the carbon flux into the atmosphere by at least 5 to 30 times compared with degassing of the same volume of extruded magma. Field and seismic data, combined with temperature modelling, show that very voluminous sill complexes are intruded and solidified in a short time span (<1000 years) during the initial phase of volcanic activity. We have recently completed an extensive mapping of Paleocene/Eocene sill complexes in the Cretaceous Vøring and Møre basins off mid-Norway. The extent of the sill complex is >80,000 km^2, whereas the estimated total volume of the sill complex is 0.9 to 2.5 x 10^4 km^3. The methane production potential in metamorphic aureoles in these two basins is in the rage 0.3 to 3.3 x10^{18} g CH_4 assuming that 0.5 to 2.0 wt. % organic carbon is converted to methane. The methane production potential in the entire NAVP is estimated to be about five times greater. The total volume of methane produced in metamorphic aureoles in NAVP is larger than the volumes required to explain the IETM and the associated light carbon isotope excursion.

URL: http://vbpr.no

V21C-0528 0830h POSTER

Global Climate Change Resulting From Voluminous Intrusive Basaltic Volcanism in Sedimentary Basins: the Methane Transport and Eruption Mechanisms

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The methane production potential in metamorphic aureoles surrounding voluminous sheet intrusions in sedimentary basins can be sufficiently large to trigger global climate change and mass extinctions. However, a causal relationship between global heating and greenhouse gasses formed by metamorphic reactions requires a mechanism for fast fluid transfer between the source region and the atmosphere. We propose that hydrothermal vent complexes may provide such fluid-migration pathways. These complexes consist of an upper crater-, dome- and eye-shaped part located at the paleosurface, and a lower cylindrical conduit zone connecting the upper part with the tip of a sill intrusion. Field evidence and numerical modelling shows that hydrothermal vent complexes are formed by explosive release of

fluids and gasses, but also that the structures are commonly re-used for later slow fluid migration. The structure and formation of hydrothermal vent complexes are similar to mud volcanoes, whereas the pressure build-up mechanisms are different. We have identified >700 hydrothermal vent complexes on seismic data in the Vøring and Møre basins, and several hundred vent complexes are located onshore in the Karoo basin in South Africa. The diameter of the upper parts of the vent complexes range from several hundred meters to >10 km. More than 95% of the vent complexes in the Vøring and Møre basins are located near the Top Paloecene level, biostratigraphic dated as 55.0 to 55.8 m.y. in one borehole penetrating the upper part of a hydrothermal vent complex. This date corresponds to the onset of the initial Eocene thermal maximum (IETM). Similarly, the Karoo igneous event (about 183 Ma) correlates with the start of the Early Toacian anoxic event. The hydrothermal vent complexes in the Karoo basin are located at the paleosurface just below the extrusive cover. Several vent complexes are also located in the deep parts of the Karoo basin close to the organic-rich layers such as the Whitehill Fm., suggesting that they may have formed by explosive release of carbon-rich gasses.

URL: http://www.fys.uio.no/pgp

V21C-0529 0830h POSTER

Laboratory Testing of Volcanic Gas Sampling Techniques

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A series of laboratory experiments were performed designed to calibrate several commonly used methods for field measurement of volcanic gas composition. H_2, CO_2, SO_2 and $CHCl_2F$ gases were mixed through carefully calibrated rotameters to form mixtures representative of the types of volcanic compositions encountered at Kilauea and Showa-Shinzan. Gas mixtures were passed through a horizontal furnace at 700°C to break down $CHCl_2F$ and form an equilibrium high-temperature mixture. With the exception of Giggenbach bottle samples, all gas sampling was performed adjacent to the furnace exit in order to roughly simulate the air-contaminated samples encountered in Nature. Giggenbach bottle samples were taken from just beyond the hot-spot 10cm down the furnace tube to minimize atmospheric contamination. Alkali-trap measurements were performed by passing gases over or bubbling gases through 6N KOH, NaOH or LiOH solution for 10 minutes. Results were highly variable with errors in measured S/Cl varying from +1600% to -19%. In general reduced Kilauea compositions showed smaller errors than the more oxidized Showa-Shinzan compositions. Results were not resolvably different in experiments where gas was bubbled through the alkaline solution. In a second set of experiments, 25mm circles of Whatman 42 filter paper were impregnated with $NaHCO_3$or $KHCO_3$ alkaline solutions stabilized with glycerol. Some filters also included Alizarin (5.6-7.2) and neutral red (6.8-8.0) Ph indicator to provide a visual monitor of gas absorption. Filters were mounted in individual holders and used in stacks of 3. Durations were adjusted to maximize reaction in the first filter in the stack and minimize reaction in the final filter. Errors in filter pack measurements were smaller and more systematic than the alkali trap measurements. S/Cl was overestimated in oxidized gas mixtures and underestimated in reduced mixtures. Alkali-trap methods allow extended unattended monitoring of volcanic gasses, but our results suggest that they are poor recorders of gas composition. Filter pack methods are somewhat better, but are more difficult to interpret than previously recognized. We suggest several refinements to the filter-pack technique that can improve accuracy. Giggenbach bottles remain the best method for volcanic gas sampling, despite the inherent difficulty and danger of obtaining samples in active volcanic environments. Relative merits of different alkali solutions and indicators are discussed.

V21C-0530 0830h POSTER

Diffuse CO_2 Degassing From Devils Kitchen, Mt. Hood, Oregon

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Research to quantify diffuse CO_2 emissions from volcanoes is a useful component of a monitoring program as increases in diffuse CO_2 emissions have been linked to volcanic unrest. The Devils Kitchen (DK) at Mt. Hood, OR is a > 5000 m^2 area of steaming ground, located near the summit of the volcano at the terminus of Coalman glacier. Numerous small, sub-boiling gas vents are scattered across the area and soil temperatures at the interior are typically elevated above background. Much of the host rock has been hydrothermally altered to clay, creating a hard packed moist surface of low permeability. At present, there are no fumaroles at DK, however many large fumaroles vent from the nearby Steel Cliffs and Crater Rock. During August 2003, we constructed a grid of 75 sites at DK using 10-m spacing, covering ≈ 5,000 m^2. CO_2 fluxes were measured using the accumulation chamber method. Soil temperatures were measured at 10-cm depth adjacent to each flux site. Fluxes and temperatures ranged from less than 8 to over 11,000 g m^{-2} d^{-1} and 5 to 88°C, respectively. The average flux at DK was 190 g m^{-2} d^{-1}. Applying this average across the sampled area yields total CO_2 emissions of 0.9 ± 0.1 t d^{-1}. Based on our field mapping after a snowfall, we estimate at least 37,000 m^2 of thermal ground is present on Mt. Hood. If the flux over these areas is similar to the flux at DK this would indicate diffuse CO_2 emissions on Mt. Hood are about 7 t d^{-1}. This estimate may be conservative as fluxes at several sites at the edge of a large area of steaming ground above Crater Rock were much greater than the maximum flux at DK. Compared to reports of total diffuse CO_2 emissions on similar volcanoes, our estimate for Mt. Hood is low and may indicate that most of the CO_2 is emitted from the fumaroles.

V21C-0531 0830h POSTER

Energy released at Teide Volcano,Tenerife, Canary Islands

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Teide volcano (3715 m high) is located at the northern scarp of the Las Cañadas caldera, a large depression at the center of Tenerife Island. Las Cañadas has been produced by multiple episodes of caldera collapse and giant landslides. The basanite-phonolite magmatic system associated with Teide volcano is emitting gases that reach the summit producing weak fumaroles. The chemical composition of these fumaroles and the flux of diffuse soil CO2 degassing at the summit cone (0.5 km2) has been used to determine the energy released as passive degassing in this volcano. Previous investigations show that Teide's summit is emitting 400 tons m2 day-1 of CO2 to the atmosphere. The composition of CH4, CO2, CO, and H2O indicate a chemical equilibrium temperature of 234°C and 75% condensation of water vapor within the volcanic edifice (Chiodini and Marini, 1998). The composition of the gases before condensation was restored and assumed to represent the composition at the equilibrium zone. The energy stored by the gases at the equilibration zone is assumed to be released as the gases move towards the discharge zone. The following processes are considered: change in pressure and temperature for water from the equilibration zone to the zone of condensation, latent heat released during the water condensation process, cooling of the condensed water from the condensation temperature to ambient temperature, and change of pressure and temperature for CO2 from the equilibrium to the discharge zone. Thermodynamic calculations of the energy released in each one of these processes indicate that 144 MW are released at Teide. Energy flux is 288 MW m-2. Most of this energy is released during the condensation process. This energy output compares with other hydrothermal systems of the world. These results show that during periods of passive degassing, fumarolic activity is limited by the geometry and elevation of the volcanic structure and the internal thermodynamic conditions.

V21C-0532 0830h POSTER

Monitoring Volcanic Plumes By Passive Samplers: Data From Mt. Etna And Stromboli Volcanoes

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Diffusive samplers are of common use in environmental monitoring for the collection of air gaseous volatiles, basing on molecular diffusion and the use of a specific adsorbent support. Here, we present the very first determinations of hydrofluoric, hydrochloric acids and sulfur dioxide in the volcanic plume of both Mount Etna and Stromboli volcanoes, in the attempt of highlighting the potentiality of passive samplers in volcano monitoring. On Mt. Etna, diffusive samplers were used during the powerful October 2002-February 2003 eruption. Data from diffusive samplers fairly matched results of direct measurements in the plume, obtained through the filter packs method (Aiuppa et al., 2002). Also, they allowed acquiring a continuous record of the chemical composition of the eruptive plume from a "safe" distance of 1 km from the vents, thus considerably decreasing the risks involved in the direct sampling. The clear time decrease of sulfur dioxide concentrations and SO2/HCl ratios we observed from mid December (2600 g·m-3 and 8.2, respectively) to early February (350 g·m-3 and 1.5, respectively) allowed us to track the progressive exhausting of volatile degassing and to forecast the imminent ending of the eruption. Diffusive samplers were used on Stromboli volcano during the last stages of 2002-03 eruption, from May to August 2003. A few determinations carried out a few days before the April 5 paroxysm highlighted S/Cl ratios as high as 8 and low Cl/F ratios, which we interpret as due to shallow degassing of a fresh gas-rich magma batch. Since then, a progressive trend of decrease of S/Cl ratio was observed, from 3.5 to 1. Highest values correspond to the reestablishment of explosive activity at summit craters, after almost two months of continuous and quiet lava emission from 600-m vents on Sciara del Fuoco, seldom interrupted by sporadic explosions. After then, S/Cl ratios present a progressive drop to very low values (1). This finding could be attributed to the decline of S-rich magma feeding from depth and/or a decrease of SO2 mass output, which probably allowed the background S/Cl ratio (marine spray?) to prevail.

V21C-0533 0830h POSTER

Use of PTFE membrane for in-situ gas phase extraction from natural waters

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The extraction of the dissolved gas phase in natural waters is a delicate operation which can frequently invalidate the analytical data. Several methodologies were developed in order to separate the dissolved gaseous phase from water. They can be divided in two main groups: the extraction laboratory technique (ELT) (Mazor, 1977; Sugisaki & Taki, 1987; Andrews et al.,1989; Holt et al. 1995; Capasso & Inguaggiato, 1998) and the extraction field technique (EFT) (Tonani, 1971; Chiodini, 1996). Recently, new EFT method have been developed using PDMS membrane, (Sanford et al., 1996; Jacinthe & Groffman, 2001). We perform a method based on semi-permeable polymeric membrane PTFE (waterproof and permeable to the gases).The sampling device consists of a PTFE tube, sealed at one end, and connected to a glass vessel. The evacuated system is plunged in the natural water for one or more days. During this time the dissolved gases flows inside the system. The equilibrium is reached after 10 days, but a theoretical model was developed to recalculate the partial pressure of each gas species, from not equilibrated gas sample. The recalculation model was developed combining Mass Balance with "Diffusion-Solution Model", the best model to describe the gas permeation through the PTFE membrane. The recalculation model was experimentally validated by several laboratory tests and compared with ELT methods. The new method was applied in groundwater of Vulcano Island, and allows us to carry out chemical and isotopic data of dissolved gas phase from a same gas sample

V21C-0534 0830h POSTER

Volatile Light Hydrocarbon Compositions of the Central American Arc and Yellowstone National Park

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The presence of organic compounds in volcanic and geothermal emissions has generally been attributed to the degradation of previously existing crustal organic material. Samples collected from areas of documented high sedimentary content are therefore expected to contain a higher quantity and greater diversity of hydrocarbons than samples collected in areas with more pronounced mantle input. We sampled 17 fumaroles and hot springs in Central America and 26 in Yellowstone National Park in order to examine the relationship between the physical and chemical characteristics of the sampling location and hydrocarbon distribution. El Salvador and Honduras gas samples were analyzed for inorganic compounds, light hydrocarbons and C isotopes of methane. Collection temperatures of the El Salvador samples ranged between 78 and 875°C. Values of δ^{13}C-CH_4 for the El Salvador samples vary between -32 and -30 $^o/_{oo}$, while the Honduras samples range between -39 and -24 $^o/_{oo}$. These values fall within the accepted range for thermogenic methane (marine source rock -40 to -30 $^o/_{oo}$ and humic source rock -30 to -25 $^o/_{oo}$). Of the hydrocarbons, methane was present in the greatest concentration, although hydrocarbons up to pentane were detected. At the highest temperatures, pentane was the only higher hydrocarbon and it was present in one sample (C1/C5 of 34), whereas in the lower temperature samples hydrocarbon variability and quantity was greater (C1/C3 of 41 to 448; C1/C4 of 132 to 2463; C1/C5 of 277 to 6305). Hydrocarbon amounts and diversity were much higher in samples with lower ^{3}He/^{4}He ratios (3.99 to 6.38 R_C/R_A) than in samples with high ratios (6.67 to 7.56 R_C/R_A). In Yellowstone National Park, gas samples were collected from sites within the caldera (^{3}He/^{4}He of 4.73 to 15.47 R_C/R_A), along the caldera rim, and outside of the caldera. Temperatures range from 12 to 94°C. These samples have been analyzed for inorganic compounds, light hydrocarbons, and C isotopes of CO_2. The δ^{13}C-CO_2 values of the samples range from -4 to -1 $^o/_{oo}$, with the lightest values seen along the caldera rim and outside the caldera, while the heaviest values are seen primarily at sites inside the caldera. The lighter C isotope values fall within the range of magmatic CO_2 (-8 to -4 $^o/_{oo}$). To produce the heavier values, magmatic carbon may have mixed with limestone-derived CO_2 ($\delta^{13}C = 0$). Relationships between light hydrocarbon compositions, major element gas chemistry and isotopic variations within these geothermal systems will be discussed.

V21C-0535 0830h POSTER

Mt. Etna (Italy) 2002 eruption: time variations of the diffuse CO2 emissions

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Soil degassing is a very common phenomenon occurring in active volcanic areas (Carapezza et al., 1980, Boubron et al. 1996, Gurrieri & Valenza 1988, Giammanco et al., 1995). In some cases, such as Mt. Etna, the total amount of soil CO2 emissions resulted comparable to the CO2 output released from the main craters (Allard et al., 1991; D'Alessandro et al., 1997). Moreover, the time variations of the soil degassing appear to be strictly correlated to the volcanic activity (Giammanco et al., 1995). Since December 2002, a network for continuous monitoring of soil CO2 degassing was installed on Mt. Etna to verify the last hypothesis. Mt. Etna is an active volcano characterized by frequent eruptions (last erupted on 2002, October 28th, one year after the previous eruption) located on the eastern part of Sicily (Italy). The remote stations were initially installed in two sites located on the East and South West flanks of the volcano. Data series recorded in these two sites during 6 months of observations before and after the end of the 2002 eruption show an opposite behavior which probably represent different degassing steps in the magma uprising towards the surface. Time correlations between variations of soil gas and of atmospheric parameters such as rain, pressure and temperature, were found only for short period. A discrete data inversion model was developed in order to evaluate the atmospheric influence on soil CO2 emissions.

V21C-0536 0830h POSTER

Temporal variations of fumarole and soil gases at Mt. Etna volcano (Italy) from 2000 to 2003.

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Gas samples were collected during the period 2000 - 2003 from six sites on Mt. Etna volcano. The main gas species emitted at all sites is CO_2, but huge emission of organic CH_4 occur at some places. The origin of CO_2 is largely magmatic, compatible with a source marked by δ^{13}C values in the range -2 to -1 $^o/_{oo}$. Concurrent He emissions were characterised by He isotope values in the range 1.02 to 7.61 Ra, the highest values being measured where air contamination was lowest, and suggest a variable contribution of a magmatic component. During the studied period significant variations of CO_2 efflux, CO_2, He, CO, CH_4 concentrations and C and He isotopes were observed more or less at all sites. The variations in the chemical and isotopic parameters measured are coherent with magma accumulation at depth and its progressive migration towards the surface. The arrival of each batch of magma at depth (> 10 km) produces anomalies (mainly CO_2 efflux and CO concentration increases) that are best observed at the most peripheral sites. Migration of magma towards the surface (depth < 10 km) produces anomalies that are observed at sites closer to the summit craters. Short-term anomalies were recognised in anomalous increases of fumaroles temperature, which occurred some weeks to some days before Etna's eruptions and were due to greater input of high-enthalpy fluids (mainly water vapour) through the major fracture systems that cut the summit of Etna. The latest data indicate a new episode of magma replenishment at depth which has then produced magma migration and accumulation at shallower depth. The intensity of the observed anomalies would suggest a likely evolution towards a new eruption in the short period.

V21C-0537 0830h POSTER

CO_2 budget from active volcanoes of central Mediterranean: preliminary estimate for Ischia Island (Italy).

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Ischia Island (46 km^2) is an active volcano located a few kilometres northwest of the bay of Naples (Central Italy). It last erupted in 1302 A.D. and its activity is currently characterised only by low-temperature (T° max. = 100° C) gas emissions, such as fumaroles and anomalous soil degassing. A geothermal reservoir (estimated reservoir temperature near 280° C; Inguaggiato et al., 2000) is also present in the island. The emitted gases are mostly water vapour and CO_2. Also H_2 is present in appreciable amounts (up to 2.5 % v/v of dry gas), together with minor concentrations of CH_4 He and CO. Based on helium and carbon isotopic ratios (R/Ra ~ 3.6; $\delta^{13}C_{(CO2)}$ ~ -2 $^o/_{oo}$), a magmatic source can be inferred for these gases. The present study was mainly aimed at carrying out a preliminary estimate of the total output of magmatic CO_2 from Ischia, considering all types of fluids emitted there. Soil CO_2 fluxes (measured with the accumulation chamber) gave a value of about 2.5 Mt a^{-1}, that is much lower than the amount estimated at Mt. Etna (13 to 25 Mt a^{-1}; Allard et al., 1991; D'Alessandro et al., 1997), but more than an order of magnitude higher than that estimated at Pantelleria Island and at Vulcano (Favara et al., 2001). The amount of CO_2 dissolved into ground water as carbonatic species is only 0.025 Mt a^{-1}, considering an annual volume of infiltrated water of about 8 $\times 10^6$ m^3. The overall output of CO_2 from Ischia indicates that this island is site of active volcanic degassing and deserves a more careful volcanological monitoring.

V21C-0538 0830h POSTER

Spatial and temporal variations of soil CO_2 flux and pressure gradient measurements at Cumbre Vieja volcano, La Palma, Canary Islands

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La Palma (730 km^2) is one of the youngest and the most active volcanic island of the Canarian archipelago. Volcanic activity has been concentrated on the southern part of the island, Cumbre Vieja volcano (220 km^2), which had been constructed during the last 1 Ma. Three major volcanic rift-zones trending N-S, NW-SE and NE-SW constitute Cumbre Vieja's major structural features. During the last 60 years, two eruptions had occurred at Cumbre Vieja along the N-S rift-zone, and the most recent one took place at the southern part of the volcanic edifice in 1971. Since fumarolic activity is absent at Cumbre Vieja, diffuse CO_2 degassing survey is a major geochemical tool for monitoring changes of volcanic activity at Cumbre Vieja. Since 1997 diffuse CO_2 degassing monitoring is applied for the volcanic surveillance program of Cumbre Vieja. Surface pressure gradient studies are also applied since 2002 to evaluate surface degassing mechanisms. Surface pressure gradient measurements were performed by means of a Setra 239 pressure transducer using a metallic probe inserted 40 cm deep. Soil CO_2 efflux measurements were performed by means of a portable NDIR sensor according to the accumulation chamber method. Most of the study area showed CO_2 efflux values lower than 6 $gm^{-2}d^{-1}$, with background values about 2 $gm^{-2}d^{-1}$. Peak CO_2 efflux values are higher than 500 $gm^{-2}d^{-1}$, and they were mainly observed in the extreme south of the N-S rift-zone near by the most recent eruption. The highest surface pressure gradient measurements (≥30 Pa m^{-1}) were also detected in and around Teneguia volcano suggesting an advective component for the diffuse CO_2 degassing for this area. The total diffuse CO_2 output released to atmosphere has been estimated for each survey showing a range of 1,250-2,500 t d^{-1} for the 1997-2003. Monitoring these geochemical parameters will improve the volcanic surveillance program of Cumbre Vieja.

URL: http://www.iter.es

V21C-0539 0830h POSTER

Diffuse mercury degassing at Poás Volcano, Costa Rica, Central America

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Degassing magma is the primary source of Hg in volcano-geothermal systems; therefore, Hg is an important constituent in volcanic gases. Diffuse Hg^0 degassing studies from Poás volcano have been yearly performed during the 2000-2003 period. Poás volcano is a large basaltic-andesite stratovolcano, located in the Central Cordillera of Costa Rica. The purpose of this study is to evaluate the spatial and temporal variantions of Hg^0 in the soil atmosphere with changes on the volcanic activity. Soil gas Hg^0 content was measured using a Jerome 431-X portable analyzer, and hundreds of measurements were performed during each survey. Sampling site distributions were similar for all the surveys covering an area of 3.4 km^2. For the four surveys, few percent of the total data showed soil Hg^0 concentrations higher than the upper detection limit of the instrument, 380 ppbV. Most of the study area showed background values of soil Hg^0 content, about 50 ppbV. Peak values of soil Hg^0 (> 300 ppbV) were mainly observed inside the main crater of Poás volcano. For the 2000 survey, peak values (> 300 ppbV) were detected at the dome within the crater. For the 2001-2003 surveys, peak values of soil Hg^0 were also osberved at the

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eastern sector of the main crater. These observed spatial variations of soil Hg^0 anomalies are temporarily correlated with an increase of fumarolic activity in the eastern part of the crater. In addition, spatial distribution of peak values of Hg^0 in the eastern sector of the crater follows a N-S trending parallel to local faulting. Soil Hg^0 distribution were spatially well correlated with CO_2 efflux data for the period 2000-2003 (Melián et al., 2001). These results suggest that a deep perturbation of the Poás volcanic-hydrothermal system has been responsible for the observed spatial distribution pattern of soil volatiles.

URL: http://www.iter.es

V21C-0540 0830h POSTER

Dynamics of diffuse helium degassing from Cumbre Vieja volcano, La Palma, Canary Islands

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La Palma island (730 km^2) is the northwestern most island of the Canarian archipelago. Cumbre Vieja volcano (220 km^2) is the result of the volcanic activity in the southern part of the island during the last 1 Ma. Six historical eruptions had occurred at Cumbre Vieja, and the most recent one took place at the extreme south of this volcano in 1971. Three major volcanic rift-zones trending N-S, NW-SE and NE-SW constitute Cumbre Vieja´s major structural features. The aim of this study is evaluate the use of diffuse helium degassing for monitoring Cumbre Vieja volcano since (1) diffuse degassing studies seems to become a powerful geochemical tool for volcano surveillance (Hernández et al., 2001), and (2) helium is an ideal geochemical gas tracer because it is chemically inert, physically stable, sparingly soluble in water under ambient conditions. Since 1997 diffuse degassing surveys are regularly performed at Cumbre Vieja. During the last 2 years these surveys have investigated helium in the soil atmosphere. Soil gas samples were collected at 40 cm deep using a metallic probe and stored in vacutainers by means of water displacement technique. Soil gas samples were analyzed for ^4He and CO_2 contents by means of a QMS within 24 hours. CO_2 efflux measurements were also performed by means of a portable NDIR sensor according to the accumulation chamber method. ΔHe contour maps ($\Delta He = He_{soilatmosphere}$-$He_{air}$) were constructed using kriging as interpolation method. Both surveys showed a good spatial agreement for ΔHe, and their peak values (> 1,800 ppbV) were mainly observed at the summit area of Cumbre Vieja along the N-S rift-zone, suggesting a deep origin for the degassing through this major structure. The total output for diffuse ^4He emission rate at Cumbre Vieja was estimated by multiplying CO2 efflux times ΔHe /ΔCO_2 ratio at each sampling site. The results showed an increase on the diffuse ^4He emission rate from 67 to 167 kg d^{-1}. Monitoring these results could be useful for the volcanic surveillance.

URL: http://www.iter.es

V21C-0541 0830h POSTER

Monitoring Diffuse Carbon Dioxide Degassing and Surface Pressure Gradient at Cerro Negro Volcano, Nicaragua

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Diffuse CO_2 emission studies are becoming a useful geochemical tool for volcano monitoring. Significant temporal variations of diffuse CO_2 degassing rate seem to be directy related to changes of activity volcanic. Since 1999 a research collaboration program between INETER and ITER has been established for monitoring diffuse CO_2 emission from Cerro Negro, the most active volcano from the western hemisphere.
Surface pressure gradient and diffuse CO_2 degassing surveys were carried out on March 2002 and 2003 at Cerro Negro. An additional survey of CO_2 efflux was performed on December 1999. Sampling site distributions were similar for the 1999, 2002 and 2003 surveys covering an area of 0.6 km^2. Pressure gradient measurements were performed by means of a Setra 239 pressure transducer, and soil CO_2 efflux measurements were performed by means of a portable NDIR sensor according to the accumulation chamber method. Surface pressure gradient values ranged from -11.7 to 232.8 Pam^{-1} and -24.2 to 102.0 Pam^{-1} for 2002 and 2003 surveys, respectively. Soil CO_2 efflux ranged from 0.5 to 35,000 $gm^{-2}d^{-1}$ for 1999, 0.3 to 26,500 $gm^{-2}d^{-1}$ for 2002, and 0.3 to 3,002 $gm^{-2}d^{-1}$ for 2003 surveys. The total diffuse CO_2 output for the 2003 survey was estimated about 34 td^{-1}, which is one and two orders of magnitude lower than the estimated for the 1999 survey, 2,800 td^{-1}, (Salazar et al., 2001) and the 2002 survey, 280 td^{-1}, (Galindo et al., 2002). These surveys took place 3 (1999), 17 (2002) and 29 (2003) months after the most recent eruption of Cerro Negro, August 1999. The observed decreasing trend on the diffuse CO_2 emission is temporarily correlated with a reducing tendency on the surface pressure gradient suggesting a lower advective component for the diffuse degassing mechanism on the surface environment at Cerro Negro. These results show a clear relationship between diffuse CO_2 emission and the eruptive cycle of Cerro Negro; therefore, the potential of this geochemical tool for its volcanic surveillance.

URL: http://www.iter.es

V21C-0542 0830h POSTER

Dinamic of Diffuse CO2 Degassing at the NW Volcanic Rift-Zone of Tenerfe, Canary Island

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Tenerife is one of the most active volcanic island of the Canarian archipelago with six historical eruptions. The most recent volcanic activity took place along the NW rift-zone in 1909, Chinyero volcano. Fumarolic activity is absent along the NW rift-zone; therefore, diffuse CO_2 degassing studies constitute a major geochemical program for the volcanic surveillance of the area. The first survey was carried out in 2000, and 446 observation sites were well distributed along the study area of (72 Km^2). The most recent survey of diffuse CO_2 degassing and surface pressure gradient measurements was carried out from July 17 to August 6, 2003 with 441 observation sites covering the same area. Soil CO_2 efflux measurements were performed by means of a portable NDIR sensor according to the accumulation chamber method, while pressure gradient measurements were performed by means of a Setra 239 Model pressure transducer. Statistical-graphical analysis of the soil CO_2 efflux data showed two overlapping populations. The background geometric mean was 1.7 $gm^{-2}d^{-1}$ and represents 97.5% of the total data. The highest observed CO_2 efflux value for this 2003 survey was 13 $gm^{-2}d^{-1}$, and it is very similar to the observed highest value for the 2000 survey, 15 $gm^{-2}d^{-1}$. These peak measurements are 7-9 times background values. Most of the study area showed background values of diffuse CO_2 emission rate for both surveys. Peak CO_2 efflux values are spatially correlated to volcanic alignments with a WNW-ESE trend suggesting a clear structural control on the mechanism of diffuse degassing. Surface pressure gradient distribution did not show a clear relationship with CO_2 efflux distribution. For the 2000 and 2003 survey, the estimated total output for de diffusee CO2 emissioon were 79 and 146 td-1, respectively.

URL: http://www.iter.es

V21C-0543 0830h POSTER

Structurally controlled diffuse ^{222}Rn degassing along the NW volcanic rift-zone of Tenerife, Canary Islands

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Three major volcanic rift-zones trending NW-SE, NE-SW and N-S are identified at Tenerife island. Most of the volcanic activity have occurred along these three major structures. The most recent eruption, Chinyero (1909), occurred along the NW rift-zone. The aim of this research is to evaluate the relationship between structural characteristics of the study area with diffuse ^{222}Rn degassing rates. Nearly fifty cinder cones have been analysed in detail to infer the eruptive fissures trend. The strike values of the 26 eruptive fissures identified ranged from 95 to 176°E, showing a mean value of 116°E. These results suggest that most of the eruptions took place along preferential pathways of WNW-ESE trended fissures and that these eruptions were effectively true fissure type eruptions. Parallel to the structural study a soil gas ^{222}Rn survey of 424 sampling sites was carried out along the NW rift-zone from July 17 to August 6, 2003. Soil gas ^{222}Rn was analyzed in situ by means of a portable radiation monitor Pylon AB-5. The highest observed soil gas ^{222}Rn was 136 pCiL^{-1}. Statistical-graphical analysis showed two overlapping populations. Soil gas ^{222}Rn concentration background geometric mean was 23 pCiL^{-1} and represents 98% of the total data. Most of the study area showed background levels of soil ^{222}Rn concentration, while peak levels were aligned along the NW rift-zone. The good spatial correlation of the soil gas ^{222}Rn concentration with the WNW-ESE trend of the rift-zone suggest that the ^{222}Rn diffuse emission is structurally controlled in the study area.

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V21D MCC: Level 1 Tuesday 0830h

Crustal and Mantle Processes in Ophiolites and Ocean Crust Generation III Posters *(joint with GP, OS, T)*

Presiding: **A Davis,** Cambridge University

V21D-0544 0830h POSTER

Preliminary Results on the Structure of Ocean Crust from new Holes Drilled in Fast-Spread Crust During ODP Leg 206

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ODP Leg 206 successfully accomplished the initial phase of a multi-leg drilling program that aims to sample a complete section of upper oceanic crust through the extrusive lavas, the sheeted dike complex, and into the gabbros. Drilling was conducted at Site 1256 (6.7N, 91.9W), which resides on 15-Ma oceanic lithosphere of the Cocos plate that was created by superfast seafloor spreading (220 mm/yr). Two holes, 1256C and 1256D were drilled into the basement to a depth of 340.3 mbsf (89.6 m sub-basement) and 752 mbsf (502 m sub-basement) respectively. The main stratigraphy of upper oceanic crust at Site 1256 consists of a sequence of massive flows and thin sheet flows with minor amounts of pillow basalts and breccias. The sequence is slightly altered and has N-MORB composition. Structural analysis carried out on board on the recovered cores from both Holes 1256C and 1256D revealed the occurrence of primary igneous as well as post-magmatic structures. Primary igneous features include magmatic fabrics, laminations and flattened vesicles, folds and shear-related structures, late magmatic veins, and fracturing. Postmagmatic structures include veins, shear veins, microfaults, joints, and breccia. Veins are the most prominent structural features and show a variety of morphologies ranging from planar and curviliear to anastomosing. In many cases veins are oriented in en echelon, and Riedel-shear arrays, giving in such case useful shear indications. Shear veins are mostly present in massive coarser-grained lithologic units and are filled with fibrous clay minerals. Shear veins and microfaults indicate both strike-slip and oblique apparent senses of shear. In Hole 1256D shear veins show a change in the sense of shear, from reverse to normal, from 645 mbsf to the bottom of the hole. More than 600 veins and joints from the basement units of Hole C and more than 1700 features from Hole D were measured in the archive half relative to the core barrel reference frame. True dip data show that structures inHole 1256D are mostly gently dipping, having most common frequency dip angles of 15°. Other dip angles are represented nearly by the same frequency throughout the hole. In Hole 1256C, true dip angles show a maximum in frequency between 10° and 20°; however, dip values around 50°-55° and 90° are common as well. Late magmatic veins are mostly gently dipping in the two holes, showing the highest frequency at 15° and 5°. By contrast, shear veins are moderately to steeply dipping in the two holes (maximum frequency ranges from 45° to 75°). In Hole