GEODYNAMICS OF SUBDUCTION ZONES: FROM NUMERICAL MODELS TO SEISMOLOGY AND POTENTIAL FIELD METHODS A SESSION IN HONOR OF HARTMUT JODICKE

MARTES 1

SALON MISMALOYA
GEOPHYSICAL MODELING OF VALLE DE BANDERAS GRABEN

Arzate Flores Jorge (Centro de Geociencias, Campus UNAM-Juriquilla), Alvarez Béjar Román (Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas, UNAM, CU, México DF, 04510), Yutsis Vsevolod (Facultad de Ciencias de la Tierra, UANL, Linares N.L.), Pacheco Martínez Jesús (Centro de Geociencias, Campus UNAM-Juriquilla) y López Loera Héctor (IPICYT, S.L.P.)
arzatej@geociencias.unam.mx

A gravimetric survey consisting of five lines and 483 stations, as well as a magnetotelluric (MT) survey consisting of 17 observation sites, were made in the Valle de Banderas region for the determination of the structural characteristics of the valley. Additionally, an aeromagnetic survey previously made was analyzed to correlate with the above geophysical measurements. Gravimetric and MT models were derived from those determinations, which confirm that the valley corresponds to a general graben structure with slumped blocks that vary from deep emplacements (2000 m) close to Banderas Bay to shallow ones (100 m) toward the NE end of the valley. Faults flanking the valley, inferred from the gravity and magnetic models, can be connected with offshore faults in Bahía de Banderas, indicating a structural connection between Banderas Bay and Banderas Valley. From the MT measurements we conclude that a 2-D resistivity behavior is observed within the graben structure whereas outside of the graben limits the behavior is 1-D, in spite of the mountainous character of the region. Gravimetric models suggest the occurrence of basin-like structures within the valley’s graben, coinciding with similar structures reported elsewhere within Banderas Bay, indicating that this may be a typical erosional feature of the graben structure. The aeromagnetic data correlates with the gravimetric and MT models, and suggests that the graben structure is an extensional zone separating granite blocks with similar magnetic signatures; it also indicates that the extensional zone continues NE beyond the limit of Banderas Valley. These results tend to confirm that Banderas Bay and Banderas Valley belong to the same tectonic structure in spite of an approximate change in orientation of 30° between them, and strengthen the idea that these structures constitute part of the NW limit of the Jalisco Block.
PROPAGATION OF THE 2001-2002 SILENT EARTHQUAKE IN THE MEXICAN SUBDUCTION ZONE

Kostoglodov Vladimir (Instituto de Geofísica, UNAM), Franco Sánchez Sara Ivonne (Instituto de Geofísica, UNAM, Mexico City, Mexico), Larsson Kristine M. (Department of Aerospace Engineering Science, University of Colorado, Boulder, CO, USA), Manea Vlad C. (Caltech, Pasadena, CA, USA), Manea Marina (Caltech, Pasadena, CA, USA) y Santiago Santiago Jose Antonio (Instituto de Geofísica, UNAM, Mexico City, Mexico) vladi@servidor.unam.mx

Among a number of silent earthquakes (SQ) recently recorded by GPS in different subduction zones (Japan, Alaska, Cascadia, New Zealand) the aseismic slow slip event of 2001-2002 in Guerrero, Mexico is the largest one with the equivalent magnitude Mw ~7.5. Sub-horizontal and shallow plate interface in the Central Mexico produces specific conditions for the ~100 km extended zone of slow transient where the SQs develop from ~80 to ~190 km inland from the trench. This wide transient zone and large slow slips of 10-20 cm on the subduction fault result in the noticeable surface displacements up to 5 cm during the SQs. Continuous GPS stations provide reliable data to trace the propagation of SQs, and to estimate the arrival time, duration and geometric attenuation. The knowledge of these propagation parameters is important to understand the origin of slow slip events and their triggering effect on large subduction earthquakes. We use the long-base tiltmeter data to define new time limits for the SQs and continuous records at 8 GPS stations to determine the propagation of the 2001-2002 SQ in Mexico. It occurs that the surface deformation from this SQ commenced almost instantly at the CAYA and IGUA GPS stations separated by ~170 km and located along the profile perpendicular to the trench. The SQ then propagated laterally parallel to the coast at ~2 km/day with an exponential attenuation of horizontal surface displacement and a linear decrease of the duration with the distance. Campaign data measured every year from 2001 to 2005 at the Oaxaca GPS network are modeled by a propagation of the 2001-2002 SQ displacement pulse. This modeling shows that the SQ ceased gradually in the central part of the Oaxaca subduction zone segment (Puerto Angel) and then apparently triggered another SQ in the SE Oaxaca (between Puerto Angel and Salina Cruz).

LOW TEMPERATURE AND HIGH AMPLITUDE MAGNETIC ANOMALY BENEATH CHIAPAS: EVIDENCE FOR A HIGHLY SERPENTINIZED MANTLE WEDGE

Manea Marina y Manea Vlad Constantin CALTECH, Seismological Laboratory, Pasadena, USA marina@gps.caltech.edu

Southern Mexico is an interesting area where the subducting Cocos slab drastically changes its geometry: from a flat slab in Central Mexico to a ~ 45º dip angle beneath Chiapas. Also, the currently active volcanic arc, the modern Chiapanecan volcanic arc, is oblique and situated far inland from the Middle America trench, where the slab depth is ~ 200 km. In contrast, the Central America volcanic arc is parallel to the Middle America trench and the slab depth is ~ 100 km. A 2D steady state thermo-mechanical model explains the calc-alkaline volcanism by high temperature (~ 1300º C) in the mantle wedge just beneath the Central America volcanic arc and strong dehydration (~ 5 wt.%) of the Cocos slab. In contrast, the thermal model for the modern Chiapanecan volcanic arc shows high P-T conditions beneath the coast where the Miocene Chiapanecan extinct arc is present, and is therefore unable to offer a reasonable explanation for the origin of the modern Chiapanecan volcanic arc. We propose a model in which the origin of the modern Chiapanecan volcanic arc is related to the space-time evolution of the Cocos slab in Central Mexico. The initiation of flat subduction in Central Mexico in the middle Miocene would have generated a hot mantle wedge inflow from NW to SE, generating the new modern Chiapanecan volcanic arc. Because of the contact between the hot mantle wedge beneath Chiapas and the proximity of a newly formed cold flat slab, the previous hot mantle wedge in Chiapas became colder in time, finally leading to the extinction of the Miocene Chiapanecan volcanic arc. The position and the distinct K-alkaline volcanism at El Chichón volcano are proposed to be related to the arrival of the highly serpentinized Tehuantepec Ridge beneath modern Chiapanecan volcanic arc. The deserpentinization of Tehuantepec Ridge would have released significant amounts of water into the overlying mantle, therefore favoring vigorous melting of the mantle wedge and probably of the slab.
SE03-5

PACIFIC PLATE REJUVENATION FROM PLUME IMPACT IN FRONT OF THE KAMCHATKA TRENCH: A MECHANISM TO PRODUCE ADAKITIC MAGMAS FOR OLD AND FAST SUBDUCTION ZONES

Manea Vlad Constantin y Manea Marina
CALTECH, Seismological Laboratory, Pasadena, USA
vlad@gps.caltech.edu

The Kamchatka subduction zone is one of the most active seismic and volcanic regions in the world and located in the proximity of the Meiji Guyot mantle plume. We propose a convection model which shows the a hot plume rising from depths greater than 1000 km would bend toward the trench, being deflected near surface by the Pacific plate movement.

Geochemical studies of volcanic rocks in Central Kamchatka show a complex pattern, from basaltic to alkaline basalt of plume type and adakites. Our models suggest that the buoyant plume cannot penetrate the cold subducting slab in order to enrich the mantle wedge and to produce the alkaline plume type basalts. Instead, a gap in the subduction process, likely created by accretion of new terrains, would create an easy way for the hot plume material to enrich the mantle wedge.

The contact between the hot plume and the oceanic plate offshore Kamchatka produces a rejuvenation of the ~100 Ma old Pacific plate and lowering the thermal age to less than 26 Ma. 2D steady state thermal models with such hot incoming slab show that the oceanic crust beneath the active volcanic arc has undergone melting and therefore adakitic volcanism.

SE03-6

FLUIDS RELEASE FROM THE SUBducted Cocos PLate and PARTIAL MELTING OF THE CRust DEDUced FROM MAGNETOTELLURIC STUDIES IN SOUTHERN MEXICO

Jodicke Hartmut (Institut für Geophysik der Westfälischen Wilhelms-Universität Münster, Germany), Jording Alexander (Institut für Geophysik der Westfälischen Wilhelms-Universität Münster, Germany), Ferrari Luca (Centro de Geociencias, Campus UNAM-Juriquilla, Querétaro, Qro., México), Arzate Flores Jorge (Centro de Geociencias, Campus UNAM-Juriquilla, Querétaro, Qro., México), Mezger Klaus I y Rupke Lars (Institut für Marine Geowissenschaften (GEOMAR), Kiel, Germany)
arzatej@geociencias.unam.mx

In order to study electrical conductivity phenomena that are associated with subduction related fluid release and melt production, magnetotelluric (MT) measurements...
APLICACIONES DE PDE2D, UN PROGRAMA DE PROPOSITOS GENERALES QUE RESUELVE ECUACIONES DIFERENCIALES PARciaLES

Sewell Granville
University of Texas at Austin, USA
sewell@math.tamu.edu

PDE2D es un programa de elementos finitos, que resuelve sistemas no-lineales de ecuaciones diferenciales parciales, dependiente o independiente del tiempo, y sistemas lineales de autovalores, en 1D, 2D (regiones arbitrarias), y 3D (regiones no-rectangulares sencillas). Tiene un interfaz interactivo, por lo tanto es muy fácil de usar, y usa elementos de hasta cuarto grado, por lo tanto tiene alta precisión. www.pde2d.com contiene una lista de más de 160 publicaciones, muchos de ellos de geofísica, donde PDE2D se usó para producir los resultados numéricos. En este charla, se presentarán algunas aplicaciones típicas de PDE2D.