Commission on Earth Science and Geodynamics

Commission report for 2002-2003: IUGG/IASPEI General Assembly Meeting in Sapporo, Japan, 30 June – 11 July 2003.

The Commission on Earth Structure and Geodynamics (CESG) helped to organize joint symposium JSS06.

JSS06: Earth Structure and Geodynamics (IASPEI, IAVCEI, IAG, IAGA, SEDI, ILP)

The JSS06 Symposium covered the general topic of "Earth Structure and Dynamics" and attracted a total of 101 accepted abstracts. It was divided into 5 oral sessions (53 presentations) and two poster sessions (48 posters). The sessions were organized according to the not always clear distinction between deep structure and dynamics (transition, deep mantle and core, 3 oral sessions and one poster session) and lithospheric structure and dynamics (2 oral sessions and one poster session). The oral sessions were well attended, with, on average 30-50 people present. The size of the room was appropriate and there was no problem with any of the audio/visual equipment. Several talks were cancelled within two weeks before the meeting - we were able to replace most of those with scheduled oral presentations by moving poster presentations to oral. There were two instances of last minute "no show", one in the Tuesday morning session and the other in the Thursday morning session. In the Thursday poster session, only half of the scheduled posters were presented, presumably because of the timing of this session towards the end of the conference and at the end of the JSS06 symposium. With few exceptions, the level of contributions to the JSS06 symposium was of more uniform quality than at the 2001 IASPEI meeting in Hanoi.

The transition and deep mantle structure sessions featured contributions from observational seismologists and geodynamicists (numerical modellers). Many seismological studies were presented on the lateral variations of structure in the upper mantle (including slabs), the mantle transition zone, the D" layer, and the outer core, using a variety of techniques: body wave travel times, surface waveforms, and converted and reflected body waves. Another focus was geodynamic modeling of mantle structures from the global to the regional scale. An emerging theme is that of large-scale electromagnetic mapping of mantle structures, with still relatively low resolution, but an indication of compatibility with seismic results. A recurring theme in both oral and poster presentations was the role of chemical versus thermal heterogeneity in characterizing the seismically observed upper mantle (as well as some lower mantle) discontinuities, in particular their depth variations, and the structure of flow in the mantle at the global scale. Another recurring theme was that of seismic anisotropy in the upper mantle and its relation to lithospheric structure. In this part of the symposium, there was more emphasis on subduction zone processes than on upwellings (i.e.

plumes). Overall, there were only three presentations on inner core topics, of which two on inner core structure and one observation of Schlichter modes. The lithospheric structure and dynamics sessions focused primarily on regional studies, using seismological modelling and observations as well as geodynamical modeling (rheology, with various constraints from geoid height, topography, GPS, heat flow and style of faulting) in several areas of the world: Uzbekistan, Afar region, Vrancea (Romania), W. Antarctica, Philippine Sea, Indonesia, Japan Islands and Tibet/China. Several presentations addressed the issue of thermal and anisotropic structure of the lithosphere and its relation to geological units. Interpretations of heterogeneities in terms of mantle plumes on the one hand and structure of subduction zones on the other were proposed.

B. Romanowicz

This part of the session covered geodynamical modeling and seismic and electromagnetic mapping of mantle structures from the global to the regional scale. Tackley and Xie presented mantle convection models incorporating chemical differentiation and evolution of isotopic systems. The models tend to overestimate the lead isotopic model age and Tackley discussed various possible reasons for this. Steinberger and O'Connell used a simple model of conduit-type plumes imbedded into a global mantle circulation model driven by plate motion and tomographically inferred density anomalies. In order to explain the shape of the Hawaii-Emperor chain, relative motion between East and West Antarctica must be taken into account. Greff-Lefftz has studied the influence of mass redistributions in the mantle due to plume ascend on True Polar Wander. While the ascent of diapiric plumes causes only little polar wander, oscillatory motions of a mid-mantle compositional boundary ("super-plumes") would explain the magnitude of polar motion. Osmaston suggested that electromagnetic torques at the core-mantle boundary play a significant role for driving plate motion. Ismail-Zadeh et al. have modeled the Vrancea subduction region (Romania) based on seismic tomography results and show that the stress distribution in the model explains the pattern of intermediate-depth seismicity. Weidle and Widiyantoro used results from the Vrancea seismic array, imbedded into a global seismic tomography model, to enhance the regional resolution and find that the can resolve the Vrancea slab to 280 km depth. Utilizing submarine cables, Koyama et al. have calculated a 3-D model of the electrical conductivity structure in the North Pacific. They find a moderate correlation of conductivity anomalies and seismic anomalies and explain the conductivity structure by temperature contrast on the order of 200^{o} and variation in water content. Seismic anisotropy was addressed in four talks. Panning and Romanowicz modeled waveforms of S-multiples using a normal mode approach to determine the degree of radial anisotropy in the mantle. Anisotropy in D" in particular is correlated with superplume structures. Gung and Romanowicz calculated a global S-velocity model including radial anisotropy based on waveform inversion. They find that differences between published S- models in the upper mantle are due to anisotropy. SH anomalies under continental shield extend deeper than SV

anomalies and high SH -velocities below 300 km are interpreted as shear-induced preferred orientation rather than a deep tectosphere. Debayle et al. used an automated waveform analysis of Rayleigh waves for mapping upper mantle S-wave structure. Including overtones is important to resolve structure down to 400 km. They find good correlation with structures determined by regional body-wave tomography, for example for the Eifel region. Azimuthal anisotropy is strong near 100 km depth but becomes weak at 200 km. Plomerova and Babuska discussed seismic results on lithospheric structure in Europe. From the TOR experiment different pattern of anisotropy are found for the Baltic shield and Central Europe. Here dipping anisotropic structures with sharp boundaries are interpreted as frozen-in fabric that predates the collection of terranes that formed Europe.

U. Christensen