Changed and Additional Abstracts

G18

GEODETIC LEVELING AND CRUSTAL MOVEMENT IN THE U.S. PART I, TOPOGRAPHY AND VERTICAL MOTION

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Tectonic deformation or systematic error? This common uncertainty in the interpretation of leveling data is nowhere more apparent than in analysis of temporal elevation change estimates which correlate with topographic relief. Is the topography a result of the observed elevation changes, or are the elevation changes spurious artifacts of topography-dependent leveling errors, such as those due to atmospheric refraction or rod miscalibration? Examination of NGS releveling suggests that topography-correlated errors are pervasive and can easily be misidentified as tectonic movement. New field experiments and theoretical calculations by the NGS confirm that refraction errors can be much larger than previously thought. In order to determine the extent of such errors, identify criteria to recognize them, and develop empirical corrections to remove their influence, 73,962 km of NGS releveling have been analyzed for correlations between apparent movement and topography. Significant correlations were visually identified for 23% of these measurements, some with correlation coefficients greater than 95%. Apparent errors greater than 100 mm per 100 m of topographic relief are indicated in some cases-several times larger than previously cited. Such errors are often easy to recognize, but they can also be quite subtle. Topographic correlation alone, however, is insufficient to confirm leveling error: there are examples of strong correlations which appear to involve real crustal motion, e.g. in New Mexico and SW Montana. Examples of questionable "movement" include data used to define the Palmdale bulge and uplift in the Appalachians. Thus topography-dependent errors may explain some, but certainly not all, patterns of apparent elevation change. In many cases, effective refraction corrections must be applied before crustal movement can be properly inferred.

G29

LONG ARC RESULTS FROM LAGEOS

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Lageos laser ranging data spanning May 1976 through October 1979 have been analyzed using long arc techniques. Single long arcs for this period have been computed which demonstrate the fidelity of the dynamical and measurement models, in addition to providing the basis on which to improve the models. The influence of numerical integration errors has been shown to be controllable to within the model accuracy. The systematic nature of the orbit element residuals is interpreted in terms of the forces acting on Lageos. Results of geophysical interest including GM and ocean tides have been estimated and their separability with other phenomena will be described.

GENESIS OF THE FOY OFFSET AND ITS SULPHIDE ORES: THE PALEOMAGNETIC EVIDENCE FROM A STUDY IN HESS TWP., SUDBURY

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Many of the sulphide deposits of the Sudbury basin are located in dike-like structures which are locally termed Offsets. The genesis of these sulphide deposits and the Offsets in which they reside has long been the subject of some controversy. For example arguments have been given for both a magmatic, and a hydrothermal derivation of the ores.

The Foy Offset, which outcrops to the north of the Sudbury basin, was examined at three localities in Hess Township. At each locality a specific geological feature was sampled. These features were; at locality 1, a contact with a cross-cutting dike; at locality 2, a contact with the country rock; and at locality 3 a contact with a second dike and a sulphide zone. From these tests it is possible to show that over the area examined the Foy Offset is a multiple intrusion. A partial sequence of intrusion can be constructed. In the sulphide zone a distinct remanence direction is observed. Two explanations are possible. For a later hydrothermal origin of the sulphide ores, the sulphide direction could represent a later TRM event. Conversely for magmatic sulphides the sulphide may be recording the resetting of low Curie point pyrrhotite remanences during a regional uplift (or cooling) event. For the hydrothermal case thermal overprinting of the sulphide direction on the main dike direction would be expected at the margin of the sulphide. No such effect would be seen in the magmatic sulphide example. In this context evidence from both margins of the sulphide zone will be discussed.

Devonian Paleomagnetic poles from the St.Cécile and St.Sébastien metasediments and hornfels, Gaspé-Connecticut Valley synclinorium, Quebec.

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The Devonian rocks covered by this study are made up of three lithologies: (1) a tightly folded sedimentary sequence of Lower Devonian age called the Compton Formation which is slightly metamorphosed to a sub-greenschist facies, (2) a two to three phase Devonian granitic stock which has created a contact metamorphic aureole (900-1100 m wide) within the Compton metasediments altered to (3) hornfels. The intrusion of the stock has considerably modified the attitude of hornfels near the periphery of the contact. We report the paleomagnetism of 150 oriented cores collected from the Compton Formation (23 sites) and the hornfels (25 sites) and a baked contact test based on a comparison of the characterestic magnetization directions of the hornfels with those obtained in an earlier study on the granitic stock. Step-wise thermal demagnetization tests on pilot samples between 400-600°C reveal that the metasediments possess a uniform thermal behaviour and a significant pre-folding remanence direction at D=225°, I=+22°. The directional behaviour of the hornfels is variable in AF and thermal tests and the mean magnetization direction (15-40 mT, 300-400°C) obtained is at D=321°, I=+20° which corresponds to post-folding magnetization. This direction obtained for hornfels yields a positive contact test with the St.Cécile-St.Sébastien granite. The respective Devonian paleomagnetic poles are in reasonable agreement with the ones reported in the literature.

049

SEISMIC STRATIGRAPHY OF THE NORTHERN BERMUDA RISE

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Analysis of low frequency seismic profiles from the northern Bermuda Rise has lead to the recognition of several seismic horizons and determination of a regional seismic stratigraphy. The lower most regional reflector, Horizon A^*, correlates with an upper Maestrichtian limestone/chalk facies. Horizon A^c, which correlates with late-early to early-middle Eocene cherts, appears above Horizon A^*. Both horizons are patchy and often interrupted by baesment peaks making their correlations sometimes difficult. Horizon yellow, limited to the central portion of the study region correlates with Laine's diffuse reflector. Although not cored, this reflector is probably caused by gas hydrate. Horizon purple appears to mark the end of the major sedimentalogical constructive phase of the northern Bermuda Rise, and piston core results indicate this reflector marks a hiatus on the Rise. The upper most reflector, silver, occurs in the southeast portion of the region and appears to mark the beginning of modern Gulf Stream circulation on the northern Bermuda Rise.

0154

JET MEANDERS AND DETACHED EDDIES IN A TWO-LAYER QUASI-GEOSTROPHIC MODEL

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Numerical calculations are performed from the initial state that a small amplitude disturbance is superposed on an eastward jet in the upper layer, while the lower layer is quiet. The jet meanders larger and larger, and then, the large meanders are cut off and generate detached eddies. Two kinds of solutions are examined; one is a spatially periodic solution, and the other is wave-packet solution.

The former solution can show the following results. Phase-velocity of the jet meanders is 20% of the maximum average velocity. Phase-velocity and a temporal growth-rate decrease caused by nonlinear effects of the finite amplitude meanders. Anticyclonic eddies detached northward have the water initially located south of the jet, while cyclonic eddies detached southward have the northern water. The eddies are detached helped by weak β-effects.

The latter solution can reveal the following results which can never be obtained from the former solution. Group-velocity is larger than phase-velocity. The detached eddies are generated two and a half wavelengths downstream of the leading edge of the wave-packet. The higher speed meanders catch the lower speed meanders up, and then, eddies are detached successively. This is the second mechanism of the eddy detaching.

0221

ANNUAL RESOLUTION OF Cs-137 FLUXES TO THE ANOXIC SEDIMENTS OF THE SAGUENAY FJORD, QUEBEC

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An anoxic, unbioturbated depositional environment at the head of the Saguenay Fjord, Quebec, contains a well preserved record of Cs-137 inputs to the sediments resulting from nuclear weapons tests conducted in the atmosphere during the past 30 years. Successive maxima in the sediment depth profile for Cs-137 correspond to annual maxima in the fallout deposition rate caused by enhanced mixing of stratospheric-tropospheric air masses during the spring months of each year. The sediment time-stratigraphy estimated from the position of yearly maxima in the Cs-137 activity profile is consistent with an average sedimentation rate of 7 cm yr^{-1} determined from the Pb-210 activity profile. The sediment inventory of Cs-137 consists of two components, one of which reflects immediate deposition of atmospherically derived Cs-137, distinguished by its phase relationship with the seasonally modulated fallout deposition rate. The second component of Cs-137 corresponds to delayed inputs which have resided in the Saguenay River drainage basin for an extended (>4 yr) period of time. The Cs-137 time-stratigraphy provides a means of comparing river discharge rates during the past 20 years with the sediment record of organic matter accumulation. This comparison provides a basis for a rainfall-sedimentation model in which enhanced erosion and resuspension of a coarser-grained component of upstream river sediments and subsequent deposition of this material in the fjord, occurs during periods of high river discharge.

INVESTIGATION OF TURBULENCE AND LANGMUIR CIRCULATION IN LAKE LADOGA

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Some results of microscale turbulence and Langmuir circulation experiments conducted during 1976 - 1978 at nearshore and offshore zones of Lake Ladoga (USSR) are presented. Power spectra for currents and internal waves over a wide range of frequencies were obtained. From the measurements of vertical fluctuations w', horizontal fluctuations u', and gradients of mean speed of currents $\frac{\partial \bar{u}}{\partial z}$, coefficients of vertical turbulent exchange (K_z) were determined. The dependencies of mean vertical current speed $\bar{w}$ and depths of penetration Z_L of Langmuir circulations as a function of wind speed $\bar{V}_a$ and stratification were also calculated.

LARGE ANTENNA MULTIFREQUENCY MICROWAVE RADIOMETER (LAMMR) SYSTEM DESIGN

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The LAMMR is a 4.3, 10.65, 18.7, 21.3, and 36.5 GHz 4 meter diameter offset reflector mechanically scanned radiometer system. These channels were selected to measure sea surface temperature and wind speed, atmospheric water vapor liquid water, precipitation, and sea ice parameters from low earth orbiting satellite systems. This system is now included in the National Oceanic Satellite System (NOSS) payloads planned for launch in the mid 80's. The system design details may be changed during the design and development of LAMMR for NOSS; the present assumed baseline will be presented. The LAMMR achieves resolutions from 36 to 7 KM from a 700 KM orbit which is a factor of 5 better resolutions than were achieved on the Nimbus-7 and Seasat-A Scanning Multichannel Microwave Radiometer (SMMR). The LAMMR also will have a larger swath (1400 KM) as well as better antenna characteristics than SMMR.

The LAMMR offset parabolic reflector uses clustered feed horns to achieve 90% beam efficiencies over the frequency range. The mechanical deflection of the surface and feed arm have been modeled to show feasibility of operation at 1 rps scan rates. The radiometer systems use total power designs calibrated with ambient load and cold sky horn samples taken each scan to achieve ΔTs from .5 to 1.6° K.

OCEAN CIRCULATION, PLATE TECTONICS AND CLIMATE

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In order to produce warm bottom water in the ocean, either the temperature of the coldest surface water must be raised or, more probably, the salinity of surface water must be reduced. The formation of evaporite deposits removes salt from the surface water of the ocean. Epicontinental seas in the high E-P band from 10° to 30° N and S can produce warm salty deep water. The area of shallow seas has decreased markedly from 100 my ago to the present. The changes in the meridional heat transport which would accompany such a circulation are compatible with a more equable climate. The chemical and isotopic effects of such a circulation should be well recorded in deep sea sediments.

S67

THE SLIP PROCESS OF OCEANIC TRANSFORM FAULTS: THE GIBBS FRACTURE ZONE EARTHQUAKES OF 1974

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Most of the slip at shallow depths on major oceanic transform faults occurs during large earthquakes. As a guide to the slip process, we have determined the mechanisms and spatial relationships among the large earthquake (M_S = 6.9, M_o = 4.5 x 10^{26} dyne-cm) of 16 October 1974 on the Gibbs Fracture Zone, a foreshock 8.5 minutes earlier, a 'precursor' event several seconds before the main shock (Kanamori and Stewart, 1976), and a number of aftershocks. The tools of this study include a moment tensor inversion from radiated Rayleigh waves, body wave synthesis, and relative event location from P wave arrival times. The moment tensor solution for the foreshock indicates a focal depth of about 10 km and a double-couple (M_o = 5.6 x 10^{23} dyne-cm) focal mechanism with a combination of right-lateral strike-slip motion and dip-slip motion on a nearly vertical fault at N96°E azimuth. Body wave synthesis of the precursor waveforms supports a shallow focal depth (about 10 km), a mechanism consistent with the strike-slip mechanism of the main shock, and a scalar moment of 7.2 x 10^{24} dyne-cm. The foreshock, precursor, and largest aftershock all occurred within 8 km of each other, while the main event occurred 30 km further west on the transform. The locations of the foreshock and precursor, just to the west of the intersection of the transform with a proposed short spreading center segment to the south (Vogt and Avery, 1973), and the sense of the dip-slip component of the foreshock (subsidence of the southern side), suggest that the 16 October 1974 transform earthquake may have been initiated by spreading on the nearby ridge segment.

SM18

NATURAL ELF AND ASSOCIATED VLF EMISSIONS BETWEEN L = 5.5 AND 8

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High resolution broadband wave spectrograms of a few Hz to 6 kHz from the SCATHA satellite are presented. These data cover the range in L shell from about 5.5 to 8.2 and most local times. Particular attention will be paid to rather frequent striated, burst-like electrostatic emissions at discrete multiples of about 70 Hz. These waves are occasionally but not always seen to occur simultaneously with electromagnetic noise at a few kHz, suggestive of a three wave parametric decay. These emissions have been seen under a wide variety of local times, L shells, magnetic activity, and both in and out of eclipse. The plasma environment surrounding the detection of these events will also be described.

OBSERVATIONS OF THE JUPITER-IO PLASMA TORUS WITH A FABRY-PEROT/CCD IMAGING SPECTROMETER

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Images of the Jupiter-Io plasma torus in the spectral lines of [SII]λ6717 and [SIII] λ9531 were obtained in March 1980 using a Fabry-Perot/CCD imaging spectrometer developed jointly by the University of Wisconsin and Princeton University. The imaging spectrometer consisted of an 18mm effective diameter Fabry-Perot etalon (free spectral range = 58 Å, passband = 1.7 Å) coupled to a 100x160 pixel CCD. At Kitt Peak National Observatory's 36-inch telescope the field of view was about 3'x5'.

The [SII] and [SIII] images provide information on the structure of the plasma torus and its orientation with respect to the Jovian magnetic and spin equators.

THE EVOLUTION OF WARM CORE EDDY J IN THE EAST AUSTRALIAN CURRENT SYSTEM, 1979/80

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Earlier work in 1977 with satellite-tracked buoys and ships revealed the long lives of eddies (approximately 1 year), and long residence times of individual buoys in them (up to 5 months), and the means by which their isothermal layers (thickness approximately 350 m) could be formed.

In 1979 eddy J near Sydney was selected for a joint physical and biological study. The resulting data set was quite comprehensive and enabled the formation of the eddy's isothermal/isohaline layer to be followed through the winter. At the end of a two-month sampling break in the summer this layer was found to lie on top of a 200 m isothermal/isohaline layer thought to be characteristic of another 1979 eddy. These observations, along with eddy J's likely history back to 1978, are discussed.

T29B

TECTONICS OF A RIDGE-TRANSFORM INTERSECTION ZONE: TAMAYO-EAST PACIFIC RISE, GULF OF CALIFORNIA

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The easternmost 8 km of the Tamayo transform fault has been examined during a 7 dive, manned submersible program using DSRV ALVIN. The transform trend is defined by the north wall, an active tectonic slope (regional gradient 30°) of which the lower part is occupied by numerous faults that dip vertically to 60° toward the transform zone and have small vertical offsets (<5 m). This principal transform displacement zone is less than 1 km and mostly less than 400m wide. Rock exposures on the north wall consist of variably lithified arenaceous and finer sediments. Abundant loose isolated blocks (typically 10-50 cm) are found in many places on the slope and consist dominantly of sedimentary rocks but some are basalt. Larger sedimentary blocks are present locally near the ridge intersection in mass wasting deposits. The inner valley of the East Pacific Rise is dominated by fresh pillow lavas and ponded flows that are observed as close as 100m to the northern wall near the ridge-transform intersection. These volcanics are dissected by fissures and small throw (<10m) faults whose trend is variable; most parallel the ridge axis but some are oblique and others follow the transform trend. Major faults on the west side of the inner rift diminish in throw toward the transform. Evidence of low level hydrothermal activity was found both in the rift valley at the transform intersection and 7 km west of the ridge axis along the transform. The PDTZ is thus confined to a narrow zone, and this borders active volcanism in the ridge-transform intersection depression. The structural features of the young crust next to the transform show relatively minor influence of transform tectonics, indicating that the upper crust formed near oceanic transforms differs little in a structural sense from that formed further away.