Gravity measurments were carried out at 110 points on two transects, N-S and E-W, crossing Pleiku Basalts. Each transect was 150 km in length and the measurment intervals were from 3 km to 5 km. Measurements were done by using two LaCoste & Romberg gravimeters Model G. We measured at three reference gravity stations for intercomparsion between the gravity reference network in Vietnam and the gravity values which we determined from the gravity points in Japan. Three Global Positioning System (GPS) receivers were used to locate the points of the gravity measurements. We determined the height based on topographic maps in the scale of 1:50,000.

We obtained simple Bouguer anomalies by assuming 2.67g/cm^3 for density of the crust. Along the N-S transect the Bouguer anomalies are more negative to the north, and along the E-W transect they are the lowest values around the middle. This results mean a distinct low density structure in the northern part of Pleiku Basalts. We will implement our data with Vietnam gravity data base and discuss the lithosphere and asthenosphere structure beneath Vietnam Plateau Basalts.

T21B-17 0830h POSTER

Microcontinental Collision and Amalgamation — a key Process for Building up the Eastern Eurasia Continental Margin in Mesozoic time

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The Phanerozoic geology of Northeast China and adjacent region is characterized by collision of continental and microcontinental fragments, terrane accretion and continental margin rifting. The Mesozoic structure of North- east China and its adjacent regions, the south of Russian Far East, the north of North Korea and the inner belt of SW Japan, is due to collision and amalgamation of North China block (NCB), Zhangguangcai-Jiamusi-Bureya block (ZJBB) and Khanka block in Triassic and Jurassic. Gudonghe-Fuerhe fault zone and Mudanjiang-Tumen- Chongjin fault zone are the two major multistage tectonic lines that juxtapose these microcontinental blocks. The fault zones were developed from and superimposed as well as reactivated Paleozoic suture zones in which ophiolites or high-pressure metamorphic rocks, olistostromes, synconvergency granites, ductile shear zones and thrust faults as well as strike-slip faults were examined. The northeast trending Dunhua-Mishan fault (the northern branch of Tan-Lu fault) is a Cenozoic rift zone that derived from a Paleozoic transcurrent plate boundary fault and a suture zone. Both the Yanbian-Grodekovsk belt and the central Jilin belt belong to Paleozoic active continental margin island arcs that correlate with Khanka block and ZJBB respectively and collide with northern passive continent margin of NCB later in Mesozoic. An indentation collision of Khanka block toward NCB and ZJBB produces a unique structure pattern in Yanbian region, Northeast China.

T21C MC: HALL D Tues 0830h
Himalaya, Tibet and Continent-Continent Collisions Posters *(joint with S)*
Presiding: **M A Edwards**, SUNY, Albany

T21C-1 0830h POSTER

The Process for the India-Eurasia Continental Collision: A New Model Based on the Crustal Structure, Seismicity and Focal Mechanism

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The continent-continent collision is one of the most important processes in the course of continental evolution. Since the collision between India and Eurasia is still continuing, it is possible to investigate the collision process not only by the examination of surficial geological data and the exploration of lithospheric structure, which is usually very expensive, but also the investigations of seismicity and focal mechanism from seismic data in this area.

In the present paper, a new India-Eurasia collision model based on the observational data from crustal structure, seismicity and focal mechanism is presented. Four subducting slabs underneath Yaruzampbo suture, High Himalaya, Lesser Himalaya and Tangula Shan could be recognized by the investigation of crustal structure and seismicity, especially the distribution of earthquakes with $h > 40$ km. The former three subducting slabs are north- dipping, while the last one is south-dipping. From a study of the focal mechanism, it is possible to locate the upper and lower boundaries of the subducting slabs. Very similar to the oceanic subduction, the continental subduction is also the principle feature of the continent-continent collision process. The retreat of subduction plates and the reversed subduction which were produced in the oceanic subduction zones also occurred in the India-Eurasia continental collision process.

T21C-2 0830h POSTER

Structural Geology of the Southwestern Margin of Nanga Parbat

M. A. Edwards ; W. S. F. Kidd (Dept of Earth and Atmospheric Sciences, University at Albany, Albany, NY 12222; ph. 518-442-4466; e-mail: me7685@csc.albany.edu); M. Asif Khan (Peshawar University, Pakistan); D. A. Schneider; P. K. Zeitler; D. Anastasio (Dept of Earth and Environmental Sciences, Lehigh University, Bethlehem, PA 18015)

The Main Mantle Thrust (MMT) is the regional contact between collider India and the overthrust Kohistan-Ladakh series in the Pakistan Himalaya. Early Himalayan-age thrusting and some later (~20 Ma?) normal motion on/near the MMT is modified by very young (e.g. 1.4 Ma leucogranite Th-Pb ages) tectonism at Nanga Parbat-Haramosh Massif (NPHM); the Himalaya's western syntaxis. Our investigations in southwest NPHM reveal a complex interplay of MMT-related (mostly convergent) structural features followed by those related to uplift and tectonism of NPHM. Across the Diamir/Bunar area, main fabrics trend N to NE. In Diamir Valley, Indian cover passive margin metapelite and carbonates in the MMT footwall are not more than a few 100's of metres thick. Here, the regionally NW-dipping Indian cover sequences and MMT hanging wall (Kamila amphibolite) are overturned (SE-dipping). These overturned layers are traceable to the Gashit fold, whose hinge line plunges ~N and axial surface dips gently-moderately east. The cover sequence thickness increases markedly to the south; several km structural thickness of carbonates, metapelites and amphibolites are present in the W-E Airl- Nashkin section, only 8 km to the south of Diamir valley. The cover sequence passes east into a dominantly plutonic 5-10 km thick crystalline sequence where coarse to fine grained granite (the Jalhari granite) grades, due to syn- to post-plutonism deformation, into granitic and porphyroclastic gneiss intercalated with gneissic basement. Regionally the cover and crystalline rocks follow the subvertical to steeply E-ESE dipping foliation, and displacement sense is consistently east side (NPHM) up and over west. Within Diamir valley, granitic and gneissic foliation, shear bands, and local fault gouge zones anastamose around less- to un-deformed Jalhari granite lenses of 10-100's metres width. Plutonism seems to be in part synkinematic, and may provide an older age limit for NPHM tectonism. The E over W sense is consistent with the development of the Gashit fold and the upper limb that includes the overturned cover/MMT layers. The sharp attenuation of the cover sequence in northern Bunar valley could be a result of excision by normal motion along the MMT but we find no compelling evidence for this. We propose that the attenuation is a result of (1) a large frontal ramp in the MMT and an underlying related duplex largely of Indian cover and/or (2) original MMT thrust belt morphology where a lateral ramp-related duplex system has imbricated (and/or infolded) local thin slices of the cover and basement.

T21C-3 0830h POSTER

Extension Above Shortening From Earthquakes in the Nanga-Parbat Massif

Seeber, L ; J.G. Armbruster (Lamont-Doherty Earth Obs., Palisades, NY,
10964; ph. 914-365-8385; e-mail: nano@lamont.ldeo.columbia.edu); A.S. Meltzer; B.C. Beaudoin; P.K. Zeitler (EES Dept., Lehigh University, Bethlehem, PA, 18015)

The Nanga Parbat massif is composed of Indian crust and cover rock which underthrust the Kohistan-Ladack terrane and is now exposed along a north to northeast trending belt of large and rapid uplift. This uplift is associated with a northwest-verging antiform, the Nanga Parbat anticline (NPA) and a southeast-dipping fault, the Lichar thrust, which outcrops along the northwestern flank of the massif. These are interpreted to be coupled structures that accommodate northwest shortening. Geology is integrated with earthquake data from the 60-station network we deployed on and around the massif during 1996 and from a more modest deployment in 1995. 130 single-event focal mechanisms were quality selected from the 340 accurate hypocenters located in the vicinity of the massif (100x100 km). The massif is particularly active on the northwestern flank, while the adjacent Kohistan terrane is prominently aseismic. The seismicity is very shallow, from above sea level, to a maximum depth of 6 km bsl where it is sharply cut off below the axis of the massif. Focal mechanisms suggest a subhorizontal detachment at this boundary which ramps up into a thrust fault toward the northwest joining the mapped surface trace of the Lichar thrust. Transport on this structure is generally to the northwest. Footwall-block seismicity is limited to the western side of the NPA. Hangingwall-block antithetic thrusting is illuminated on the southeastern side of the massif and correlates with mapped structures. While we recorded some thrust focal mechanisms, most of the observed seismicity is from a set of subparallel shallow normal faults striking west to southwest and dipping south to southeast. These faults accommodate extension approximately in the same direction as the transport on the underlying thrust fault. Seismogenic normal faulting is concentrated in the region with highest relief on the western limb of the antiform, between the Indus River and the Nanga Parbat ridge. This faulting can be interpreted as both flexural slip in the overturned northwest flank of the anticline and as gravity-driven tectonic denudation by book- shelf like block rotation about horizontal-axes. The superposition of shallow horizontal extension above crustal shortening at Nanga Parbat may exemplify the effect of topographic stress in regions of convergence and mountain building.

T21C-4 0830h POSTER

Further Evidence for Late Miocene Reactivation of the Main Central Thrust (Nepal Himalaya) and the Significance of the MCT-I

EJ Catlos ; TM Harrison; M Grove; OM Lovera; A Yin (Dept. of Earth and Space Sci. and IGPP, UCLA, Los Angeles, CA 90095; ph. 1-310-206-8075); MJ Kohn; FJ Ryerson (LLNL, Livermore, CA 94550); P Le Fort (CNRS, Grenoble, 38301, France); BN Upretil (Tribhuvan Univ., Kathmandu, Nepal)

The Main Central Thrust (MCT), a fundamental feature of the Himalayan orogen, places high grade crystalline rocks of the Tibetan Slab over the lower-grade Midlands Formations. A 4-8 km thick shear zone, termed the MCT Zone, underlies the MCT. The lack of pronounced structural or metamorphic breaks across this shear zone makes it difficult to recognize surfaces that accommodated significant displacement. Recently, Th-Pb ion microprobe dating of monazite inclusions in garnets from central Nepal have be interpreted to indicate that inverted metamorphic sequences underlying the MCT formed by the transposition of two right-way-up metamorphic sequences during ca. 8-4 Ma reactivation of the MCT. This event significantly post-dates the ca. 22 Ma anatexis and recrystallization characterizing the hanging wall. Monazite growth in garnet grade rocks (P=7 kbar, T=530°C) of the Lower Midlands (Kuncha) Formation, Burhi Gandaki, occurred at 8-5 Ma, due to both Late Miocene slip on the MCT and activation of the MCT Zone. K-Ar mica ages indicate that deformation had largely ceased by ~4 Ma. To assess the extent of Late Miocene reactivation, similar results were obtained from the Darondi Khola, central Nepal. Two closely spaced samples from the Lower Midlands yield Th-Pb monazite inclusion ages in garnet (P=6 kbar, T=530°C) of 8 Ma, consistent with the Burhi Gandaki result. However, two Upper Midlands samples give older garnet (P~9 kbar, T~575°C) apparent growth ages of 13-11 Ma and 15.8 Ma. Insight into the significance of these latter dates comes from depth-profiling measurements made on monazite grains separated from a pegmatite immediately above the MCT. Th-Pb ages systematically increase from 5 to 15 Ma, indicating the existence of a Pb* diffusion profile within 2 μm of grain surfaces. This is consistent with our earlier view that the hanging wall was maintained at high temperature during the Early Miocene and cooled as a consequence of Late Miocene MCT reactivation. We suggest that the 16-11 Ma Upper Midlands ages reflect diffusive Pb loss during a protracted period at elevated temperature (~ 600°C) following Early Miocene crystallization. This interpretation implies that there is an important Late Miocene structural break between the Upper and Lower Midland Formations (i.e., the MCT-I of Arita). K-Ar dating of micas from the Darondi traverse underscore the widespread nature of the rapid denudation attending the ca. 6-4 Ma activation of the MCT Zone.

T21C-5 0830h POSTER

A new Gravity Survey in Nepal: Constraints on the Mechanical Properties of the Lithosphere and on the Crustal Structure

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In November 1996 we have carried out a gravity survey in the framework of the Nepalese-French IDYLHIM cooperation program. Our goal was to fill critical gaps in the existing gravity profiles across Hymalaya-Tibet, which is crucial for modelling the flexure of the Indian lithosphere subducting beneath the Himalayas and for imaging the crustal structure. During our survey, we collected more than 150 new gravity measurements along roughly N-S profiles using two Scintrex CG3 meters. Data were tied to the IGSN71 base in Kathmandu. Accurate geographic coordinates were obtained from the Nepalese Geodetic Survey benchmarks and GPS positionning. Inner zones terrain corrections were estimated in the field, and outer zones, up to 167 km were computed with various DTM. The overall accuracy of the Bouguer anomaly ranges between 0.5 and 5 mGal depending on the terrain roughness. We thus mapped the short wavelengths gravity anomalies across the main geological boundaries such as the Main Central Thrust (MCT), the Main Boundary Thrust (MBT) and the Main Frontal Thrust (MFT). In addition, our data complemented with those collected during the 1982 French survey in Tibet, with data from the Bureau Gravimétrique International and with previously published ones, allow to get three 2500 km-long continuous Bouguer anomaly profiles from South India to the Tarim Basin. We present and discuss here the first results of the data analysis in terms of: 1- detailed crustal structure in the vicinity of the MCT, MBT and MFT in light of geological observations; and 2- flexure of the Indian lithosphere assuming realistic rheology. Our primary results suggest decoupling between the lower crust and mantle and weakening of the lithosphere beneath the Himalayas resulting in localized reductions of the computed E.E.T.

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0830 h **T21B-17** *POSTER* Microcontinental Collision and Amalgamation: A Key Process for Building Up the Eastern Eurasia Continental Margin in Mesozoic Time: **X Liu,** K Tamaki

T21C MC: HALL D Tues 0830 h
Himalaya, Tibet and Continent-Continent Collisions Posters *(joint with S)*
***Presiding:* M A Edwards,** SUNY, Albany

0830 h **T21C-01** *POSTER* The Process for the India-Eurasia Continental Collision: A New Model Based on the Crustal Structure, Seismicity, and Focal Mechanism: **R Zeng,** Z Ding, Y Zhang

0830 h **T21C-02** *POSTER* Structural Geology of the Southwestern Margin of Nanga Parbat: **M A Edwards,** W S F Kidd, M Asif Khan, D A Schneider, P K Zeitler, D Anastasio

0830 h **T21C-03** *POSTER* Extension Above Shortening From Earthquakes in the Nanga-Parbat Massif: **L Seeber,** J G Armbruster, A S Meltzer, B C Beaudoin, P K Zeitler

0830 h **T21C-04** *POSTER* Further Evidence for Late Miocene Reactivation of the Main Central Thrust (Nepal Himalaya) and the Significance of the MCT-I: **E J Catlos,** T M Harrison, M Grove, O M Lovera, A Yin, M J Kohn, F J Ryerson, P Le Fort, B N Upretil

0830 h **T21C-05** *POSTER* A New Gravity Survey in Nepal: Constraints on the Mechanical Properties of the Lithosphere and on the Crustal Structure: **G Martelet,** M Diament, T R Shakya, E B Burov

0830 h **T21C-06** *POSTER* A Magnetotelluric Profile in Central Nepal: **G Marquis,** F Perrier, C Lemonnier, B Kafle, S Sapkota, M Chitrakar, M R Pandey, R P Tandukar

0830 h **T21C-07** *POSTER* A GPS Permanent Network in Nepal: **M Flouzat,** T Heritier, J P Avouac, J B de Chabalier, M R Pandey, R Tandukar, B Kafle

0830 h **T21C-08** *POSTER* The Relationship Between E-W Extension and N-S Deformation in Southern Tibet: Data From the Thakkhola Graben: **J M Hurtado Jr,** K V Hodges

0830 h **T21C-09** *POSTER* Structural Evolution of the Kangmar Dome, Southern Tibet: **Y Wang,** J Lee, W S Dinklage, W J Chen, J L Wan

0830 h **T21C-10** *POSTER* Thrust-Fault Partitioning of Intermontane Basins in the Kyrgyz Tien Shan: **D W Burbank,** J K McClean, S Thompson, M Bullen, C M Rubin, M M Miller, K Abdrakhmatov, R Weldon, A V Mikolaichuk

0830 h **T21C-11** *POSTER* Active Faulting and Folding in the Kochkorka Intermontane Basin of the Kyrgyz Tien Shan, Central Asia: **S C Thompson,** R J Weldon, K E Abdrakhmatov, M G Miller, R M Langridge, M E Bullen, J K McLean

0830 h **T21C-12** *POSTER* Distribution of Deformation Within the Kyrgyz Tien Shan Mountains, Central Asia: **R J Weldon,** K E Abdrakhmatov, C M Rubin, D W Burbank, M M Miller, S C Thompson, J K McLean, M E Bullen, M G Miller, R M Langridge

0830 h **T21C-13** *POSTER* Digital Elevation Model Analysis Applied to Active Tectonic Study in Central Asia: **S McManus,** J R Arrowsmith, M Strecker

0830 h **T21C-14** *POSTER* Seismic Bright Spots and Magma Emplacement in the Continental Crust: **A R Ross,** L D Brown

0830 h **T21C-15** *POSTER* Electromagnetic Image of a Continent-Continent Collision Zone: The Pyrenees: **J Ledo,** C Ayala, J Pous, P Queralt

0830 h **T21C-16** *POSTER* Conditions for Syn- and Post-Orogenic Collapse: **M Liu,** Y Shen

0830 h **T21C-17** *POSTER* **WITHDRAWN**

0830 h **T21C-18** *POSTER* Geochemistry and Tectonic Setting of the Kermanshah Ophiolite of the Zagros Suture Zone, Western Iran: Implications on Tethyan Plate Tectonics: A A Hassanipak, **A M Ghazi**

0830 h **T21C-19** *POSTER* Petrology, Geochemistry,and Preliminary $^{40}Ar/^{39}Ar$ Ages and Isotopic Analyses of the Khoy Ophiolite Complex, Northwestern Iran: Implications for Tethyan Tectonics: **A M Ghazi,** A A Hassanipak, R A Ducan, L G Hogan, J J Mahoney

0830 h **T21C-20** *POSTER* $^{40}Ar/^{39}Ar$ Ages, Preliminary Isotopic, Analyses and REE Characteristics of the Band Ziarat Ophiolite Complex, Southeastern Iran: K Wallace, **A M Ghazi,** A A Hassanipak, J J Mahoney, R A Duncan, L G Hogen

T21D MC: 120 Tues 0830 h
Rifting and Passive Margins I
***Presiding:* T A Ehlers,** Univ of Utah; **U S ten Brink,** USGS, Woods Hole

0830 h **T21D-01** Basins and Fault Segments Along the Dead Sea Transform: **U S ten Brink,** M Rybakov, A Bataynen, M Hassouneh, Y Y Rotstein, A Al-Zoubi, V Goldshmidt

0845 h **T21D-02** The Motion Between Nubia and Somalia Recorded Along the Southwest Indian Ridge Since Chron 5: **J W Lemaux,** R G Gordon, J Y Royer

0900 h **T21D-03** Sampling of the Crust-Mantle Boundary Under a Rift Zone: Preliminary Results of the ODP Leg 173 in the Ocean-Continent Transition of the West Iberia Passive Margin: **M O Beslier,** R B Whitmarsh, P J Wallace

0915 h **T21D-04** Temporal and Spatial Strain Partitioning During Continental Extension: Constraints From the Southern Gabon-Congo Continental Margin: **D H Barker,** G D Karner, N W Driscoll

0930 h **T21D-05** Speculative Propagating Rift-Subduction Zone Interactions With Possible Consequences for Continental Margin Evolution: **R N Hey**

0945 h **T21D-06** Small-Scale Convection and Igneous Crust Production at Rifted Continental Margins: **R Boutilier,** C Keen

1000 h *BREAK*

1020 h **T21D-07** A Three-Dimensional Computer Simulation of the Evolution of Lake Malawi, East African Rift System: **J Contreras,** C H Scholz, G C King

1035 h **T21D-08** Thermal History, Browse Basin, North West Shelf, Australia: **G R Beardsmore**

1050 h **T21D-09** Three-Dimensional Structure of Laguna Salada Basin and Its Thermal Regime: **R E Chavez,** L Flores, M Ladron de Guevara, J O Campos

1105 h **T21D-10** 2D Inverse Modeling of the Extensional Basins Evolution: **K Poplavskii,** Y Podladtchikov, R Stephenson

1120 h **T21D-11** Heat and Mass Transport in the Upper Rhine Graben: Regional and Local Models for a Hot-Dry Rock System: D Pribnow, **S Hurter,** C Clauser

1135 h **T21D-12** Normal Fault Thermal Regimes: Are 2-D Models Necessary for Apatite Fission Track Interpretation?: **T A Ehlers,** D S Chapman, P A Armstrong

1997 FALL MEETING

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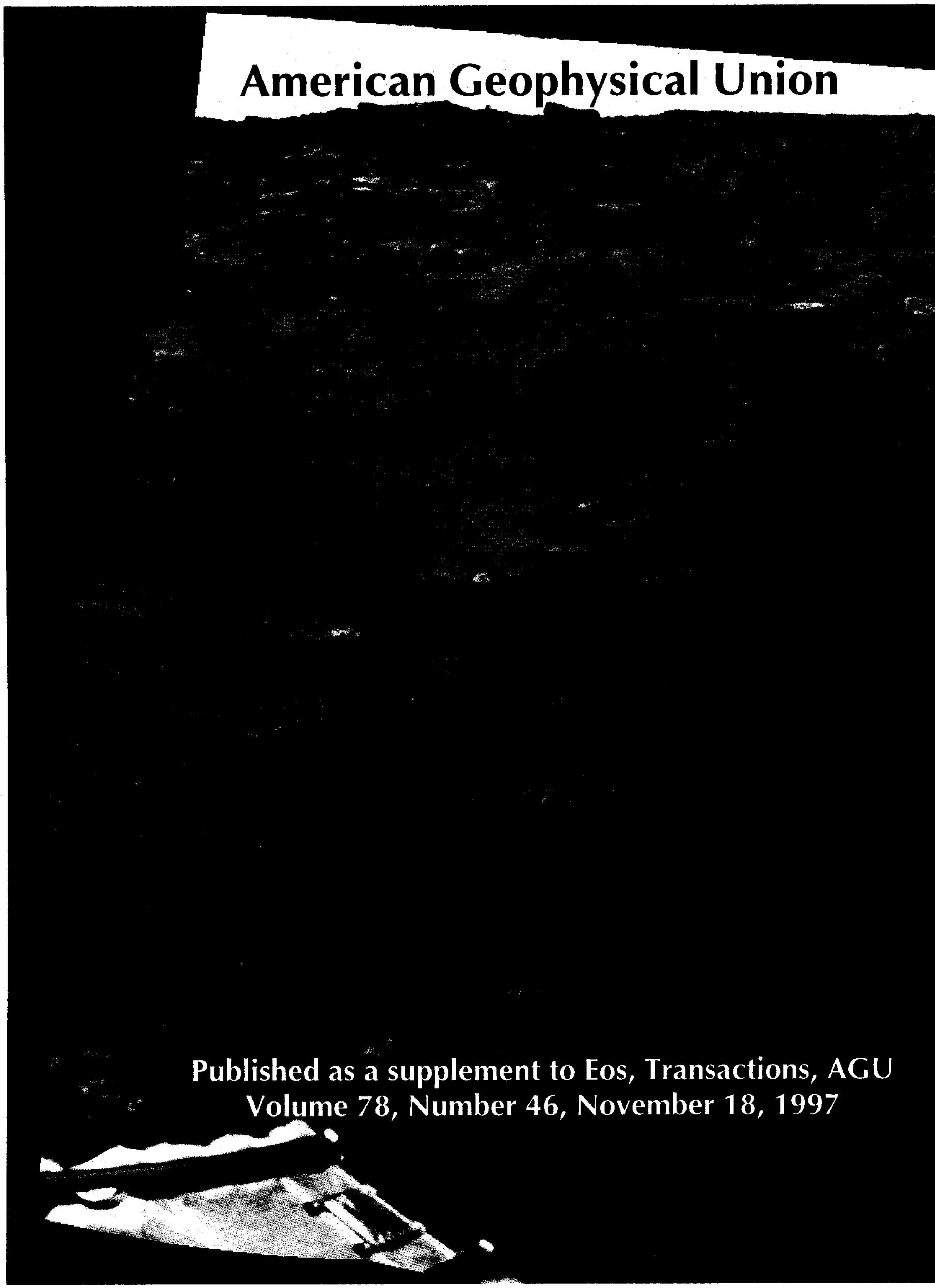

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