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Numerical Facility in Geodynamics

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Final Report for Period: 05/2003 - 04/2006
Submitted on: 06/02/2006
Principal Investigator: Koons, Peter O.
Award ID: 0236756
Organization: University of Maine
Title:
Numerical Facility in Geodynamics

Project Participants

Senior Personnel

Name: Koons, Peter
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Johnson, Scott
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Upton, Phaedra
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Activities and Findings

Journal Publications

Books or Other One-time Publications

Web/Internet Site

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Contributions

Categories for which nothing is reported:

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Activities and Findings: Any Research and Education Activities
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National Science Foundation, EAR Instrumentation and Facilities. “Numerical facility in geodynamics.” PI P O Koons. Co-PIs S E Johnson, P Upton University of Maine

Using the funds from this grant, together with those from the University of Maine to the PI (Koons), we have purchased a cluster of DELL dual core machines that permit multi-processor parallel computing on up to 16 processors with extension into the University of Maine Supercomputer facility described below. Software purchased from these funds includes finite element, finite difference, visualization software, and standard data presentation software. This cluster forms the core of the Numerical Facility for Geodynamics at the University of Maine and serves faculty, graduate, and undergraduate students from within the Department of Earth Sciences and the Climate Change Institute. The primary use is for three-dimensional mechanical modeling of the deforming lithosphere coupled with 3d thermal modeling and investigations into surface evolution.

Initially, our proposal had requested funding for one year to aid in construction of a center for numerical modeling in geodynamics. We were granted the approximate amount that we requested but over a three year period rather than for the single year that we had requested. This decision on the part of the panel to extend the grant over three years has proven very valuable in that the extra time has allowed us to leverage the facility money with other research proposals to NSF and other funding bodies, and, more importantly, has provided us with time to link more completely with other University of Maine computing centers. In particular, we have developed our cluster to integrate with the Super computing multi-node center being developed at the Target Technology Center in Orono, Maine. The primary cluster contains 256 compute nodes, each containing dual power PC 2.0 Ghz processors (i.e., for a total of 512 compute processors) two gigabytes of RAM and 80 Gigabyte serial ATA disk drives for local storage. These compute nodes can boot into either MacOSX or the Linux operating system. Separate master nodes are provided for each cluster and virtual LANs are used to dynamically assign compute nodes to a cluster. The master node that controls the MacOSX cluster contains dual power PC 2.0 Ghz G5 processors, with four gigabytes of memory, and a 240-gigabyte Serial ATA local disk drive, and a dual fibre channel PCIX card to communicate with the cluster-wide storage system. The master node that controls the (Debian) Linux cluster contains dual 2.0 Ghz power PC processors , with two gigabytes of RAM and an 80-gigabyte serial ATA disk for local storage as well as fibre channel connection to the cluster-wide storage system. The overall cluster is designed in such a way that nodes may be dynamically assigned to either the OSX cluster or the Linux cluster as the needs arise. The cluster-wide storage system is based on Apple Xserve Raid devices and is easily expandable. Communication between nodes currently uses dual gigabit Ethernet connections and is in the process of being upgraded to a high speed fiber optic network.

The resulting numerical capability attracts students and faculty from within and outside of the University of Maine for research, teaching and outreach. The Facility has provided a central tool in MSc and PhD research by students in the Department of Earth Sciences and Climate Change Institute at the University of Maine including: L. Brown (MSc) ,M. Dupee (MSc), C.Rodda (MSc), A.Barker (MSc), H.Short (PhD), W. Groome (PhD), C.Gerbi (PhD), C. Hofstede (PhD), E. Osterberg (PhD).

One of the goals of the facility has been to serve as a center of numerical modeling for other investigators from Maine and northern New England, as well as from the larger national and international research community. In this respect, we have been successful, attracting collaborators from other institutes in Maine (D. Reusch, UMF; D. Eusden, Bates College) leading to co-supervision of students from each of these institutes. The facility has been at the core of collaborative research projects where the University of Maine researchers provide numerical modeling for projects that include P. Armstrong (Cal. State Fullerton); M. Bishop (U. Nebraska); J. Blum (U. Michigan); R. Bruhn (U. Utah); C.P. Chamberlain (Stanford); A.F. Cooper (U. Otago); D. Craw (U. Otago); J. Freymueller (U. Alaska); B. Hallet (U. Washington); P. Haeusler (USGS); M. Henderson (U.Otago); W.S.F. Kidd (SUNY Albany); D. Montgomery (U. Washington); A. Meltzer (Lehigh); R. J. Norris (U. Otago); G. Pavlis (U. Indiana); T. Pavlis (U. New Orleans); L. Serpa (U. New Orleans); J. Shroder (U. Nebraska); D.West (Middlebury); P. Zeitler (Lehigh). Many of these individuals have visited our facility to use the computational facilities and to work with PI's on hardware and software funded by this proposal.

International cooperation has grown around this facility through collaborative programs with Prof. Robinson (Norway), Dr. M. Terry (Bayreuth, Germany), Prof. M Strecker (Potsdam, Germany), Prof D. Craw (New Zealand), Dr. M Begbie (New Zealand). These links have led to ongoing research projects with international faculty and student exchange.

Publications from research employing the numerical facility (~15)

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Jacobson, A. D., J. D. Blum, C.P. Chamberlain, D. Craw, P. O. Koons, 2003, Climatic and tectonic controls on weathering in the New Zealand Southern Alps. Geochimica et Cosmochimica Acta, 67, 29-46

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Upton, P., Craw, D., James, Z., and Koons, P.O., 2004, Structure and late Cenozoic tectonics of the Southern Two Thumb Range, mid-Canterbury, New Zealand. New Zealand Journal of Geology and Geophysics. 47, 141-153.

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W.R. Buck, A.L. Densmore, A.F. Friedrich, N. Hovius, E. Kirby, P.O. Koons, T. Nagel, F. Schlunegger, M. Strecker, F. von Blanckenburg Environmental Effects on/of Faulting, Dahlem Workshop: The Dynamics of Fault Zones, In Press; MIT Press.

Craw, D., P. O. Koons, P. K. Zeitler and W. S. F. Kidd, 2005, Fluid evolution and thermal structure in the rapidly exhuming gneiss complex of Namche Barwa–Gyala Peri, eastern Himalayan syntaxis, J. Metamorphic Geol., 2005, 23, 829–845.

Gerbi, C. C., S. E. Johnson, and P. O. Koons, 2005, Controls on low-pressure anatexis, J. Metamorphic Geol., doi:10.1111/j.1525-1314.2005.00628.x

Upton,P., P.O. Koons, Three-dimensional geodynamic framework for the Central Southern Alps, New Zealand: Integrating geology, geophysics and mechanical observations; Submitted to AGU Monograph: Geotectonic Investigation of a Modern Continent-Continent Collisional Orogen: Southern Alps, NZ

Groome, W.G., Johnson, S.E. and Koons, P.O. (accepted pending revision) The effects of porphyroblast growth on the effective viscosity of metapelitic rocks: implications for the strength of the middle crust. Journal of Metamorphic Geology (accepted)

Abstracts from professional presentations related to this proposal (~38)

Koons, P. O., Meltzer, A.S., Zeitler, P.K., 2003, (Invited) Rheological Consequences of Rapid Erosion in Active Orogens, Eos Trans. AGU, 84(46), Fall Meet. Suppl.,

Hallet, B., Finnegan, N. J., Koons, P. O., Fletcher, R. C., Montgomery, D.R., 2003, Stability of Major River Knickpoints Throughout the Himalaya: Evidence for Strong Coupling Between Erosion and Rock Uplift, Eos Trans. AGU, 84(46), Fall Meet. Suppl.,

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Upton, P., Short, H., Koons, P.O., Johnson, S.E., West, D., 2003, Application of erosional-rheological coupled mechanical models to ancient orogens: with reference to the Norumbega fault system. Geological Society of America Abstracts, 35, 3, 12-4.

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Koons, P.O., Upton, P., 2004, Rheological Control on Strain Distribution in Oblique Convergence. Eos Transactions AGU, 85(17), Joint Assembly Supplement, V13A-02

Upton, P., Koons, P.O., Mueller, K., Chen, Y. 2004, Modelling interactions between erosion and tectonics in three-dimensions; examples from New Zealand and Taiwan. Bollettino di Geofisica teorica ed applicata Vol 45 - N. 1 Supplement. From Mountains to Sedimentary Basins: Modelling and Testing Geological Processes. 1-11.

Groome, W.G.; Johnson, S.E.; Koons, P.O., 2004, Modeling the relations among porphyroblast growth, pseudomorphism and strain localization in turbidite successions. Geological Society of America Annual Meeting Abstracts and Program. October 2004, Abstract # 80-3

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Zeitler, P.K., Koons, P.O., Melzer, A., Edwards, M., W. S. F. Kidd, (Invited) Co-Anatectic Crustal Failure in the Absence of Geophysically Detectable Partial Melt, Eos Trans. AGU, Fall Meet. Suppl.; in press December, 2004

Melzer, Sol, S., Zurek, B., Xuanyang, Z., Jianlong, Z., Yuping, L., Koons, P.O., Crustal Deformation and Mantle Flow: The Eastern Syntaxis Seismic Experiment, Eos Trans. AGU, Fall Meet. Suppl.; in press December, 2004

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Koons, P.O., Craw, D., Upton, P., Henderson, C.M., Co-evolution of strain and topography of the Central South Island, New Zealand. SIGHT workshop, Christchurch, New Zealand June 20-23, 2005

Upton, P., Koons, P.O., Three-dimensional geodynamic modeling of collision zones: Integrating geology, geophysics and mechanical observations. Invited keynote talk, Workshop on Geodynamic Modeling of Tectonic Processes, June 10-12, 2005, Breckenridge, CO

Upton, P., Markley, M., Koons, P.O., Theory and Application of Fault-Related Folding in Foreland Basins, 25 June to 4 July 2005, Beijing, China

Upton, P., Koons, P.O. Three-dimensional geodynamic modeling of the Southern Alps of New Zealand: integrating models and observations to understand crustal rheology. Eos Trans. AGU, Fall Meet. Suppl.; in press December, 2005

Koons, P O., B Hallet, A C Henck, L Yuping, P Zeitler, Topographic Expression of Crustal Velocity Curls: An Example from Eastern Himalaya to Burma. Eos Trans. AGU, Fall Meet. Suppl.; in press December, 2005

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Groome, W.G., Koons, P.O. and Johnson, S.E. (2006) Metamorphism, transient mid-crustal rheology and the exhumation of high-grade metamorphic rocks. Northeast

Section Meeting, Geological Society of America , Harrisburg , Pennsylvania , March 2006

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Upton, P., Koons, P.O. and S. E. Johnson, Three-dimensional geodynamic modeling of oblique orogenesis: application to New Zealand and the Acadian Orogen of Maine., Northeast Section Meeting, Geological Society of America , Harrisburg , Pennsylvania , March 2006

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Rodda, C. Koons, P.O., Upton, P. , Modelling ultra-high pressure terrane evolution: Initial Results. Northeast Section Meeting, Geological Society of America, Harrisburg, Pennsylvania , March 2006

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