Final Report
“PBO Mexico” Workshop
Held at Scripps Institution of Oceanography, 18 June 2002

Yehuda Bock, Organizer
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Scripps Institution of Oceanography
9500 Gilman Drive
La Jolla, CA 92093-0225

19 February 2004

Summary

A one-day workshop was held at Scripps Institution of Oceanography on 18 June 2002 to advance North America-wide coordination between Mexican and U.S. investigators on the Plate Boundary Observatory (http://www.earthscope.org/pbo/index.html), a component of the larger EarthScope project (http://www.earthscope.org/). At the time of the workshop, EarthScope had not yet been funded, but it was clear that funding was to be limited to installations within the U.S. Nevertheless, it was clear that EarthScope’s goals could not be met without collaboration with scientists in Canada and Mexico and without expanding the existing geophysical infrastructure within those countries. There were a total of 18 participants at the workshop, including 8 scientists from Mexican institutions and 9 scientists from U.S. institutions (Appendix A). Most of the participants gave presentations, and there was considerable time for questions and discussions (Appendix B).

The science focus was how the active tectonic features in Mexico would impact our ability to interpret the results from PBO. The programmatic focus was to coordinate various interested parties in the U.S. who could contribute to the continuous GPS backbone in Mexico, and to accelerate programs in Mexico.

Projected and actual expenses are given in Appendix C.

Recommendations

The workshop participants proposed a PBO Mexico committee including representatives from Mexico and U.S. institutions. Suggested U.S. members included Yehuda Bock, Chuck DeMets, Tim Dixon, Ken Hudnut, Kristine Larson, and Tim Melbourne. Suggested Mexico representatives included Enrique Cabral, Javier Gonzalez, Vladimir Kostoglodov, Bertha Marquez, and Juan Jose Ramirez Ruiz. Shri Krishna Singh was suggested as committee chair. The workshop participants also recommended that EarthScope/PBO fund a full-time scientist to promote Mexico-U.S. collaboration, preferably a Spanish speaker. One scientist suggested as a good candidate was Luciana Astiz.

The proposed committee has yet to be instituted.
Science Summary

Mexico is characterized by a wide variety of contemporary tectonic processes (Figure 1) including ocean spreading in the Gulf of California, continental transform faulting along the Cerro Prieto-Imperial faults, extension in the Basin and Range of the Sonora desert, subduction along the Middle American trench, and extensive volcanic/geothermal activity along the Mexican volcanic belt and Colima rift (Figures 2-3). A thorough understanding of Pacific/North America plate boundary deformation, in particular the transition from ocean spreading in the Gulf of California to continental transform faulting along the southern San Andreas fault, requires coordinated observations in Mexico and close collaboration with our Mexican counterparts. Understanding earthquake hazards in southern California also require observations in northern Mexico and Baja California. Faults extend directly across the international border such as the Imperial-Cerro Prieto fault system, the Elsinore-Laguna Salada fault, the San Miguel-Vallecitos fault which likely transfers strain to the Rose Canyon fault in San Diego, and the trans-Baja faults such as the Agua Blanca which transfers some portion of the plate motion to southern California offshore faults (e.g. San Clemente).

Figure 1. Tectonic Setting. From presentation by Vladimir Kostoglodov.
Figure 2. Active Volcanoes in Mexico. From presentation by Enrique Cabral.
Mexican and U.S. investigators have been collaborating on survey-mode GPS projects in Mexico since the 1980's, including deformation studies in southern California/Baja/Gulf of California (Figure 4), regional deformation along the Pacific/North America plate boundary, deformation of the Jalisco block associated with subduction of the Rivera and Cocos plates (Figure 5), and volcanic deformation (Figure 6). Several large and destructive earthquakes that occurred (and did not occur) in Mexico during this period (Figures 7-8) have stressed the societal importance of these tectonic studies.

Mexican participation in geodetic and seismic infrastructure comes primarily from two groups, Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (CICESE) in Ensenada, Baja California, and Instituto de Geofisica, Universidad Nacional Autonoma de Mexico (UNAM) in Mexico City. These two groups are also responsible for operating extensive arrays of seismic instrumentation. However, other academic and government research groups (some represented at the meeting) maintain active research programs.
Figure 4. Seismicity and Major Faults Crossing the U.S.-Mexico Border. From presentation by Tim Dixon.

Figure 6. Collaborative Mexico-U.S. research at Popocatépetl Volcano. From presentation by Enrique Cabral.
Figure 7. Major Mexico Earthquakes. From presentation by Vladimir Kostoglodov.

Figure 8. Guerrero Seismic Gap. From presentation by Vladimir Kostoglodov.
Infrastructure Summary

Open access to CGPS data in Mexico for U.S. and Mexico investigators is limited. Four sites in northern Baja California (GUAX, CORX, CIC1, SPMX) operated by CICESE are part of SCIGN (Figure 9) and data are freely available. Site GUAX is maintained collaboratively with UNAVCO and is an important site for PBO as it rests firmly on the Pacific Plate.

Figure 9. SCIGN/CICESE/UNAVCO CGPS stations including Northern Baja California

The SOPAC archive, for example, has available only 3 other CGPS sites in Mexico (YAIG, CAYA, DOAR) operated by UNAM (Figure 10 – also see Web link below). Of these, timely access to data is limited to one site (DOAR).

There are other CGPS sites in Mexico that are not widely available. UNAM maintains a Web site (http://tlacaelel.igeofcu.unam.mx/~vladimir/gpsred/gpsred.html) that documents the CGPS network (“SISMOLOGIA-IGEF”) including operational and future sites (Figure 11). Many of these sites were funded by CONACYT (the Mexican National Science Foundation), and involved collaboration with U.S. investigators. A number of these sites collect high-rate (10 Hz) GPS data, and are co-located with broadband seismic instruments. SCIGN has contributed GPS
equipment to CICESE (4 units) and UNAM (1 unit) and assisted in the installation of sites with CICESE in northern Baja California (SPMX, CORX, GUAX), and with UNAM at Yautape (YAIG – Figure 10). As mentioned above, sites established with CICESE have been fully integrated within SCIGN. Timely and complete access to data from YAIG has been limited. Some data from the Guerrero Coast GPS Network can be accessed from the UNAVCO archive http://archive.unavco.org/query/group?gid=1608).

Figure 10. Mexican CGPS Data available at SOPAC.

A 14-station national GPS network (Red Geodesica Nacional Activa - RGNA) is operated by Instituto Nacional de Estadística, Geografía e Informática (INEGI) with older generation GPS equipment (Figure 12). Scripps Institution of Oceanography has worked with INEGI to upgrade their equipment, and has contributed a new receiver for operation at INEGI’s central facility in Aguascalientes. A continuous GPS training session at SIO was held for participants from the 3 primary Mexican groups (CICESE, INEGI, and UNAM) on January 11-14, 2000, covering site monumentation and installation, receiver operations, archiving, data dissemination, and data analysis. This collaboration has been bogged down by bureaucracy, and no data from RGNA are currently available to investigators.
Figure 11. SISMOLOGIA-IGEF CGPS network operated by UNAM. Source: http://tlacaelel.igeofcu.unam.mx/~vladimir/gpsred/gpsred.html

Figure 12. Red Geodesica Nacional Activa (RGNA) network operated by INEGI. Source: http://mapserver.inegi.gob.mx/geografia/espanol/normatividad/infgeodesia/mapag.cfm
Acknowledgements

The U.S. National Science Foundation, through subcontracts to Scripps Institution of Oceanography from UCAR’s University NAVSTAR Consortium (UNAVCO), funded the PBO Mexico Workshop. Thanks to all who participated and/or expressed interest in the workshop (see Appendix A for a partial list), Kristine Larson for help in organization, and Kitty Haak for coordination.
Appendix A – PBO Mexico Workshop Participants

Yehuda Bock ybock@ucsd.edu
Enrique Cabral ecabral@igeofcu.unam.mx
Tim Dixon tim@corsica.rsmas.miami.edu
John Fletcher jfletche@cicese.mx
Javier Gonzalez javier@cicese.mx
Tom Herring tah@prey.mit.edu
Ken Hudnut hudnut@usgs.gov
Kristine Larson kristine.larson@colorado.edu
Tony Lowry arlowry@valdemar.colorado.edu
Mike Jackson mikej@unavco.ucar.edu
Juan Jose Ramirez Ruiz ramirez@cgic.ucol.mx
Osvaldo Sanchez osvaldo@ollin.igeofcu.unam.mx
Shri Krishna Singh krishna@ollin.igeofcu.unam.mx
Richard Snay rich@ngs.noaa.gov
Francisco Suarez fsuarez@cicese.mx
Tim Melbourne tim@geology.cwu.edu
Vladimir Kostoglodov vladi@servidor.unam.mx

Invited but could not attend:

Luciana Astiz luciana.astiz@ctbto.org
Berta Marquez Azua bmarquez@udgserv.cencar.udg.mx
Chuck DeMets chuck@geology.wisc.edu
Jeff Freymueller jeff@giseis.alaska.edu
Antonio Hernandez Navarro Antonio.Hernandez@inegi.gob.mx
Garry Karner garry@ldeo.columbia.edu
Ciro Martinez Garcia ciro@cicese.mx
Javier Pacheco javier@ollin.igeofcu.unam.mx
Paul Silver silver@dtm.ciw.edu
Mario Alberto Reyes Ibarra mareyes@dgg.inegi.gob.mx
Francisco Javier Rodriguez Agudo frodrigu@dgg.inegi.gob.mx
Tom Soler tom@ngs.noaa.gov
Joann Stock jstock@gps.caltech.edu
Wayne Thatcher thatcher@usgs.gov
Jaime Urrutia Fucugauchi juf@tonatiuh.igeofcu.unam.mx
Appendix B – PBO Mexico Workshop Agenda

Location: Munk Seminar Room in the Munk Lab, Cecil H. and Ida M. Green Institute of Geophysics and Planetary Physics, Scripps Institution of Oceanography, La Jolla

Date: Tuesday, June 18, 2002
Time: 9AM-4PM

Morning Agenda: Science and Infrastructure Overviews (Moderator - Kristine Larson)
Note: These should be informal talks with participant interaction
Note: Other participants should be prepared to present relevant material
9:00 Introduction - Yehuda Bock
9:15 GPS and plate boundary study in Mexico - Vladimir Kostoglodov
9:45 Observations of aseismic transient deformation at subduction zones in the Americas- Tim Melbourne
10:15 Break
10:30 Trans-Mexican volcano belt - Enrique Cabral
10:55 GPS studies in northern Baja California - Tim Dixon
11:20 Continuous GPS and its applications to civilian infrastructure (the CORS array in North America) - Richard Snay
11:40 Real-Time GPS Sub-Networks in SCIGN and CSRC - Yehuda Bock
12:00 Lunch

Afternoon Agenda: Scientific and Programmatic Goals (Moderator - Shri Krishna Singh)
Talks by John Fletcher, Javier Gonzalez, and Francisco Suarez on Baja California Tectonics
Talk by Juan Jose Ramirez Ruiz on Volcanological Research in Colima

Discussion Period:
Distilling scientific rationale for Earthscope/PBO collaboration with Mexico
Status of Continuous GPS Networks in the Southwest U.S.
Status of Continuous GPS Networks in Mexico (UNAM, CICESE and INEGI)
Integration of continuous GPS networks in Mexico
Linkage of Mexican GPS network with PBO
Data Exchange
GPS network design
How to fund activity in Mexico (e.g., NSF/NASA-Conacyt umbrella agreement)?
Appendix C – Financial Report

Projected Expenses:

X-Sender: jdavis@cfa-pop1.harvard.edu
Date: Tue, 14 May 2002 15:53:02 -0400
To: Yehuda Bock <ybock@igpp.ucsd.edu>
From: Jim Davis <jdavis@cfa.harvard.edu>
Subject: Mexico-PBO Workshop
Cc: Tom Herring <tah@chandler.mit.edu>, Wayne Shiver <shiver@ucar.edu>

Dear Yehuda,

The original planning for this workshop assumed eight persons for two days, with a total estimated cost of $10,588.

Tom Herring is the P.I. and Wayne Shiver the Co-I. With their agreement, I am assigning you to be the organizer for this event.

The preferred method for handling this expense is for your organization to incur the costs and then to submit an itemized invoice to me at UNAVCO, Inc. (see address below).

The estimated costs for the budgeted categories are given below. UNAVCO, Inc. will reimburse all costs associated with this conference, regardless of the number of attendees, up to a maximum of $10,588. Per Diem rates must not be exceeded without prior written approval. Only economy-class airfare can be reimbursed.

The NSF cost category associated with this workshop is "Participant Support Costs." Therefore, no indirect costs (overhead) can be reimbursed. Only those costs appropriate to this cost category can be reimbursed.

Thank you for organizing this workshop. I know it will be productive.

Please feel free to contact me with any questions.

Jim

Workshop: US-Mexico Backbone Coordination Workshop
Location: San Diego, CA
Organizer: Dr Yehuda Bock
Est attendees: Eight (8)

Maximum per diem rates per person:
----------------------------------
Lodging: Not to exceed $124
Meals and incidental expenses (M&IE): Not to exceed $46

Budgeted amounts:

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Total Estimated Costs: $10,588
Actual Expenses:

INVOICE

INVOICE NO: 91902  
DATE: October 23, 2002

To: Harvard-Smithsonian Center for Astrophysics  
   60 Garden Street, MS 42  
   Cambridge, MA 02138

From: University of California, San Diego  
   IGPP, 0225  
   9500 Gilman Drive  
   San Diego, CA 92093-0225

Workshop: US-Mexico Backbone Coordination Workshop  
Location: La Jolla, CA  
Date: June 18, 2002  
Organizer: Dr. Yehuda Bock  
Attendees: 18

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TOTAL DUE $6,293.23