

FINAL REPORT
SCEC #11494
February 1, 2006 to January 1, 2007

**“US-TURKEY WORKSHOP: COMPARATIVE STUDIES OF
THE NORTH ANATOLIAN FAULT (NORTHWEST TURKEY)
AND THE SAN ANDREAS FAULT (SOUTHERN CALIFORNIA)”**

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An international workshop was convened at Istanbul Technical University from August 14 to August 18, 2006 about “Comparative Studies of the North Anatolian Fault (northwest Turkey) and the San Andreas Fault (Southern California)”. The workshop was jointly funded by SCEC, NSF’s OISE program, and Istanbul Technical University (ITU). The main objectives were to facilitate multinational research projects that can shed new light on the seismotectonics of continental transform faults and to formalize a collaboration between SCEC and a consortium of research institutions in Turkey. The San Andreas Fault and the North Anatolian Fault are two major continental transform faults that share many characteristics. Both fault systems are right-lateral transforms that slip at rates of 20-35 mm/yr and that endanger metropolitan areas with huge populations: Los Angeles (17 million) and Istanbul (13 million). As a consequence, the U.S. and Turkey are each sponsoring large-scale research programs to characterize and monitor these fault systems. International comparative studies should allow for better earthquake forecasts, better estimates of strong ground motions, and better technology for early warning, all of which have the potential to substantially reduce earthquake losses.

Together, the NSF and SCEC grants provided full or partial travel support to 24 U.S. scientists. An additional 9 U.S. scientists funded their travel from other sources. US participants included 1 post-doc, 6 graduate students; they also comprised 9 women and 2 scientists from underrepresented groups in the geosciences. Many Turkish scientists and Turkish graduate students attended the workshop, as well as a dozen scientists from the European Union and from Japan. The total number of participants in the workshop was about 80 (see Appendix 1). Turkish participants came from ITU, the Kandilli Observatory of Bosphorus University, the University of Istanbul, the Marmara Research Center in Gebze, the Middle East Technical University (METU) in Ankara, and the General Directorate of Mineral Research and Exploration (MTA) in Ankara. This SCEC grant financed the travel expenses of 5 keynote speakers and partially funded travel for 3 graduate students. 4 of these recipients were either not US citizens or permanent resident, or were not residing in the US, and therefore were ineligible for NSF travel support. Unfortunately, Dr. David Bowman (Cal. State Fullerton), one of the keynote speakers, was not able to attend the workshop, as his flight was cancelled due to the “terror alert” enforced at many international airports the week of the workshop.

The workshop was organized around three days of keynote presentations, discussions sessions, and poster sessions, followed by two one-day field trips (see Appendix). On August 15, many participants joined a dinner cruise on the Bosphorus, which was an occasion for further exchange in an enjoyable setting. The two field trips on August 17 and 18 were also successful and good hands-on introductions to the seismotectonics of the North Anatolian fault for those not

already familiar with it. Thanks to the contacts established during the workshop, several US scientists who never worked in Turkey before visited with colleagues in Istanbul immediately after the workshop and discussed possible collaborations.

Details about the workshop, including the abstract volume, the agenda, and one of the field trip guides, are posted at <http://projects.crustal.ucsb.edu/NAF-SAF-2006>.

1. RECENT AND ON-GOING RESEARCH INITIATIVES FOR THE NORTH ANATOLIAN FAULT

A comparative study between the two fault systems would be greatly aided by the parallel establishment of digital fault, stratigraphic, and 3-dimensional seismic velocity representations of the fault systems. SCEC is now maintaining and developing such a “Community Modeling Environment” for the southern San Andreas Fault. During the workshop, and also since the workshop, Turkish and European colleagues described independent efforts to develop similar digital representations for the North Anatolian fault. The following initiatives are noteworthy and a joint SCEC-Turkey efforts should build on their results:

- The REL.I.E.F. project (=RELIable Information on Earthquake Faulting; <http://www.ingv.it/paleo/RELIEF>), which ended in 2005, was supported by the European Commission in the aftermath of the devastating 1999 Izmit earthquake. The project gathered detailed paleoseismological data along the Izmit-Duzce and Ganos segments of the North Anatolian Fault, with the goal to provide the necessary data to compute scenario-based strong ground motion simulations. This project was coordinated by Mustafa Megrahoui at the Institut de Physique du Globe (Strasbourg, France), in collaboration with Serdar Akyuz and Gulsen Ucar for Istanbul Technical University, INGV (Rome, Italy), Brunel University (UK), ETH (Zurich, Switzerland), and University of Bergen (Norway). A database of finite-source rupture models has been released (www.seismo.ethz.ch/srcmod).
- A major study titled “Istanbul seismic microzonation and earthquake hazard mitigation and disaster prevention study” was carried out jointly by Turkish and Japanese (JICA) scientists and engineers. The study, completed in 2002, has compiled geological and seismological data, and lead to the acquisition of a vast amount of geotechnical data. Ground motion calculations, including site amplifications, were made for an earthquake of magnitude $M_w = 7.5$ on the North Anatolian fault under the Sea of Marmara. An engineering evaluation of the infrastructure, commercial, industrial and residential buildings were carried out for each ward of the city to determine vulnerability. This study predicted that in the case of a $M_w = 7.5$ earthquake more than 50,000 buildings would be heavily damaged, 2 million people would require at least temporary shelter, and fatalities would exceed 70,000.
- Another major project is the “Istanbul Earthquake Rapid Response and Early Warning Ground Motion Network” established by the Kandilli Observatory of Bogaziçi University. Its goal is to provide near real-time damage assessment maps in case of a major earthquake. About 150 strong motion instruments deployed across the city will measure ground motion and be used to provide a rapid damage estimate. The results would go to the Istanbul Mayor’s Office, the Emergency Management Office, and the Governor’s Office. All data transmission and computations have been designed with adequate backup to function even in the case of the largest credible earthquake for the region. The second part of the project, also installed by the Kandilli Observatory, is the Earthquake Early Warning System for Istanbul and the Marmara region. Ten strong motion instruments have been placed as close to the fault trace as possible. In

case of an earthquake the system updates the magnitude estimate based on ground motion amplitude and duration, and issues an alarm automatically as magnitude estimate exceeds a threshold. For the Istanbul region, this system could provide up to 30 seconds of advanced warning before maximum ground shaking occurs. It is designed to provide information directly to the emergency management offices and to other institutions such as the utilities.

- Istanbul Technical University recently established a high performance computing center. As a direct follow-up to this workshop, ITU has formally invited scientists at the Kandilli Observatory of Bogaziçi University to implement a ground motion model for Istanbul that would make use of this new facility. Scientists and administrators from both universities agreed that a Turkish version of the SCEC's Terrashake 3-D ground motion modeling project (and the community model therein) would be a very suitable project for the new facility. That concept has gathered enthusiastic support from everyone and might be sponsored not only by the Turkish Scientific Research Foundation (TUBITAK), but probably also by local authorities such as the Municipality of Istanbul.
- The General Directorate of Mineral Research and Exploration (MTA) has recently revised its Active Fault Map for northwest Turkey, using an original mapping scale of 1:25,000 (although data will be published at 1:250,000)
- The "World Stress Map" project, lead by Karlsruhe University, is compiling a digital fault database for northwest Turkey (<http://www.world-stress-map.org>).
- ESONET (=European Seas Observatory Network), an initiative sponsored by the European Union, selected the Marmara Sea as one of eleven sites where state-of-the-art cabled seafloor observatories may be deployed. Should this project materialize, one of the first priority will be the installation of ocean bottom seismometers along the submerged trace of the North Anatolian Fault. Such a project would involve massive infrastructure in terms of computational power, would require that all data be freely accessible to participating countries, and that a structured digital archiving system be emplaced. These elements would be of obvious benefit to establishing a SCEC-like Community Modeling Environment for the North Anatolian Fault.

2. DISCUSSIONS WITH REPRESENTATIVES FROM TURKISH INSTITUTIONS

Two meetings in smaller groups with key representatives from Turkish institutions, led by Tom Jordan and Naci Görür to discuss possible strategy for joint investigations, took place on August 15 and 16. The following people (whose affiliation are listed in the appendix) were present at the second of these meetings:

Mustafa Aktar, Namik Çagatay, Ibrahim Cemen, Milene Cormier, Ömer Emre, Mustafa Erdik, Haluk Eyidogan, Louis Géli, Naci Görür, Pierre Henri, Tobias Hergert, Tom Jordan, Ali Kocyigit, Alvis Lisenbee, Roland Person, Leonardo Seeber, Christopher Sorlien, Michael Steckler, Okan Tuysuz, Tiphaine Zitter, and five other Turkish scientists. Tom Jordan and Naci Görür introduced the first meeting by presenting their visions to formalize partnerships on several levels. From a SCEC point of view, a focus around a collaboratory for earthquake predictability would be desirable. Turkish scientists expressed their wish to focus the effort on seismic hazards in the Marmara region, and indicated that much funding may be available from the European Union should a strong international proposal be submitted.

3. RECOMMENDATIONS FROM THE BREAK-OUT GROUPS

Four break-out groups discussed issues related to 1) discrepancies between geological and geodetic slip rates, 2) temporal evolution of strike-slip fault systems, 3) paleoseismology and fault segmentation, and 4) ground motion and rupture dynamics. Recommendations from the break-out groups were cross-cutting and can be summarized as follows.

- Efforts should continue to determine the fine-scale geometry of the fault system, something critical to addressing the following issues:
 - Oversimplified fault models might account for part or all of the discrepancies between geological and geodetic slip rates. In addition, little is known about the width of the fault zones, or about the impact of fault gouge versus bedrock on deformation rates.
 - Reliable estimates of slip distribution depend on an accurate knowledge of fault geometry.
 - Reliable models of seismic sources and fault kinematics are also strongly dependent on an accurate fault representation.
- For the same reasons, the 3rd dimension (subsurface structure) of the North Anatolian fault should be carefully evaluated using a variety of techniques, including seismic profiling, seismic stratigraphy, the precise location of micro-earthquakes, and detailed gravity maps.
- In order to investigate the discrepancy between geodetic and geological rates, reliable geological rates should be gathered at many locations, including along the subsidiary branches of the North Anatolian Fault. On-going GPS campaigns should be stepped up in order to investigate seismic/interseismic cycles in fault slip, including possible accelerated slip rates during interseismic periods.
- An accurate seismic velocity structure for NW Turkey is critical for developing reliable ground motion simulations, precisely locating earthquakes and defining fault planes, and by extension, for developing reliable geodetic models. Techniques might include multichannel seismic profiling in transform basins, wide angle seismic profiling, and seismic tomography, both onshore and offshore.
- The Quaternary evolution of the fault system in the Marmara Sea may be unraveled with a combination of seismic stratigraphy and long sediment cores, such as may be collected with the International Ocean Drilling Program. This approach may be applied to provide additional control on the seismic structure of the fault zone.
- Ultimately, our goal is to understand how earthquakes nucleate and thus reduce seismic hazards. That goal may be within reach using a combination of computationally intensive ground motion simulation models, as well as comprehensive databases of waveforms, earthquake catalogues, seismicity data, source characterizations, etc.

4. FURTHER ACTIONS

As a follow-up to this workshop, a pre-proposal was submitted by SCEC to the NSF-PIRE initiative (Partnership for International Research and Education) that laid out a strategy for facilitating a U.S.-Turkish collaboration. Submission of a full PIRE proposal was unfortunately not invited. However, Turkish scientists have confirmed their intention to pursue the effort toward developing collaborative research projects with SCEC. In particular, Tom Jordan invited Turkish scientists to be partners in study of earthquake predictability, using the North Anatolian Fault as a natural laboratory. Further discussions will be needed to overcome differing attitudes amongst Turkish institutions, and a reciprocal workshop in the US would present the best

environment to develop a consensus strategy. Possibly, such workshop could be coupled with the annual SCEC meeting, next September 2008, or with the fall meeting of the American Geophysical Union in San Francisco in December 2007, which is generally well attended by Turkish scientists.

5. TURKISH INSTITUTIONS AND CONTACTS

Researchers at the following institutions expressed their interest in developing collaborative projects with SCEC. The named scientists agreed to serve as a relay with their colleagues and administrators.

ISTANBUL TECHNICAL UNIVERSITY (ITU).

Prof. Naci Görür
Prof. Namik Çagatay
Prof. Celal Sengör
Prof. Aral Okay

*KANDILLI OBSERVATORY AND EARTHQUAKE RESEARCH INSTITUTE (KOERI),
BOGAZIÇI UNIVERSITY, ISTANBUL.*

Prof. Mustafa Aktar
Prof. Mustafa Erdik

*GENERAL DIRECTORATE OF MINERAL RESEARCH AND EXPLORATION (MTA),
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Dr. Ömer Emre

MIDDLE EAST TECHNICAL UNIVERSITY (METU), ANKARA.

Prof. Ali Kocyigit

ISTANBUL UNIVERSITY.

Prof. Naside Ozer

MARMARA RESEARCH CENTER, GEBZE.

This research institution is managed by the TUBITAK (The Turkish national research foundation). While TUBITAK is facing a national controversy over research funding and strategy [see for example the News sections of the issues of *NATURE* published on April 28, 2005 and November 3, 2005], first-rate scientists such as Dr. Serdar Özalaybey (active and passive seismology) and Dr. Semih Ergintav (geodesy) have long collaborated with numerous scientists at the national and international levels.

6. ACKNOWLEDGEMENTS

The Rector of Istanbul Technical University, Dr. Faruk Karadogan, is gratefully acknowledged for facilitating this workshop and hosting the ice-breaker cocktail. This workshop would not have been possible without the effort of Prof. Naci Görür, who hosted the workshop and firmly supports the concept of international collaboration. Dr. Cenk Yaltirak oversaw all the logistical aspects of the workshop and co-lead the field trip the Ganos fault segment. Gulsen Uçarkus and other ITU scientists spent much time coordinating this workshop and graciously helped smooth out a host of small problems. Drs. Aral Okay and Ömer Emre organized and led the two very successful field trips. Drs. Sinan Akciz, Mehmet Celebi, Ibrahim Cemen, Robert Reilinger, and Nafi Toksoz provided useful guidance in preparing for the workshop. The workshop was made possible with support from this grant (SCEC #11494) and NSF grant OISE- 0624039.

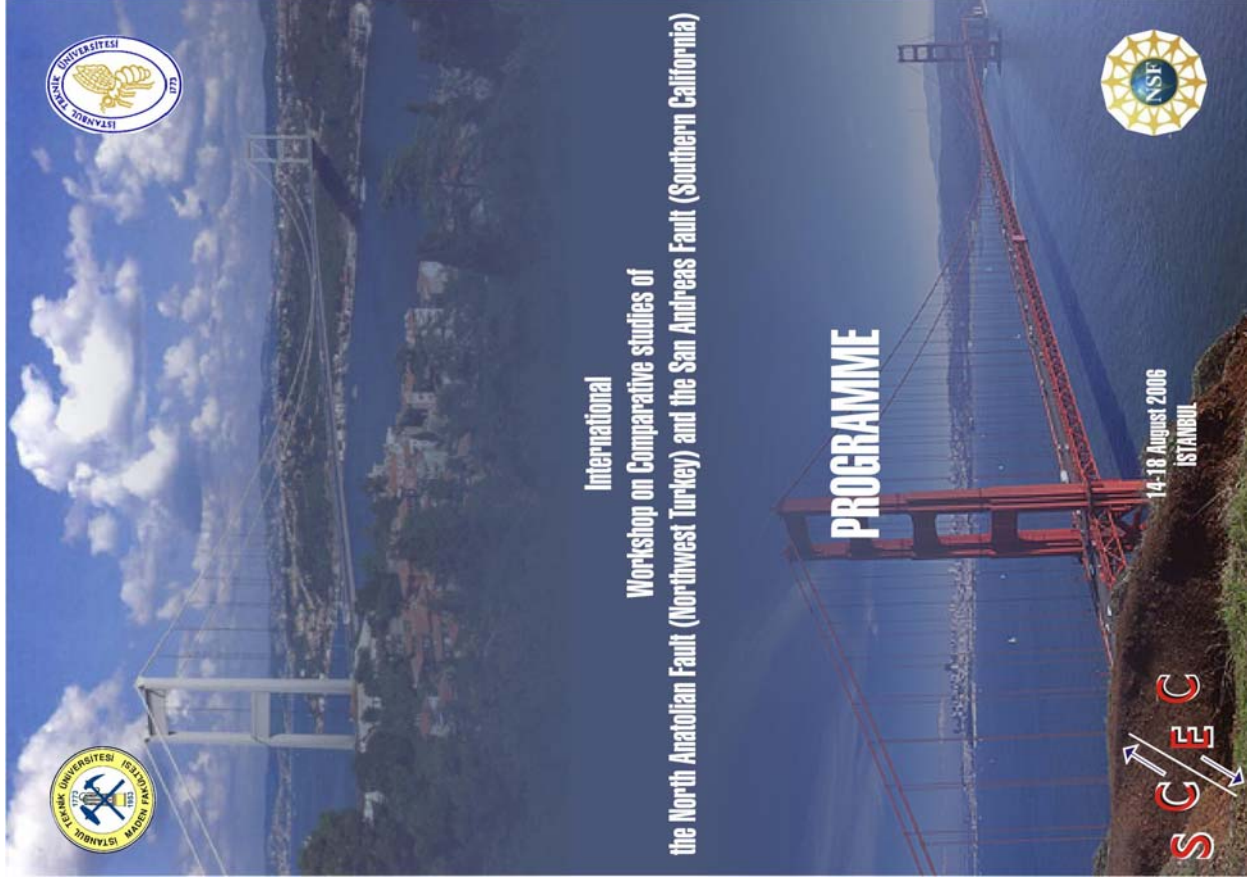
APPENDIX 1. PARTICIPANTS

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Thomas Rockwell, San Diego State University, USA

14 AUGUST 2006 MONDAY

09.00-09.25 REGISTRATION

09.25-09.40 OPENING SPEECHES

Naci GÖRÜR (Chairman) **Faruk KARADOĞAN** (ITU, Rector)

INTRODUCTORY SESSION

09.40-10.05 **Naci GÖRÜR**, Istanbul Technical University

A Brief history of earthquake research in the Sea of Marmara since the 1999 Earthquakes

10.05-10.35 **Thomas JORDAN**, University of Southern California & Southern California Earthquake Center (SCEC)

The SCEC's program of earthquake system science in southern California

10.35-10.50 Coffee Break

SESSION-1

THE NORTH ANATOLIAN AND SAN ANDREAS FAULT SYSTEMS

10.50-11.20 **A.M.Celal ŞENGÖR**, Istanbul Technical University

The North Anatolian Fault

11.20-11.50 **James DOLAN**, University of Southern California

Comparison of paleoseismological evidence for patterns of earthquake occurrence on the North Anatolian and San Andreas

Faults: The importance of structural context

11.50 LUNCH

SESSION-2

EVOLUTION OF TRANSFORM SYSTEMS FROM DECADEAL TO MILLION-YEAR TIMESCALES

13.15-13.40 **David BOWMAN**, California State University

Lessons for the tectonics of the Western USA from the evolution of the North Anatolian Fault and the Aegean

13.40-14.05 **Aral OKAY**, Istanbul Technical University

Evolution of transform basins and ridges with special references to the Marmara Sea

14.05-14.30 **İsmail KUŞÇU MTA**,

Stepover Geometry in the Gemlik Bay on the Southern Strand of the NAF

14.30-15.00 Panel-led discussion

15.00-15.15 COFFEE BREAK

SESSION-3

FAULT KINEMATICS: HOLOCENE EARTHQUAKE CYCLES

15.15-15.40 **Thomas ROCKWELL**, San Diego State University

Paleoseismology of the 1912, 1944 and 1999 ruptures on the North Anatolian fault: Implications for late Holocene patterns of strain release

15.40-16.05 **Elizabeth HEARN**, University of British Columbia, Vancouver

Dynamics of the North Anatolian and San Andreas fault zones: Hypotheses, models, and open questions

16.05-16.30 **Robert REILINGER**, Massachusetts Institute of Technology, Cambridge
Semih ERGİNTAY, Marmara Research Center, Gebze

Space geodetic constraints on the earthquake deformation cycle along the North Anatolian Fault

DISCUSSIONS IN BREAKOUT GROUPS

16.40-18.20 *Topics will be selected from following list or other suggestions*

What factors account for time-varying behavior, why the differences between SAF and NAF?

What drives vertical motions?

Strain partitioning versus oblique motion

Effects of pre-existing structures on the orientation and evolution of active ones

Controversies: continued pull-apart extension, cessation of extreme extension, dipping faults?

Fault bends, partially blind faults, slip partitioning, and oblique slip?

Quantitative structural models for meaningful comparisons of the North Anatolian and San Andreas fault systems

How is stress accommodated and transferred during the earthquake cycle? Vertical axis rotation and affect on displacement on domain-bounding faults

Discriminating loading determined from GPS on sub-parallel deeply-locked faults

Basin effects on GPS data (fluids, sediment compaction).

GPS deformation modeled using 3D fault representations.

15 AUGUST 2006, TUESDAY

09.00-09.45 Breakout groups reporting on discussion from previous day

SESSION-4

FAULT RUPTURES: SEGMENTATION, TRIGGERING, CLUSTERING

- 09.45-10.10 **Susan HOUGH**, US Geological Survey, Pasadena
Remotely triggered earthquakes
- 10.10-10.35 **Susana CUSTÓDIO** University of California Santa Barbara
The Parkfield Section of the San Andreas Fault, California: Characteristic or Complementary Earthquake Ruptures?

10.35-10.50 COFFEE BREAK

SESSION-5

DETAILED STRATIGRAPHIC STUDIES, FIELD STUDIES, AND SEISMOTECTONICS

- 10.50-11.15 **Namık ÇAĞATAY**, Istanbul Technical University
Late Quaternary stratigraphy and sedimentology of the Marmara Sea: Implications for tectonic studies
- 11.15-11.40 **Ali KOÇYIGIT**, Middle East technical University (METU), Ankara
The transition zone between the extensional and strike-slip neotectonic regimes in southern Marmara region: Bursa Graben
- 11.40-12.05 **Okan TÜYSÜZ**, Istanbul Technical University
Morphotectonic features along the Tosya-Havza segment of the North Anatolian Fault
- 12.05-12.30 **Craig NICHOLSON**, University of California – Santa Barbara
Combining high-resolution climate studies and tectonics: Imaging complex folding in 4 dimensions above active blind faults

12.30-13.00 PANEL-LED DISCUSSION

13.00 LUNCH SESSION-6

EARTHQUAKE HAZARDS

- 14.15-14.40 **Mustafa ERDİK**, Kandilli Observatory and Earthquake Research Institute, Istanbul
Assessment of earthquake hazard in Marmara Region, Turkey
- 14.40-15.05 **Kim OLSEN**, San Diego State University
TeraShake: Large-scale simulation of ground motion in Los Angeles for a M7.7 earthquake on the southern San Andreas Fault
- 15.05-15.30 **Sinan ÖZEREN**, Istanbul Technical University
A semi-spectral approach for the mathematical modeling for the underwater landslide tsunami scenarios in the Sea of Marmara
- 15.30-15.45 COFFEE BREAK

SESSION-7

POSTERS & DISCUSSIONS

- 15.45-17.15 *Poster titles in the Abstract Books*
- 17.15-18.30 **DISCUSSIONS IN BREAKOUT GROUPS**
Topics to be selected from following list or other suggestions made during the workshop:
- Stress loading and earthquake clustering.
 - Complex fault geometries, rock type, rupture patterns, and dynamics of fault rupture
 - Microseismicity and fault zone properties
 - The need for quality stratigraphy to characterize tectonic evolution and deformation rates
 - Dual use of high-resolution seismic data and cores for paleoclimate and paleoseismology
 - Fluid flow along fault zones, and its impact on earthquakes
 - Does shallow velocity structure near fault affect ground motions at distant site?
 - Assessing tsunami and landslide hazards

16 AUGUST 2006, WEDNESDAY

09.00-09.45 Reports from the breakout groups from previous day

SESSION-9

STRATEGIES FOR MULTINATIONAL AND MULTIDISCIPLINARY INVESTIGATIONS

09.45-10.05 **Thomas JORDAN**

Collaboratory for the Study of Earthquake Predictability

10.05-10.25 **Naci GÖRÜR**

Strategies for future investigations of the North Anatolian Fault

10.25-10.40 COFFEE BREAK

SESSION-10

EMERGING TECHNOLOGIES FOR FAULT IMAGING AND MONITORING

10.40-11.00 **David CHADWELL**, Scripps Oceanographic Institution, San Diego

Underwater geodetic monitoring

11.00-11.20 **Mike JACKSON**, UNAVCO (NAVstar Consortium), Boulder

The EarthScope Plate Boundary Observatory

11.20-11.40 **Roland PERSON**, Ifremer, Brest

ESONET: The European Seafloor Observatory NETWORK

11.40-12.15 PANEL-LED DISCUSSION

12.15-13.30 LUNCH

SESSION-11

RECENT, ON-GOING, OR UPCOMING INVESTIGATIONS ALONG THE NORTH ANATOLIAN FAULT AND THE SAN ANDREAS FAULT

13.30-13.45 **Pierre HENRY**, College de France, Aix-en-Provence

Cold seeps along the main Marmara Fault: Context and perspectives for monitoring

13.45-14.00 **Emin DEMİRBAĞ**, Istanbul Technical University **Michael**

STECKLER, Lamont-Doherty Earth Observatory, Palisades

Seismic reflection surveys in the Marmara Sea

14.00-14.15 **Ömer EMRE**, General Directorate of Mineral Research and Exploration (MTA), Ankara **Sinan AKCIZ**, University of

California, Irvine *Status of paleoseismological studies along SAF & NAF*

14.15-14.30 **Gülen UÇARKUS**, Istanbul Technical University

The RELIEF project along the North Anatolian Fault

14.30-14.45 **Hayrullah KARABULUT**, Bogazici University, Istanbul

Status of seismometer networks, including OBS, in NW Turkey

14.45-15.00 **Semih ERGİNTAV**, Marmara Research Center (MAM)

GPS monitoring of the North Anatolian Fault

15.00-15.15 **Christopher SORLIEN**, University of California, Santa Barbara

Community fault, stratigraphic, and 3D seismic velocity models for southern California and Northwest Turkey

15.15-15.45 PANEL-LED DISCUSSION

15.45-16.30 COFFEE BREAK AND POSTERS

DISCUSSION IN BREAKOUT GROUPS

16.30-18.00 *Topics to be selected from the following list and other suggestions made during the workshop:*

Strategies for quantitative comparison between North Anatolian and San Andreas fault systems.

Potential for quantitative comparison using similar community fault models

Underwater monitoring of fault activity: seafloor observatories

SCEC-like effort on paleoseismology (includes lakes and sea)

Data distribution and archiving: building an open source and free access database for the NAF

Many of the themes will be delineated by participants during the workshop.

Some probable themes follow.

Implementation of a unified fault, stratigraphic, and seismic velocity

representation of the several strands and fault blocks of the North

Anatolian Fault zone, with initial focus on northwest Turkey, including

seismicity information and GPS data.

Submarine observatory to monitor activities along the North Anatolian Fault

beneath the Marmara Sea. A seafloor observatory would not only provide

new insight into submerged continental transform faults, it might also

provide critical warnings should anomalous activities be detected.

Expanding a comprehensive, permanent onshore/offshore geodetic array in Turkey

Extending investigations to the region surrounding the North Anatolian Fault:

Aegean Sea and Southwest Turkey.

Strategies for producing a high quality stratigraphy (offshore and onshore) for

quantifying long-term tectonic rates; Possible role for EMCOL

(Eastern Mediterranean Centre of Oceanography and Limnology) and

IODP in addressing tectonic evolution of Marmara Sea.

POSTERS

Fault characteristics, segmentation and paleoseismology along the 9 August 1912 Ganos earthquake-rupture (North Anatolian Fault, Turkey)

M. Ersen AKSOY, Mustafa MEGRAOUI, Matthieu FERRY, Ziyadin ÇAKIR, Serdar AKYUZ, Volkan KARABACAK, Erhan ALTUNEL

GPS Measurements on the western Marmara segment of North Anatolian Fault

M. Uğur ALTIN, Hakan YAVAŞOĞLU, Ergin TARI, Orhan BAYKAL, Raşan ÇAKMAK, Turan ERDEN, Semih ERGİNTAY, M. Korhan ERTURAÇ, Cankut D. İNCE, Himmet KARAMAN, Ufuk TARI, Okan TÜYSÜZ, Mustafa YANALAK

Slip partitioning and regional stress fields from geometrically irregular Faults

David BOWMAN, Geoffrey KING, David OGLESBY and Paul TAPPONIER

Creeping along the North Anatolian Fault at Ismetpasa (Western Turkey): Rate and extent from InSAR

Ziyadin ÇAKIR, Ahmet M. AKOĞLU, Semih ERGİNTAY, Samir BELABBES, Mustapha MEGHRAOUI

Subsurface structure of the San Andreas Fault: Probable analog to the North Anatolian Fault

Rufus D. CATCHINGS, Michael J. RYMER, Mark R. GOLDMAN

Comparison of strong-motion Networks along North-Anatolian (NAF-Turkey) and San Andreas (SAF-California) Faults – Need to Enhance

Mehmet ÇELEBI

Constructing a 3D block diagram of the tectonic features in the Central Basin, the Marmara Sea, by means of bathymetric and seismic reflection data

Emin DEMİRBAĞ, Doğa DÜŞÜNÜR, Hülya KURT, Kerim SARIKAVAK, Suna ÇETİN

Paleoseismological investigations on 1999 İzmit earthquake surface rupture

Aynur DİKBAS, H. Serdar AKYUZ, Cengiz ZABCI, Gürsel SUNAL, Matthieu FERRY, Çağlar YALCINER, Erhan ALTUNEL

Earthquake ground motion simulation for İstanbul

Eser DURUKAL and Mustafa ERDİK

Revised active fault map of Northwest Anatolia: Fault geometry and kinematics surrounding Sea of Marmara

Ömer EMRE, Ahmet DOĞAN, Fuat ŞAROĞLU, Cengiz YILDIRIM, Volkan ÖZAKSOY

Characteristics of the Major Splays of the Central North Anatolian Fault.

M. Korhan ERTURAÇ and Okan TÜYSÜZ

Analysis of micro-seismicity of İstanbul greater city area and active faults

Haluk EYİDOĞAN

Submarine earthquake geology in the Marmara Sea: a multiscale approach for seismic risk assessment.

*Luca GASPERINI, Alina POLANIA, Valentina FERRANTE, Giovanni BORTOLUZZI, Luca BELLUCCI***Ground motion prediction for Turkish Earthquakes**

Polat GÜLKAN and Erol KALKAN

Reconciling geodetic observations of time-dependent deformation around faults with their geologic slip rates: Dynamic models of the North Anatolian and San

Andreas Faults

Elizabeth H. HEARN, Semih ERGİNTAY, Robert REILINGER, Simon MCCLUSKY

Numerical stress field model for the Marmara Sea region

Oliver HEIDBACH, Tobias HERGERT, Anne BECEL, Alfred HIRN

Seismic and geodetic study of the 1999 İzmit and Duzce earthquake sequence

A. Ozgun KONCA, Don V. HELMBERGER, Sebastien LePRINCE, Jean-Philippe AVOUAC

Towards an understanding of the constancy (or non-constancy) of slip-rates on the North Anatolian fault

Özgür KOZACI, James F. DOLAN, Robert FINKEL

Structural interpretation of multi-channel seismic reflection data in the Gulf of İzmit, Marmara Sea

Hülya KURT and Esra YÜCESOY

An outline of the Turkish – Japanese post-1999 İzmit earthquake research in the Gulf of İzmit: Offshore faults, submarine mass movements, seafloor gas seeps and offshore paleoseismology

İsmail KUŞÇU, Makoto OKAMURA, Hiromi MATSUOKA, Kunio YAMAMORI, Yasuo AWATA, Selim ÖZALP

Extinction of Pull-apart Basins in the Sea of Marmara: Transition from Pull-apart Mechanism to a Single, Through-going Fault

İsmail KUŞÇU

Tectonic map of the Western Portion, North Anatolian Fault System

Avis L. LISENBEE and Nuri UZUNLAR

Three-Dimensional fault topology in the Ventura Basin, California, and a new technique for creating three-dimensional interseismic mechanical models in complex regions.

Scott MARSHALL, Michele COOKE and Susan OWEN

Submarine earthquake geology along the North Anatolia Fault in the Marmara Sea, Turkey: What we learnt about transform basins, earthquakes, and sedimentation

Cecilia M.G. McHUGH, Leonardo SEEBER, Marie-Helene CORMIER, Jessica DUTTON, Namik CAĞATAY, Alina POLONIA

Macroseismic, paleoseismic, and archaeoseismic data: Independent records of earthquake recurrence

Tina M. NIEMI

Dynamic versus static Cloumb Stress trigerring of Earthquakes on the North Anatolian, Turkey

Kim B. OLSEN and Ross STEIN

Late Holocene uplift of the Hersek Ridge on the restraining bend of NAFS

Yolkun ÖZAKSOY, Ömer EMRE, Ahmet DOĞAN, Cengiz YILDIRIM, Selim ÖZALP, Fatma TOKAY

Segment structure of the southern strand of the North Anatolian Fault system and paleoseismic behaviour of the Gemlik Fault, NW Anatolia

Selim ÖZALP, Ömer EMRE and Ahmet DOĞAN

Seismicity parameters and scaling properties of earthquakes in Marmara, western NAF

Naşide ÖZER and Savaş CEYLAN_

Source inversion resolution analysis of the 2004 Mw6.0 Parkfield Earthquake

Morgan T. PAGE, Susana CUSTÓDIO, Ralph J. ARCHULETA, and J. M. CARLSON

Analysis of stress and failure around step-overs and slip-gaps for strike-slip fault systems

Badie ROWSHANDEL

Behavior of the San Andreas fault over the last 5000 years: Wrightwood's clues and questions

Kate CHARER

Imaging and mapping active 3D Fault geometry in the California Continental Borderland

Catherine Sarah SCHINDLER, Craig NICHOLSON, Christopher SORLIEN

Simulation of strong ground motion from the 2004 Parkfield Earthquake

Karin ŞEŞETYAN and Eser DURUKAL

Fault segmentation effects on sequences of dynamic events

Bruce E SHAW

Kinematics of the faults cutting the Pliocene deposits in the Gulf of Izmit and surroundings

Ufuk TARI and Okan TÜYSÜZ

The Eastern Marmara pull-apart junction (North Anatolian Fault) and its relation to the submarine end of the 1999 Izmit earthquake rupture

Gülşen UÇARKUŞ, Rolando ARMLIO, Nicholas PONDARD, Bertrand. MEYER, Ziyaddin ÇAKIR

Neotectonic evolution of the Uludağ Uplift and its connection with of the North Anatolian Fault Zone (Bursa-Turkey)

Cenk YALTIIRAK and Cem GAZIOĞLU

Geomorphic manifestations of the damage assymetry induced by rupture propagation direction along the 1943 and 1944 rupture zones of the NAFZ

Cengiz YILDIRIM, Öry DOR, Thomas K. ROCKWELL, Ömer EMRE, Yehuda BEN-ZION, Matthew SISK and T.Yigit DUMAN

Slope instability in the Sea of Marmara and relationship with active faulting

Tiphaine ZITTER, Pierre HENRY, Mehmet Sinan ÖZEREN_

PBO Borehole Strainmeters

David MENCIN

Strategies for characterizing seafloor deformation along the submarine extensions of continental transforms

Marie Helene CORMIER, Leonardo SEEBER, Cecilia M.G. McHUGH, David CHADWELL, Spahr WEBB

Bends on continental transforms and the North Anatolian Fault in the Marmara Sea

Leonardo SEEBER, Cecilia M.G. McHUGH, Marie-Helene CORMIER, Ömer EMRE, Christopher C. SORLIEN

New paleoseismological constraints on the behaviour of the San Andreas Fault in the Carrizo Plain.

Sinan AKÇİZ, Lisa B. GRANT, Ramon ARROWSMITH

How did the North Anatolian and San Andreas Fault Zones effect

developments of the Western Anatolia extended terrane in Turkey and the Southern Basins and Ranges in the USA, Respectively?

Ibrahim ÇEMEN_



- 1: Earthquake Research Center Workshop Hall
- 2: Lake Side Residence
- 3: Princess Hotel
- 4: SDKM Restaurant
- 5: Camlik Restaurant

- 6: Faculty of Mines & Eurasia Institute of Earth Sciences
- 7: Pisa & Kebab House
- A: Main entrance for Macka direction
- B: Central entrance for Princess hotel
- C: Istinye entrance for exit Bosphorus-Istinye bay