

SIO 239: Frontiers in Plate Boundary Deformation

<http://topex.ucsd.edu/sio239>

Instructor

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Class Times and Location

Meeting Day: Tuesday Time: 3:30-5:00 Location: Munk Conf.

Course Credit & Grading

Seminar course 2 units S/U (no letter grade)

No exams

Informal feedback for summary presentations

Course Description

This seminar course will explore state-of-the-art measurement techniques and contemporary observations of active plate boundaries, with particular emphasis on the North American Continent and the San Andreas Fault System. The goal of this course will be to provide an introduction to present-day knowledge of the North American-Pacific Plate boundary, on-going efforts for measuring plate boundary deformation, and controversial questions that future seismic, geodetic, and drilling observations (eg., EarthScope) hope to unravel. Through a series of assigned readings combined with short overview presentations, students will lead discussions covering selected topics such as San Andreas deformation, deep seismic tremors along the Cascadia Subduction Zone and findings from recent earthquakes (eg., M6.0 Parkfield earthquake). The use of modern instrumentation systems such as the US Seismic Array, the Plate Boundary Observatory, and the San Andreas Fault Observatory at Depth will also be introduced.

Course Schedule

(*subject to change*)

Date	Topic	Reading	Discussion Leader
9/27	Overview		
10//4	San Andreas Fault System	Weldon et al., 2005; 2004; Townend and Zoback, 2004; Powell & Weldon, 1992	Smith
10/11	Sierran Microplate & Eastern CA Shear Zone	Unruh et al., 2003; Savage et al., 1990; Sauber et al., 1994]	TBA
10/18	Cascadia Silent Earthquakes	Melbourne et al., 2005; Szeliga et al., 2004; Rogers & Dragert, 2003	TBA
10/25	Parkfield Seismicity & 2004 event	Rubinstein and Beroza, 2005; Schorlemmer and Wiemer, 2005; Waldhauser et al., 2004	TBA
11/1	SAFOD Pilot Hole Observations	Hickman et al., 2004; McPhee et al., 2004; Nadeau et al., 2004	TBA
11/8	SAFOD: Instrumentation	TBA	Mark Zumberge
11/15	PBO: High-rate GPS	Langbein and Bock, 2004	Yehuda Bock
11/22	PBO: Long-term geodetic data	Jackson , 2003	Duncan Agnew
11/29	USArray: Instrumentation and Data	Marfurt et al., 2003; Owens et al., 2003; Pavlis, 2003; Levander, 2003	Frank Vernon

Proposed Reading

San Andreas Fault System (10/4/05)

Weldon, R. J., T. E. Fumal (2005), G. P. Biasi, and K. M. Scharer, Past and Future Earthquakes on the San Andreas Fault, *Science*, 308, 966-967.

Weldon, R. J. K. M. Scharer, T. E. Fumal, G. P. Biasi (2004), Wrightwood and the earthquake cycle: What a long recurrence record tells us about how faults work, *GSA Today*, 14, doi:10.1130/1052-5173(2004)014.

Townend, J., and M. D. Zoback (2004), Regional tectonic stress near the San Andreas fault in central and southern California, *Geophys. Res. Lett.*, 31, doi:10.1029/2003GL018918.

Powell, R. E., and R. J. Weldon (1992), Evolution of the San Andreas Fault, *An. Rev. Earth Plan. Sci.*, 20, 431-468.

(Supp.) Wallace, R. E. (1990), The San Andreas Fault System, California, USGS Prof. Paper 1515.

(Supp.) Luyendyk, B. (1991), A model for Neogene crustal rotations, transtension, and transpression in southern California, *Geol. Soc. Am. Bull.*, 103, 1528-1536.

(Supp.) Flesch, L. M., W. E. Holt, A. J. Haines, and B. Shen-Tu (2000), Dynamics of the Pacific-North American Plate Boundary in the Western United States, *Science*, 287, 834-836.

Sierran Microplate/Eastern CA Shear Zone (10/11/05)

Unruh, J., J. Humphrey, and A. Barron (2003), Transtensional model for the Sierra Nevada frontal fault system, eastern California, *Geology*, 31, 327-330.

Savage, J. C., M. Lisowski, and W.H. Prescott (1990), An apparent shear zone trending north-northwest across the Mojave Desert into Owen Valley, eastern California, *Geophys. Res. Lett.*, 17, 2113-2116.

Sauber, J., W. Thatcher, S.C. Solomon, and M. Lisowski (1994), Geodetic slip rate for the eastern California shear zone and recurrence time of Mojave Desert earthquakes, *Nature*, 367, 264-266.

Cascadia Subduction Zone (10/18/05)

Melbourne, T. I., W. M. Szeliga, M. M. Miller, and V. M. Santillan (2005), Extent and duration of the 2003 Cascadia slow earthquake, *Geophys. Res. Lett.*, 32, doi:10.1029/2004GL021790.

Szeliga, W., T. I. Melbourne, M. M. Miller, and V. M. Santillan (2004). Southern Cascadia episodic slow earthquakes, *Geophys. Res. Lett.*, 31,

doi:10.1029/2004GL020824.

Rogers, G., and H. Dragert (2003), Episodic Tremor and Slip on the Cascadia Subduction Zone: The Chatter of Silent Slip, *Science*, 300, 1942-1943.

(Supp.) Dragert, H. K. Wang, T. S. James (2001), A Silent Slip Event on the Deeper Cascadia Subduction Interface, *Science*, 292, 1525-1528.

(Supp.) Hirn, A., and M. Laigle (2004), Silent Heralds of Megathrust Earthquakes, *Science*, 305, 1917-1918.

(Supp.) Miller, M. M., T. Melbourne, D. J. Johnson, and W. Q. Sumner (2002), Periodic Slow Earthquakes from the Cascadia Subduction Zone, *Science*, 295, 2423.

(Supp.) Melbourne, T. I., and F. H. Webb (2003), Slow but not quite silent, *Science*, 300, 1886-1887.

Parkfield Seismicity & 2004 Earthquake (10/25/05)

Rubinstein, J. L., and G. C. Beroza (2005), Depth constraints on nonlinear strong ground motion from the 2004 Parkfield earthquake, *Geophys. Res. Lett.*, 32, doi:10.1029/2005GL023189.

Schorlemmer, D., and S. Wiemer (2005), Microseismicity data forecast rupture area, *Nature*, 434, 1086.

Waldhauser, F., W. L. Ellsworth, D. P. Schaff, and A. Cole (2004), Streaks, multiplets, and holes: High-resolution spati-temporal behavior of Parkfield seismicity, *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL020649.

(Supp.) Murray, J. R., and P. Segall (2005), Spatiotemporal evolution of a transient slip event on the San Andreas fault near Parkfield, California, *J. Geophys. Res.*, 110, doi:10.1029/2005JB003651.

(Supp.) Niu, F., P. g. Silver, R. M. Nadeau, and T. V. McEvilly (2003), Migration of seismic scatterers associated with the 1993 Parkfield aseismic transient event, *Nature*, 426, 544-548.

San Andreas Fault Observatory at Depth, SAFOD (11/1/05)

Hickman, S., M. Zoback, and W. Ellsworth (2004), Introduction to special section: Preparing for the San Andreas Fault Observatory at Depth, *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL020688.

McPhee, D. K., Jachens, R. C., and C. M. Wentworth (2004), Crustal structure across the San Andreas Fault at the SAFOD potential field and geologic studies, *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL019363.

Nadeau, R. M., A. Michelini, R. A. Uhrhammer, D. Dolenc, and T. V. McEvilly (2004), Detailed kinematics, structure, and recurrence of micro-seismicity in the SAFOD target region, *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL019409.

(Supp.) Thurber, C., S. Roecker, H. Zhang, S. Baher, and W. Ellsworth (2004), Fine-scale structure of the San Andreas fault zone and location of the SAFOD target earthquakes, *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL019398.

(Supp.) Chery, J., M. D. Zoback, and S. Hickman (2004), A mechanical model of the San Andreas fault and SAFOD Pilot Hole stress measurements, *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL019521.

(Supp.) Williams, C. F., F. V. Grubb, and S. P. Galanis (2004), Heat flow in the SAFOD pilot hole and implications for the strength of the San Andreas Fault, *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL019352.

Plate Boundary Observatory (High-rate GPS) (11/8/05)

Langbein, J., and Y. Bock, High-rate real-time GPS network at Parkfield: Utility for detecting fault slip and seismic displacements (2004), *Geophys. Res. Lett.*, 31, doi:10.1029/2003GL019408.

(Supp.) The Plate Boundary Observatory: Creating a Four-Dimensional Image of the Deformation of Western North America (a white paper providing the scientific rationale and deployment strategy for a Plate Boundary Observatory, presented by the PBO Steering Committee to the National Science Foundation).

Others:

See course website for pdf links!