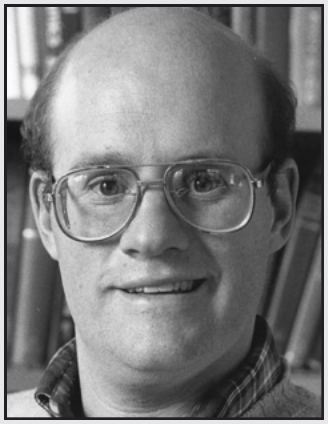
GEORGE P. WOOLLARD AWARD

Presented to Seth Stein



Seth A. Stein
Northwestern University

Citation by Donna M. Jurdy

Each year the Geophysics Division of the GSA gives the George P. Woollard award to a distinguished scientist for "outstanding contributions to geology through the application of the principles and techniques of geophysics." It is a pleasure — and honor — to deliver the citation for the Woollard Award's 2009 recipient, Seth Stein.

Seth Stein, the William Deering Professor of Earth & Planetary Sciences at Northwestern University, investigates plate boundary processes and deformation within the lithosphere by using a range of techniques including space-based geodesy, seismology, and marine geophysics.

Stein specializes in the integration of diverse techniques for tectonic studies. His graduate work at Caltech used earthquakes to prove that the 90 East Ridge was tectonically active, as opposed to the "aseismic" feature it was assumed to be. This laid the foundation for his later reanalysis of plate motions in the Indian Ocean. He also developed techniques for normal mode studies that many years later gave the first full insight into the Great 2004 Sumatra earthquake. Early in his career at Northwestern, he spearheaded a team of graduate students along with another faculty member in a project that reexamined the burgeoning relative plate motion dataset. From this work they developed NUVEL-1, a model that provided new insights into plate motions around the world over the past 3 Myr. This accounted for "missing" motion on the San Andreas fault and demonstrated that India and Australia are distinct plates. The NUVEL model is routinely compared with results from space-based systems to identify temporal changes in plate motion. It is the standard to describe plate motions and allows testing of the rigid plate hypothesis and measurements of intra-plate deformation. Seth developed widely-used models for the role of microplates in changing the geometry of plate boundaries. He also examined aspects of thermal evolution of the ocean floor including the dependence of earthquake depths and topography on lithospheric age, and the magnitude and distribution of hydrothermal water flux forming a primary interaction between the solid earth and ocean/atmosphere. Also, he combined GPS satellite, geology, and earthquake data for a view of temporal and spatial variation of Andean mountain building. This showed the deformation extends from the trench to the continental interior.

More recently in his career Seth Stein has shifted attention to seismological problems with relevance to society. With a GPS field survey, he demonstrated that little or no present-day deformation is occurring at the New Madrid seismic zone, triggering a major reassessment of the processes and hazards there. A productive debate has ensued about the appropriate hazard mitigation policy. Most recently, he has been a leader in studying the great 2004 Sumatra earthquake, showing how the giant tsunami was generated and identifying which other subduction zones can generate such events. The rupture area was determined to be 1200 km in length, considerably longer than thought, which established that similar events should not be expected in 500 years. He undertook the first comprehensive view of postglacial rebound across North America, constraining glaciation history and mantle viscosity. This GPS study provided the first full mapping of present vertical and horizontal glacial rebound and subsidence which showed detail not visible from shoreline observations alone. Data led to improved mantle viscosity models and revealed that another major ice lobe existed, west of Hudson's Bay.

Beyond his ground-breaking scientific research, he has also had a major impact in formulating public policy to mitigate earthquake hazards. He has worked extensively with news media to improve public understanding of earthquake hazards and policy, as well as made contributions in earth science education. Seth Stein served as Scientific Director of the UNAVCO GPS Consortium, and was one of the founders of the Earthscope program. He has written a widely-used seismology textbook, and edited 5 books about plate boundary zones, intraplate earthquakes, and the Mesozoic Pacific. He has recently completed a popular book about earthquakes in the midwest and is in the process of developing a new textbook for geophysics at a sophomore level. He has been an IRIS-SSA Distinguished Lecturer and speaks widely on seismology and tectonics.

Especially active in service outside for professional organizations and universities, he selflessly offers his expertise and considerable energy. Truly a model advisor, he has a long history of mentoring successful graduate students, many now faculty advisors themselves, and others in industry or government laboratories. Out of the numerous past students who have worked with him, four were recognized by AGU Outstanding Student Paper awards.

The diversity and productivity of Seth Stein's research throughout his career, as well as his efforts in education, outreach, and public policy, make him deserving of the George P. Woollard Award.

Response by Seth Stein

Thank you very much, Donna for that generous citation.

I very much appreciate this award and am deeply grateful to the Geophysics Division, to GSA, and to the geological community that we're all part of.

Getting up here reminds me of the story of the medical school dean who tells new students "Half of what we will teach you in the next five years is wrong. The problem is that we don't know which half."

I think that's a good description of earth science. We're all working on trying to understand more about how our complicated planet works. We do make progress, but it's a messy process.

We've all probably tried to explain how science really works compared to the ideal "scientific method" people learn in elementary school. The ideal scientist is like a lone explorer who examines the possible paths to a clearly visible mountain, chooses the best, and heads on. Real scientists are like a mob of hikers trying to find the way to an unseen lake through dense woods full of swamps, mosquitoes and poison ivy. We argue about which routes look best, try different ones, follow them when they seem to be working, and try others when they aren't. It's exciting and fun but also confusing and frustrating. Eventually, mostly through luck, we reach the lake, often by different routes that get there about the same time. Once we're at the lake, we argue whether it's the right lake.

The moral is that while searching for the lake we were all confused and going in the wrong directions about half the time. Eventually, we got there as a group by combining many people's efforts. It's hard to say who contributed what, since we're all sure that we played the key role. It's also not that important, because after relaxing in satisfaction for a while, we realize that this lake is just a small pond. We've made progress, but the big lake is somewhere higher up on the mountain, and it's time to get to work looking for it. Almost all the projects we do, big or small, are a lot like hunting for the lake. We got there with lots of help — from the people we worked with, from other people working on that problem or related problems, and from the broad community whose knowledge we drew on. Moreover, the results are just part of a much bigger picture.

In that spirit, I'd like to thank many people.

The first is my wife, Carol. We've been a two-geologist family for 28 years, with all the fun and complications that poses. When we go to the same meetings, there's the issue of leaving children. Since we live where "Ferris Beuhler's Day Off", "Home Alone", and "Risky Business" were filmed you get the idea. There's the problem of long absences. When Carol was gone twice for a month doing heat flow work off Costa Rica, I did the Mr. Mom stuff. I remember talking to a mother who said her family couldn't function if she were gone overnight. There are the issues of talking to children. When we explained to our 3-year old son that the average old ocean basins were about a kilometer shallower than previously thought, he worried whether there was enough room for whales. On the other hand, our daughter is an avid rock climber, but doesn't care where they came from.

Next are my colleagues. In particular, over many years Donna Jurdy and Brad Sageman made our department a comfortable place. Emile Okal does the opposite — he makes life uncomfortable by coming up with several neat scientific problems a day that he wants to solve immediately. Since that's more than even he can solve working 12-hour days, I get dragged into a few and fun results often emerge.

A lot of one's closest colleagues are students. I've been lucky to work — as an advisor or a coauthor — with great students: Doug Wiens, Joe Engeln, Paul Stoddard, Gary Acton, Charles DeMets, Don Argus, Paul Lundgren, George Helffrich, John Brodholt, Michael Wysession, John Weber, Thomas Shoberg, Lisa Leffler, John DeLaughter, Fred Marton, Phil Richardson, Andy Newman, Eryn Klosko, Alberto Lopez, Kim Schramm, James Hebden, Laura Swafford, and Carl Ebeling. They were fun, thought for themselves, and didn't worry about conventional wisdom they heard from me or elsewhere. When they didn't agree with me, I got responses like "I can't believe you missed that" or "that's stupid." They were often right, of course.

Then there are coauthors: a great part of science is working with and learning from so many smart people. As you get older the numbers grow — my records show 167 coauthors. I'd use up my time listing everyone, but thanks in particular to Bob Geller, Richard Gordon, Tetsuzo Seno, Sierd Cloetingh, Rinus Wortel, Tim Dixon, Steve Kirby, John Schneider, Giovanni Sella, Anke Friedrich, Mian Liu, and Eric Calais.

I'd like to finish up with some thoughts about an issue many us have been mulling over. We do exciting science, but ofen don't do as well communicating it to the public. There's broad if diffuse interest in issues of the earth, energy and environment. For example, we had a window of public interest for almost two weeks between December 26, 2004, when the Indian ocean tsunami that killed more than 200,000 people dominated the news, until January 7 when Brad Pitt and Jennifer Aniston announced that they were splitting up.

Still, on many important issues — natural hazards, global warming, natural resources, etc. — much of the public doesn't appreciate concepts that we learned as undergraduates and teach our undergraduates. They certainly don't appreciate that these are areas about which we still have lots to learn. For example, I read a piece in the *Sierra Club Bulletin* advising students about "green careers" and was amused that none of them involved science. I wrote a letter — which to be fair, they printed — pointing out that addressing environmental issues without science was like hiking without a map — it's easy to get lost.

The good news is that we're trying hard to communicate our science in lots of ways. It's different from talking among ourselves, as I've learned while doing things like IRIS/SSA lectures and now writing a general audience book. Still, it's fun and I encourage anyone interested to try. We know how exciting and fun it is to work on problems that are both challenging and relevant to people's lives, but the trick is to convey this to everyone else.