Early Days of EarthScope

Pre-EarthScope Development

Coming Together – EarthScope Vision

Politics, Dark Days, Stronger Proposal

Success

Lessons Learned for Future Projects

Jim Whitcomb

Early Days of EarthScope

Pre-EarthScope Development

NSF Management

- Director: Rita Colwell
- Deputy Director: Joseph Bordogna
- Assistant Director for Geosciences (GEO): Robert Corell, replaced by Margaret Leinen in 2000
- Division Director for Earth Sciences (EAR): Herman Zimmerman

Early Days of EarthScope

Pre-EarthScope Development

San Andreas Drilling Project

- Advances in directional drilling, sampling, and logging technology
- Search for best site
- Proposals from ~ 1989 – 10 years with no funding
- Site characterization surveys supported by NSF and ICDP
- Name did not fit MRE vision of construction
- Changed to San Andreas Fault Observatory at Depth - SAFOD

Early Days of EarthScope

Pre-EarthScope Development

USArray (United States Seismic Array)

- Advances in seismometers – broad band
- Advances in recording capacity
- Advances in communication – radio and cellular
- Extensive experience in campaign array projects
- 1998 submission to call for MRE ideas

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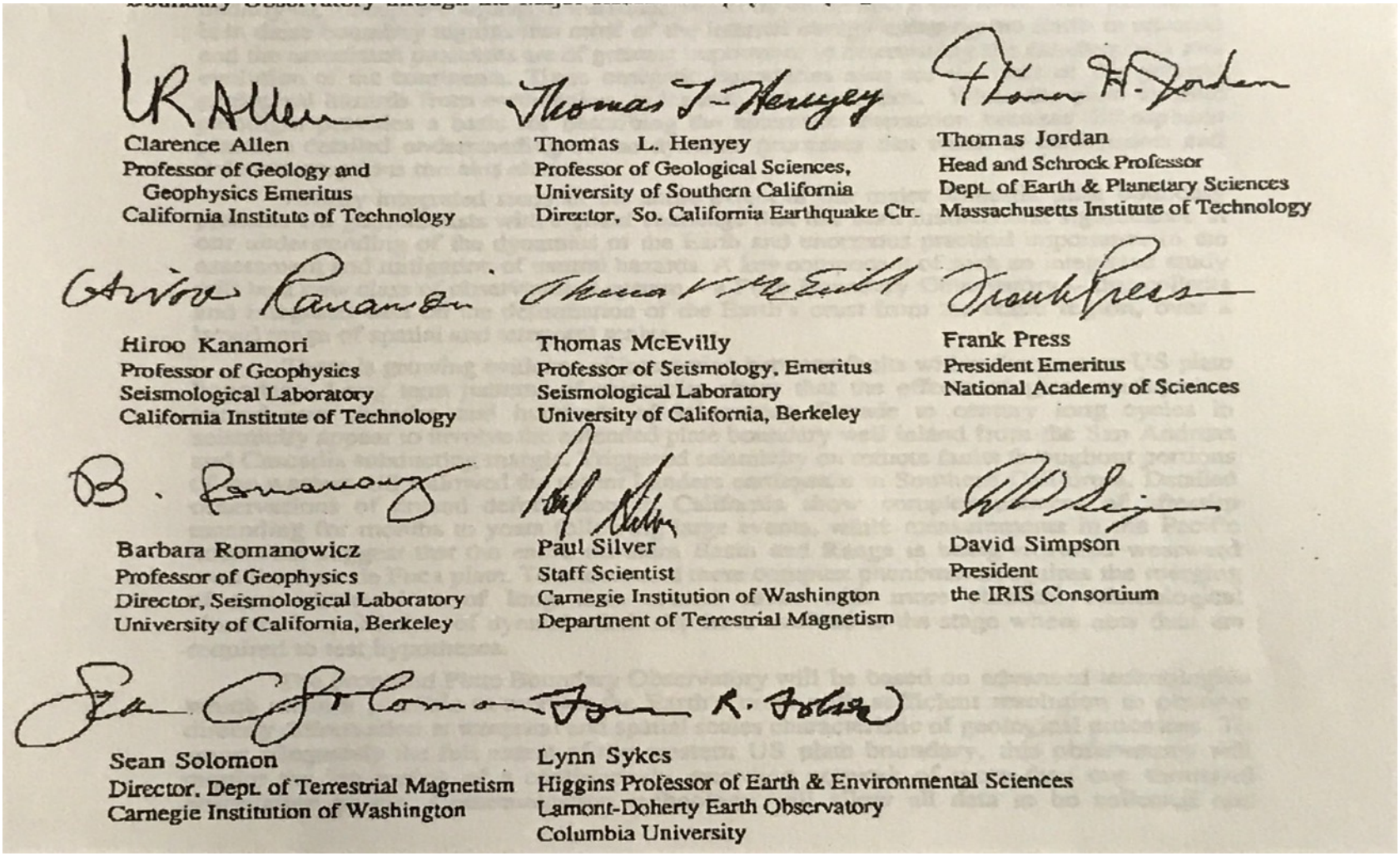
Pre-EarthScope Development

PBO – Plate Boundary Observatory

- Advances in extra-terrestrial reference frame positioning
- 1970's VLBI showed promise – tie to quasars
- 1980's development of GPS
- 1985 birth of UNAVCO with four TI 4100 GPS systems
- Accuracy improvement – orbits, software, civilian access
- Fixed installations (SCIGN, Panga, Japan, etc.)
- January 1998 PBO letter to Bob Corell (later to Rita Colwell)

Early Days of EarthScope

PBO 1/20/98 Letter to Corell - Signatories



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Pre-EarthScope Development

InSAR – Interferometric Synthetic Aperture Radar

- Seasat – 1978 – InSAR detected wake of submerged submarines
- At least 4 civilian InSAR missions proposed to NASA in the 1990's
- Last one - ECHO – proposed in 98-99 with $50 M NSF co-funding
- 40 years without a U.S. civilian InSAR mission
- Several non-U.S. countries now have InSAR missions
- Latest proposed NASA InSAR civilian mission is NISAR

Early Days of EarthScope

Pre-EarthScope Development

Major Research Equipment (MRE) Account

- Established in 1995 - later renamed Major Research Equipment and Facility Construction (MREFC) Account
- Used to fund equipment and facilities too expensive for Directorates (greater than 10% of Directorate annual budget: ~$50M in FY2000 for Geosciences Directorate)
- Before 1998 used solely by Physics, Astronomy, and Polar
- 1998 - Colwell invited rest of NSF to propose to MRE account
- EAR invited ideas most likely to fit MRE criteria
- Received brief outlines for USArray and PBO in 1998

Early Days of EarthScope

Coming Together – EarthScope Vision

SCEC – Southern California Earthquake Center

- NSF Science and Technology Center Competition (STC)
- 1991 start, maximum of 11 years with phase out of funding
- 1998 recompetition in STC program, well-reviewed
- STC policy to not renew any existing centers
- I suggested to Tom Henyey (Director) a March 1999 meeting with Corell and Zimmerman
- Later suggested that explore other emerging initiatives plus SCEC
- Other plans underway to support SCEC
- Initial SCEC funding irregularities made transition easier

Life Imitates Art

Early Days of EarthScope

Coming Together – EarthScope Vision

March 22, 1999 Meeting with Corell and Zimmerman

- Robin Reichlin, Tom Henyey, and I invited leaders from InSAR, PBO, USArray, SCEC, IRIS, UNAVCO, and San Andreas Drilling Project
- Bring forward initiatives under development for ~10 years
- Some concern in each group that their initiative would be subsumed in a larger effort
- Corell and Zimmerman excited
- Hallway conversation: Zimmerman – “Let’s do it all!”
- MRE only source large enough; required integrated vision of Earth dynamics, structure, and hazard study
- Telescope analog: EarthScope (Geoscope and Terrascope taken)
- Natural agency partners: USGS, NASA, DOE

Early Days of EarthScope

Coming Together – EarthScope Vision

April 22, 1999 GEO Retreat and MRE Panel Meeting

- My presentation to GEO retreat in the morning
- Corell presentation to MRE Panel meeting in the afternoon; preliminary approval to further develop proposal
- MRE proposal written internally with input from community
- Phase I: USArray and SAFOD (scope, firm numbers in hand)
- Phase II: PBO (working on scope and firm numbers)
- Phase III: InSAR (ECHO proposal, NASA-dependent)
- I presented to MRE Panel, other internal NSF panels, and National Science Board (July 29, 1999 meeting)
- Phase I included in FY2001 President's Budget Request

Early Days of EarthScope

Politics, Dark Days, Stronger Proposal

- Congress removed EarthScope from FY 2001 budget
  "without prejudice" citing NSF funding shortfalls
- MRE projects are large enough to have Congressional attention
- NSF sets MRE order, but other MRE projects' backers tried
  to "jump the queue" via Congress
- National Science Board approved Phase II on October 19, 2000
- 2001 National Research Council Review of EarthScope
- Proposal now integrated Phases I and II: USArray, PBO, SAFOD
- Support for M-T, InSAR data, geochemistry laboratories added
- Additional contingency added
- EarthScope not included in NSF FY 2002 budget request
- Behind the scenes "horse trading"?

Early Days of EarthScope

Success

- 2001 – NSB affirmed EarthScope one of NSF's highest priorities
- 2002 - President's FY 2003 Budget Request included EarthScope
- 2002 - Congress appropriated $29,805,000 for FY 2003 start of USArray, PBO, and SAFOD

Early Days of EarthScope

Success

- Late 2002 – Need proposals to do construction and operations
- Permission to have sole-source proposals
- December 2002 proposal deadline
- *Ad Hoc* and panel review
- May 2003 National Science Board approval, $218,648,641: 60 mos
- September 2003 start
- 2003 - Permission to hire full-time Program Officer for EarthScope construction and operation: Kaye Shedlock, later replaced by Greg Anderson

Early Days of EarthScope

Success

- 13 ½ years after start, 18 years after first proposed
- EarthScope now in operations and maintenance phase
  funded within EAR and currently run by Greg Anderson
- EarthScope Science a separate program funded within EAR
  and currently run by Maggie Benoit (with Greg Anderson)

Early Days of EarthScope

Lessons Learned for Future Projects

<u>Planning-Stage Needs</u>

- Inside-NSF advocate(s) – true believer, vision, work with upper management, present to NSF committees and NSB
- Effective Upper Management (DD, AD) – enthusiastic (or at least sympathetic) to science, vision, leadership, ability to commit to long-term process, community has an important role to play in providing candidates
- Effective Early Planning – firm scope, firm costs, technology in hand, meaningful partnerships in hand
- Active Community – effective contacts with NSF upper management, OMB, and Congress

Early Days of EarthScope

Lessons Learned for Future Projects

<u>An Example of Effective Interaction with Congress</u>

"**NSF ordered to build three ships** – Congress has told the National Science Foundation (NSF) to build three research Ships…" Jeffery Mervis, Science, May 1, 2017

Early Days of EarthScope

Lessons Learned for Future Projects

Must Find Funding Source that Matches Project Size and Character

- Major Research Instrumentation: < $4 M
- Science and Technology Centers: $5 M /yr, $55 M for 11 yrs
- Mid-Sized: < $100 M (GEO), equipment and facility construction or project (?), can be done by Directorate (?)
- MREFC Account: > $100 M (for GEO), equipment and facility construction only, O&M typically 10-20% yearly of total cost and must come from Directorate (note O&M $ same level as Mid-Sized $), add science funding cost
- Partnerships with real financial contribution important
- Need permanent Program Officer (not rotator) with strong oversight skills

Early Days of EarthScope

Lessons Learned for Future Projects

Community Input

- EarthScope Working Group – late 1999, early 2000
  25 members, Executive Committee – Tom Henyey (Chair), Anne Meltzer, Bernard Minster, Paul Silver, Bob Smith, Mark Zoback
- 2001 National Research Council Review of EarthScope
- EarthScope Science and Education Advisory Committee
  Formed in September 2003 under FICA (Sunshine Act)

Early Days of EarthScope

Lessons Learned for Future Projects

"… to dream big and to be prepared mentally and financially to act fast when opportunities present themselves."

Warren Buffet, 2017 Letter to Shareholders