

If Seismograms Could Talk; The True Story Behind How That Wiggle Came To Be

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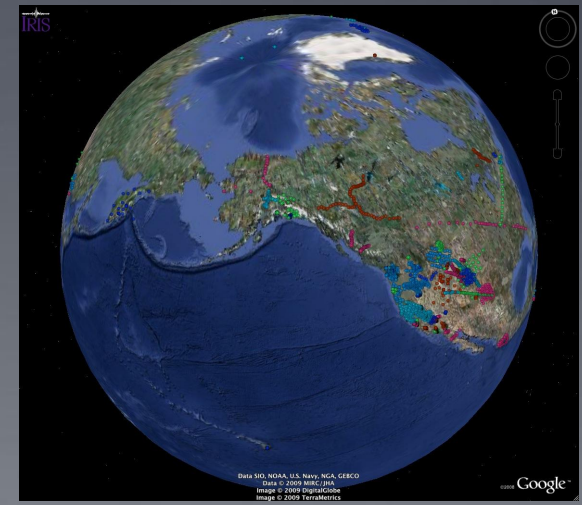
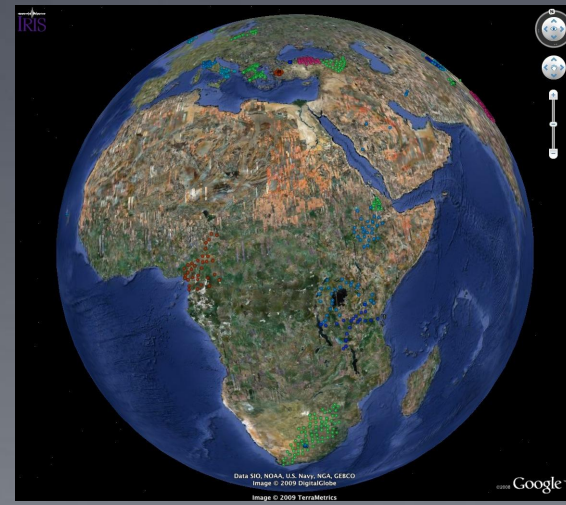
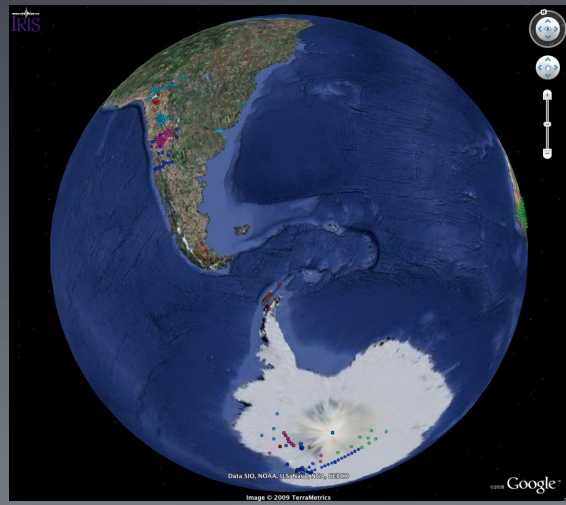
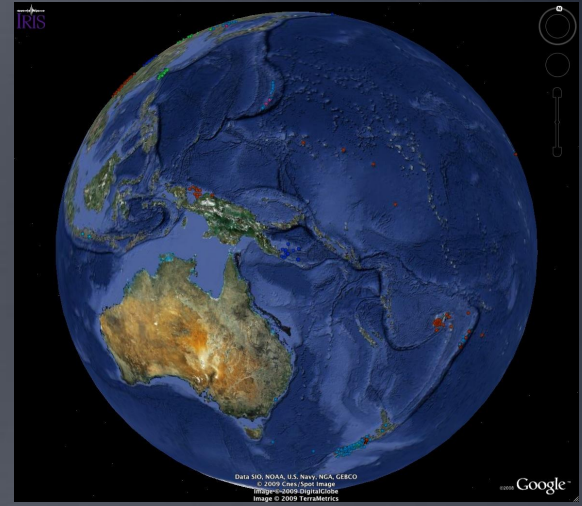
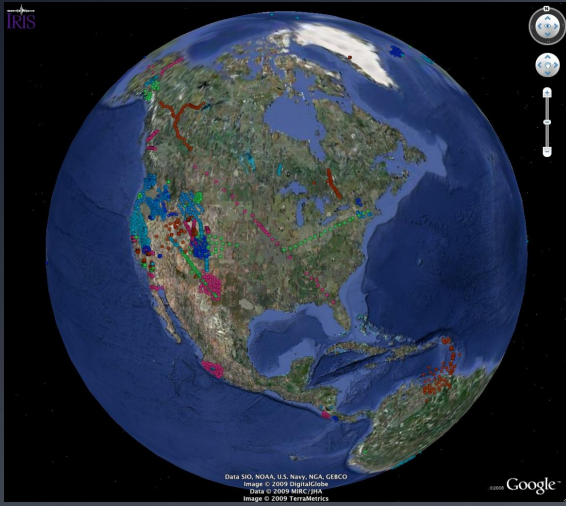
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*2 New Mexico Tech

IRIS-PASSCAL Instrument Center

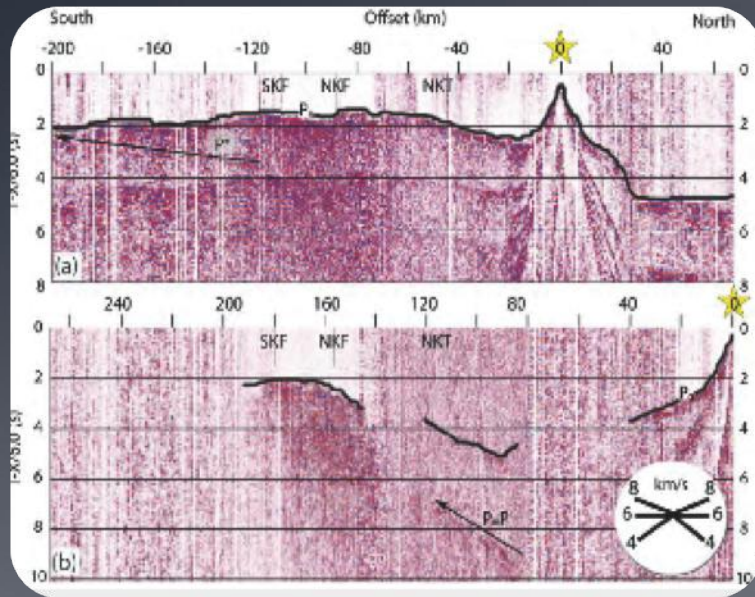
Socorro, New Mexico

Over 4000 PASSCAL stations deployed worldwide since 1990
More than 20 Terra-bytes archived



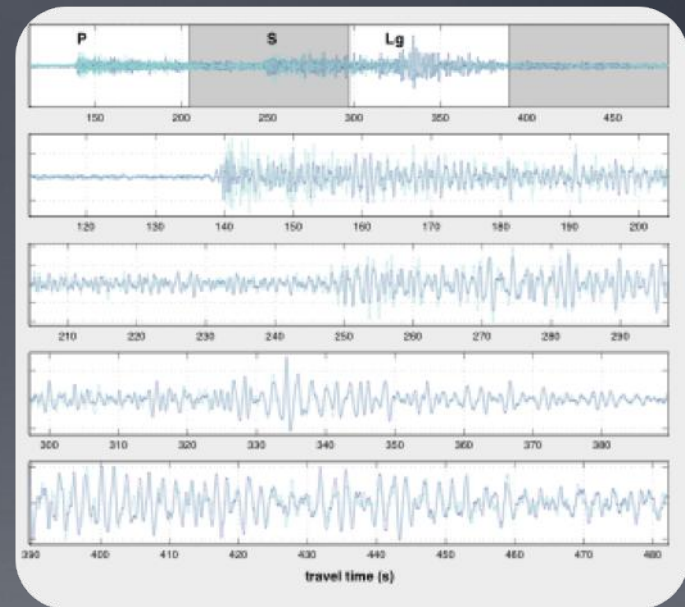
What does it take (toil, treasure, tribulation) to acquire this precious data?

Shot gathers using Texans



INDEPTH IV (Tibetan Plateau)
from Zhao, Klemperer

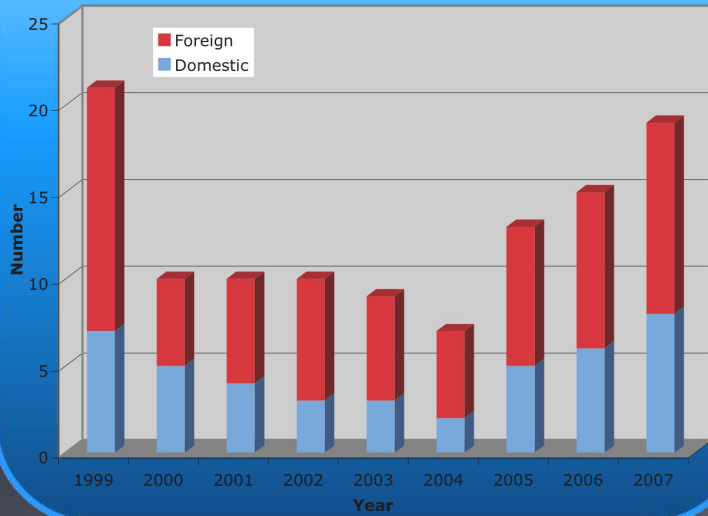
Broadband station seismogram



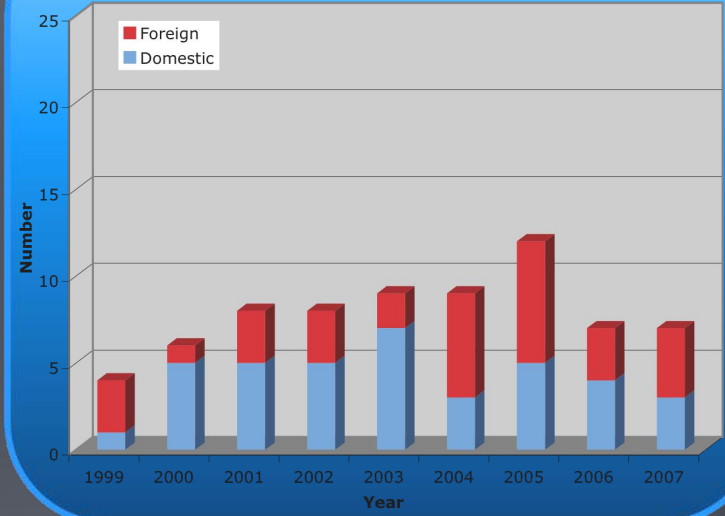
China; from Schaff, Richards

Historical use of PASSCAL Instruments by Type

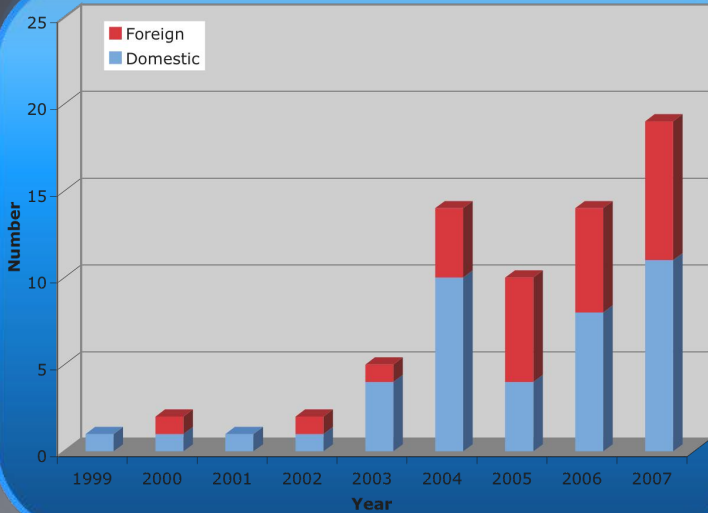
Broadband Experiments



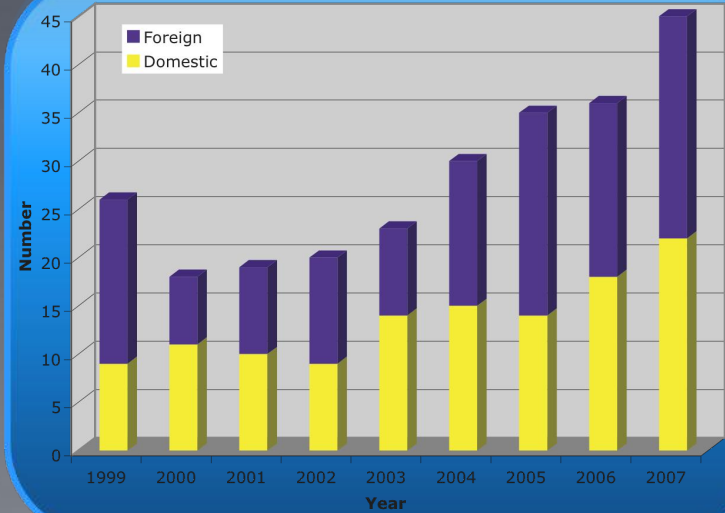
Texan Experiments



Short Period Experiments



Combined Experiments



Compare two theoretical types of experiments

Active Source

- 2000 stations
- 500 meter station spacing
- 2 deployments
- 20 shots
- 250 sps recording

Broadband Passive

- 50 stations
 - 30 Km spacing
 - 5 service runs in 2 year deployment period
 - 40 sps recording
-

A typical active source Texan experiment

Basic Equipment

Single channel
DAS w/ 4.5 Hz
vertical sensor
"Texan"



Transfer case,
programming, data
offload, & transport



Texan programming, data offload



135 such cases and space required for 2000 Texans



Texan deployment

- 12 teams can deploy 2000 stations in 3 days (~56 stns/team/day) = 10 minutes install & 5 minute drive



T. Stern, North Island, New Zealand



W. Zamora, North Island, New Zealand



High resolution Texan experiment, Hill Air Force Base, Utah, A. Levander

Drilling and shooting



INDEPTH IV, Tibet

A typical Broadband experiment

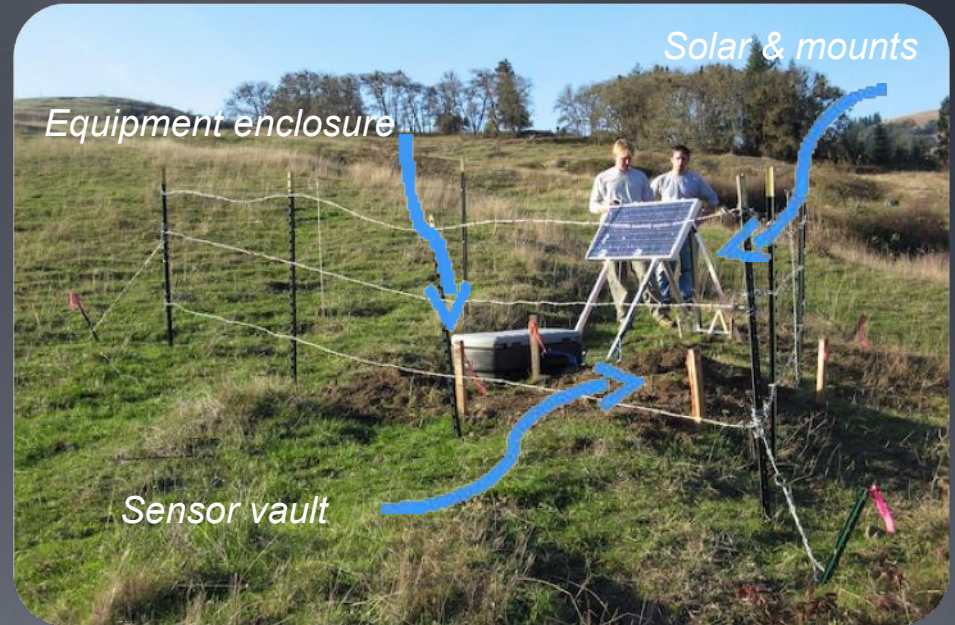


BB sensors

Data acquisition systems



Installed station



Transport of ~30 BB stations from airport



Huddle test stations before deployment



Pack stations in deployment vehicle



Digging in stations (~1 m deep)



Southern Chile 2007, Russo

Setting in vaults, solar and instrument programming



Chile 2004, Beck, Zandt, (L. Wagner, K. Kopper pictured)

Servicing (every 3-4 months recommended)



South-Eastern Tibet, 2003, A. Meltzer (S. Sol pictured)

Data download - processing



*South-Eastern Tibet, 2003
(Zhao, S. Sol, B. Beaudoin,
A. Meltzer pictured)*

Estimated Time

- Total field days for Broadband experiment is ~3x more than active source experiment (46 vs. 125)
- Biggest difference is in multiple service runs needed for BB experiments

Task	Time (dys)	No. People	TXN (ppl-dys)	BB (ppl-dys)
Training and Logistics mtg	2	3	6	
	2	3		6
Pre-experiment coordination	15	1	15	
	15	1		15
Travel - field work - recon -permitting	20	4	80	
	20	4		80
Installation	3	25	75	
	18	6		<u>120</u>
Service	3	25	75	
	50	4		<u>200</u>
Demobilization	3	25	75	
	20	6		<u>120</u>
Data Processing	7	1	1	

Logistics

- Estimated air shipment to Asia (long haul) and local transport (truck, train)
- Averaged costs and size/weight from 3 recent shipments (Taiwan, Tibet, Greece)
- BB example is less volume, heavier and much more expensive to ship

50 BB Stations		2000 Texans	
1 BB stn = 146 lbs		1 Txn stn = 6lbs	
1 BB stn = 0.25 plt		1 Txn stn = 0.008 plt	
1 BB stn = 1.9 pcs		1 Txn stn = 0.095 pcs	
Shipment size weight estimate			
50 BB stns = 7,300 lbs		2000 Txns = 1,200 lbs	
50 BB stns = 12. plts		2000 Txns = 16 plts	
50 BB stns = 95 pcs		2000 Txns = 190 pcs	
Estimated shipping costs			
International air transport = \$3.20/lbs one way			
In country trucking cost > 300 mile = \$1.6/lbs			
50 BB stns air = \$46,720		2000 Txn air = \$7,680	
50 BB stns local = \$11,680		2000 Txn local = \$1,920	
Total = \$58,400		Total = \$9,300	

Estimated data

- Texan deployments can have large volumes of raw data to process (> 1 Terabyte), but relatively small amounts of data to analyze
 - Broadband data is voluminous both in raw form and to analyze
- Value**
- Texan data per byte is more valuable in terms of level of effort and shipping costs

50 BB Stations

40 sps x 3 channels x 2 years = 15.2 Gbytes/deployment
50 stations x 15.2 Gbytes/deployment = **760 Gbyte/experiment**

2000 Texans

256 Mbyte/TXN x 2 deployments x 2000 stations = **1.02 Tbytes**
(possible raw data)
20 shots x 250 sps x 90 sec records x 2000 = **1.8 Gbyte/experiment**

(people effort)

50 BB Stations

549 ppl/dys / 760 Gbyte = **0.72**
ppl/dys/Gbyte

2000 Texans

333 ppl/dys/1.8Gbyte = **185**
ppl/dys/Gbyte

(shipping costs)

50 BB Stations

\$58,400/760 Gbyte = **\$76.8**
/Gbyte

2000 Texans

\$5,167/1.8 Gbyte=
\$5,167/Gbyte

The unexpected ... expect it



Travel is always dangerous
and unpredictable



