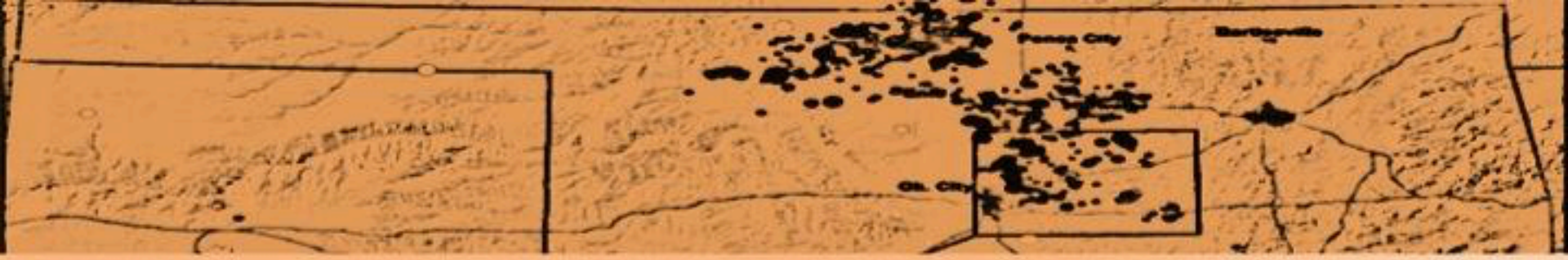

USGS aftershock deployment testing and QC

Austin Holland, Tyler Storm, Dave Wilson, Leo Sandoval, Steve Ploetz, BJ Oakes

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USGS Rapid Deployment/Aftershock Systems

- 17 boxes currently deployed in Oklahoma
- 17 boxes ready for deployment
- Each box contains
  - REFTEK DAS
  - 2G or 4G Episensor
  - Trillium Compact
- 5 Systems for specialized studies
  - Only 3-Channel DAS
  - Trillium Compact

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Vault Styles

Two different “direct-bury” vault styles in use.

- ➔ One is based on a bucket attached to a baseplate with duct-seal
  - Vault is oriented and partially buried and leveled
  - Instruments are leveled inside vault
- ➔ The other is a water-tight enclosure made of corian ends and PVC pipe.
  - Instruments are rigidly mounted in vault and leveled such that the bubble level on lid matches the instrument.
  - Vault is marked with sensor orientation indicators and is leveled and oriented at installation
- ➔ Tests indicate that the noise between the two vaults is comparable, but the sealed vaults take longer to settle.

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Testing Process (Why test in a noisy building when there are quiet tunnels?)

Currently test up to 6 systems at a time

Each Episensor is flipped tested to ensure the gain is correctly identified

The instruments are then noise tested in the ASL library for 3 to days

All equipment from a single deployable system (box) is tested

Proper operation is ensured for

- RT130
- GPS clock
- Recording media
- Backup battery systems & All cables

(Left to Right): Bob Hutt, John Filson, Bob Engdahl, and Jon Peterson

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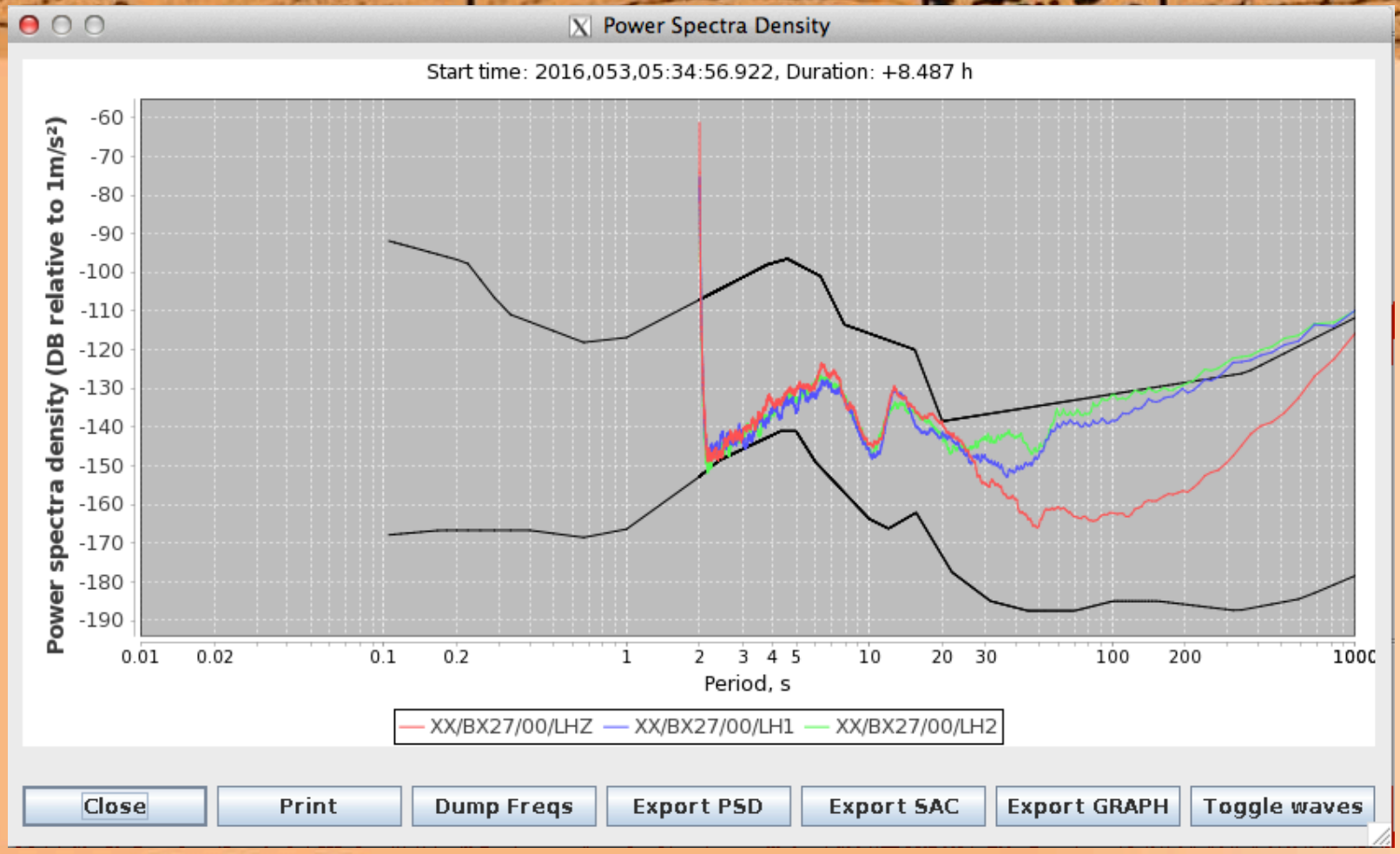
Broadband noise levels in the ASL library



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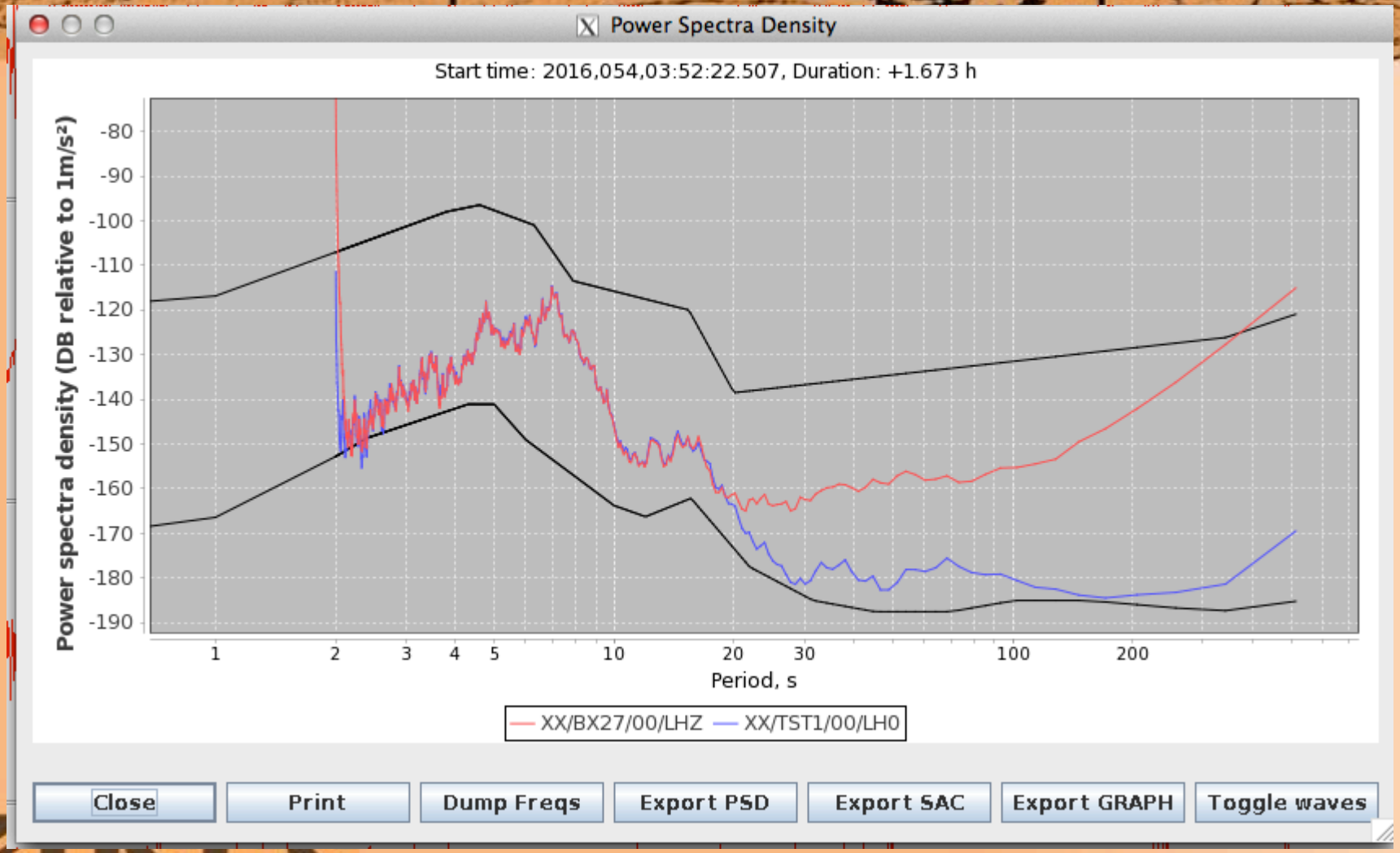
Comparison to a reference Instrument



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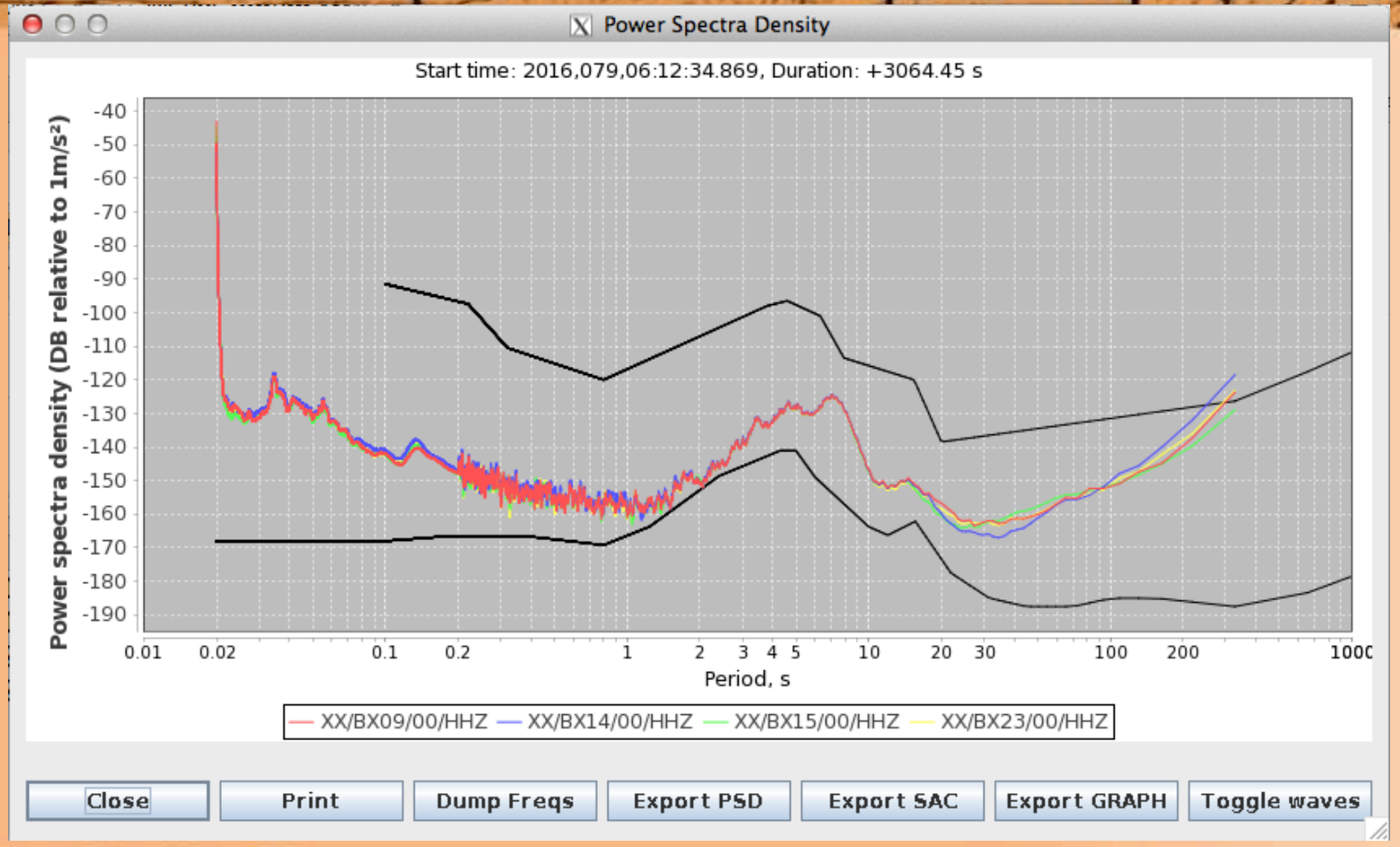
Noise comparisons between systems



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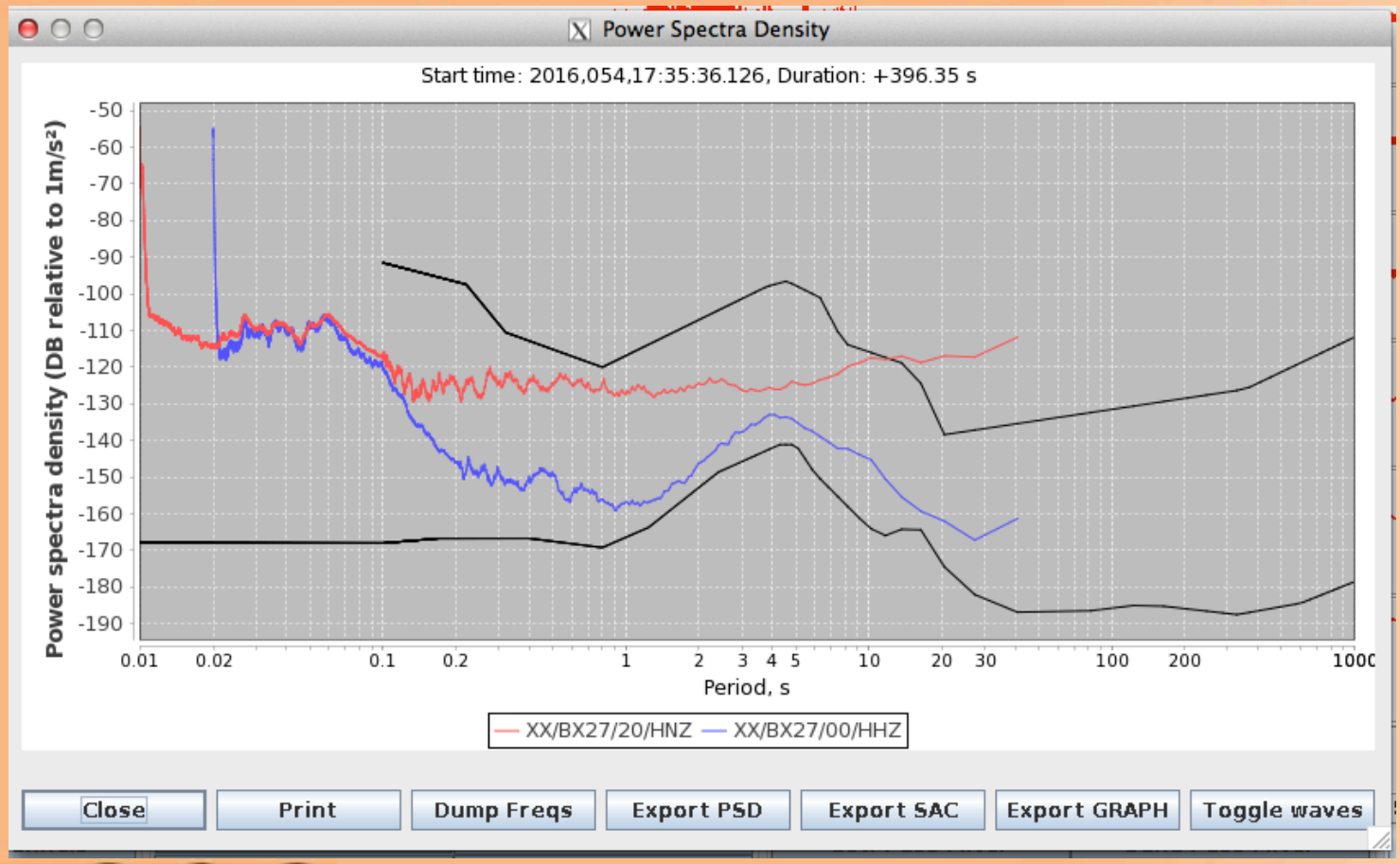
Use noise to validate metadata and response of instruments at higher frequencies



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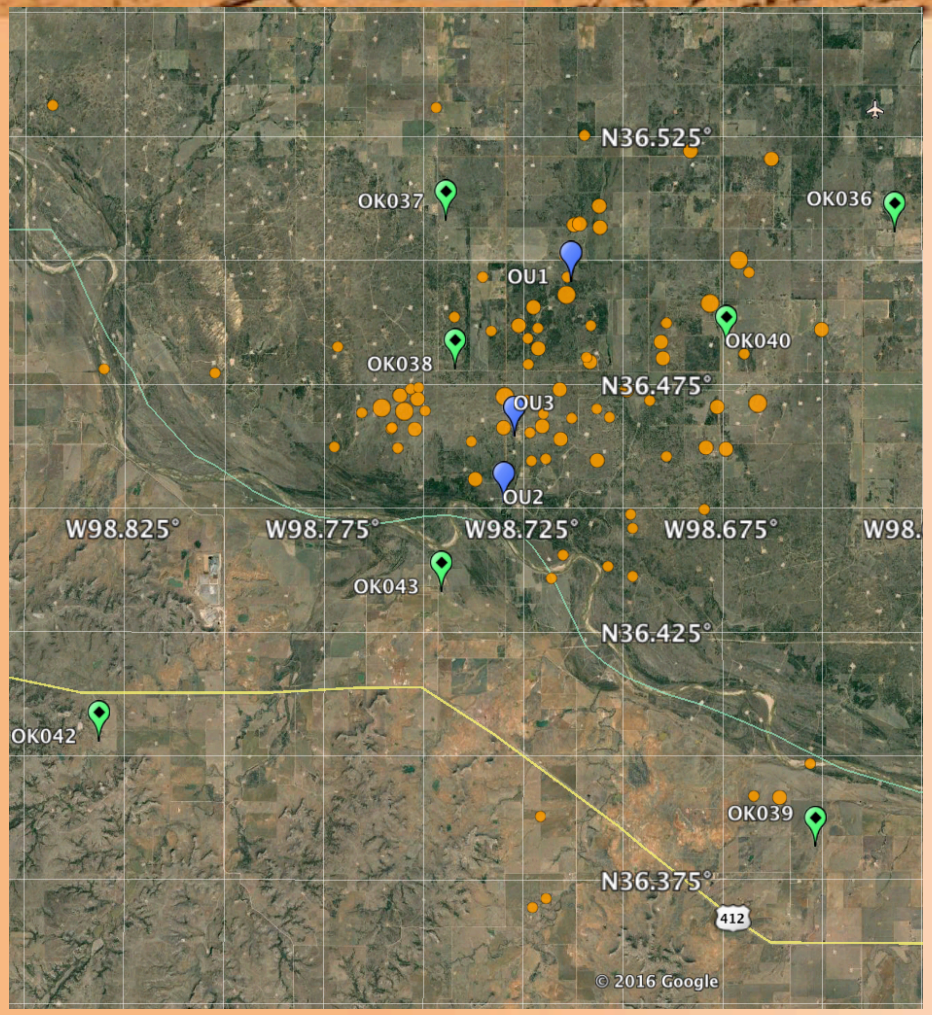
Testing during and after deployment

- Identify any instruments that may have been damaged in transport
- Identify proper equipment installation
- Ensure metadata is properly propagated and accurate
- Episensor flip tests prior to burial of vault
- Initial noise tests are done after installation
  - Identify failing or noisy components
- Use aftershocks to help QC instruments



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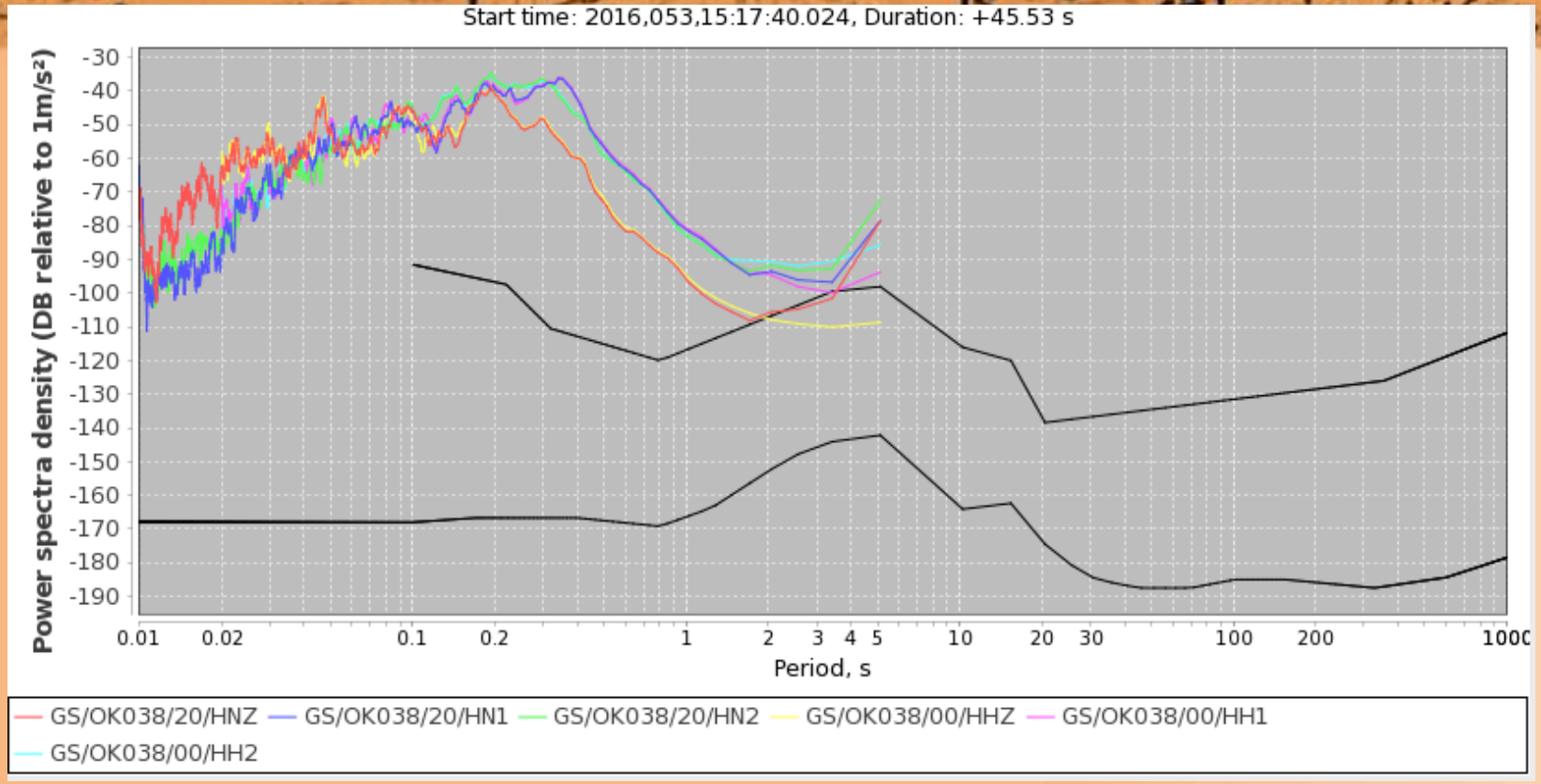
Acceleration PSD for a M3.7 in deployment



Co-located seismometer and accelerometer PSDs directly overlay for the same components.

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DQA For Aftershock Systems

Legend | Station Summary | All | From 2016-03-16 | To 2016-03-23 | Date Format: Date: YYYY-MM-DD | Update

Weights | Export | Columns | Groups

Search: OK

Network	Station	ALNM Deviation: 4-8	ALNM Deviation: 18-22	Availability	Dead Channel	Event Compare Strong Motion	Gap Count	NLNM Deviation: 0.5-1	NLNM Deviation: 0.125-0.25	NLNM Deviation: 4-8	NLNM Deviation: 18-22	NLNM Deviation: 90-110	NLNM Deviation: 200-500	Station Deviation: 4-8	Station Deviation: 18-22	Station Deviation: 90-110	Station Deviation: 200-500	Timing Quality	Aggregate
GS	ADOK			87.5			0											100	95.83
GS	OK025	20.09	19.67	100	1		0	33.89	48.95	19.22	35.41	44.35	52.45	-0.61	17.93	20.92	22.33	100	65.82
GS	OK029	15.34	11.16	100	1		0	33.25	52.95	18.25	31.67	42.66	52.88	-3.22	8.89	8.2	11.14	100	77.85
GS	OK030	10.69	7.2	100	1		0	37.67	54.59	17.53	39.36	53.57	65.21	-2.87	13.46	14.35	19.25	100	66.96
GS	OK031	23.01	23.37	100	1		0	47.86	52.83	31.32	62.1	84.31	92.94	9.46	30.05	39.69	43.57	100	51.91
GS	OK032	22.73	20.91	97.1	1		25	45.59	62.91	21.13	41.74	50.25	58.22	2.24	18.95	24.67	26.79	100	54.84
GS	OK033	33.93	33.57	68.24	1		39	36.15	50.97	19.71	35.31	48.55	58.09	-0.76	0.33	11.52	19.76	100	65.52
GS	OK034	38.83	41.56	94.14	1		40	45.38	51.82	26.35	54.6	68.86	78.08	11.21	30.38	32.35	34.96	100	46.21
GS	OK035	11.27	7.31	100	1		5	42.66	62.81	18.01	39.37	54.95	63.93	-2.75	15.83	21.74	23.22	100	57.32
GS	OK036	15.14	11.07	100	1		3	40.4	59.14	18.22	31.52	40.21	48.7					100	82.57
GS	OK037	11.11	7.21	100	1		6	41.52	59.52	19.48	42.2	57.91	69.88					100	70.25
GS	OK038	10.88	5.61	100	1		0	42.82	70.66	18.4	33.96	43.64	52.61					100	86.92
GS	OK039	16.44	14.09	100	1		0	40.08	51.39	23.04	42.44	55.2	63.92					100	82.1
GS	OK040	74.53	84.12	99.61	1		133	54.6	64.9	28.3	55.24	73.64	84.82					100	61.93
GS	OK041	11.79	8.04	100	1		5	43.75	59.45	19.83	42.21	53.45	61.51					100	73.69
GS	OK042	16.45	14.06	99.99	1		9	40.53	55.47	19.05	40.75	54.09	63.8					100	70.6
GS	OK043	16.18	13.55	100	1		0	41.88	59.1	18.2	35.86	46.56	53.67					100	86.17

Showing 1 to 17 of 17 entries (filtered from 30 total entries)

Have implemented a DQA for short term deployments.

To deal with accelerometer noise we added comparison with Clinton and Cauzzi noise model.

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Why test in a noisy building when there are quiet tunnels?

Test many instruments at once, rapid turn around after deployment

Not disturbing tests and experiments in the quieter vaults

Noise levels are adequate to determine whether equipment is operating and metadata properly characterized

Cultural noise provides the ability to examine response to frequencies dominant in local/aftershock seismicity.

Ensures testing of a complete system and that all components are operational.

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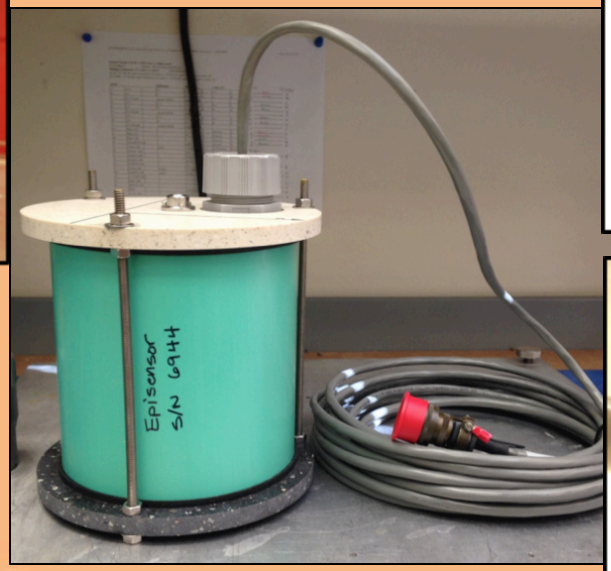
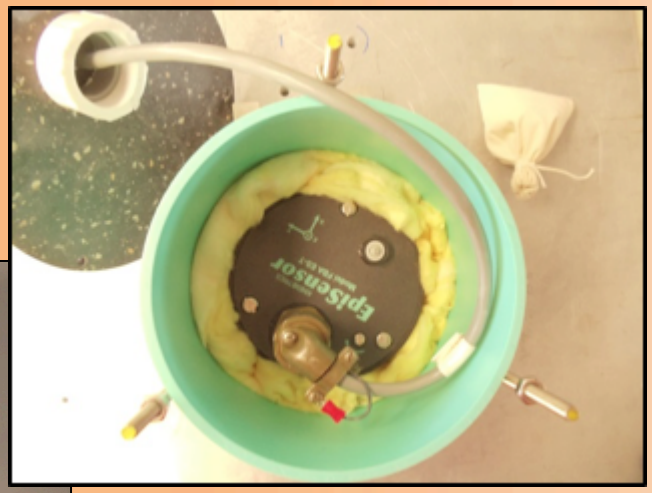
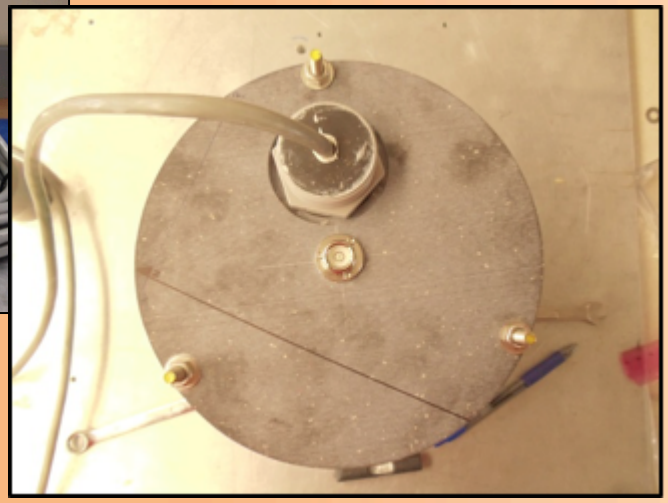
Hutt Vaults







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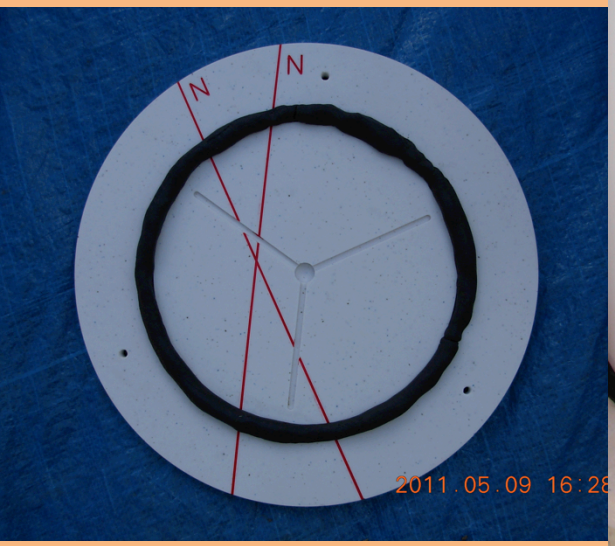
Bucket Vaults



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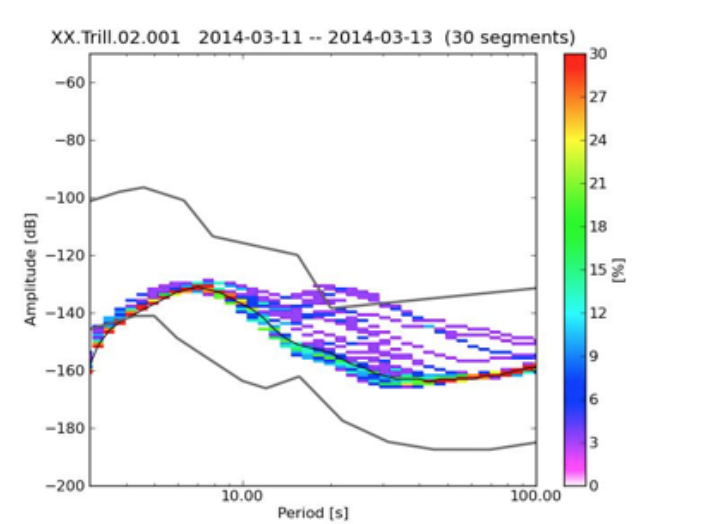
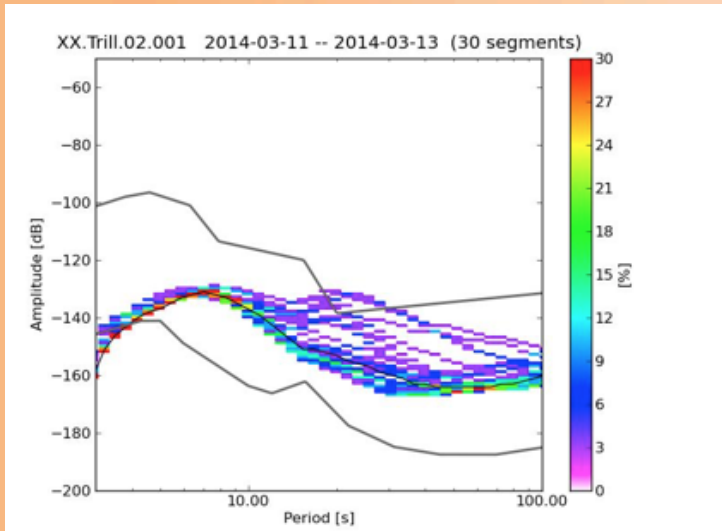
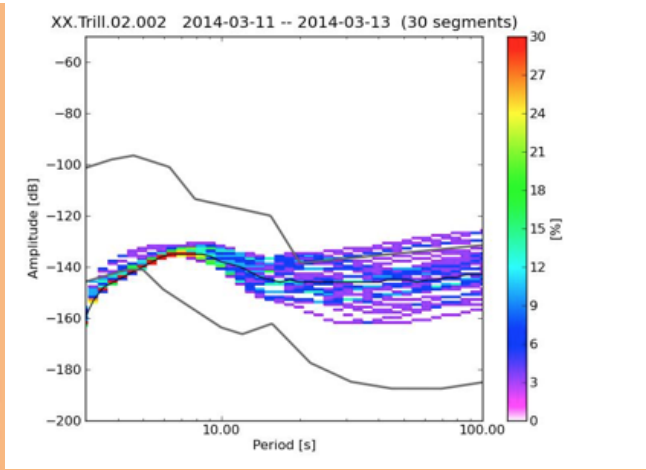
Noise Comparisons

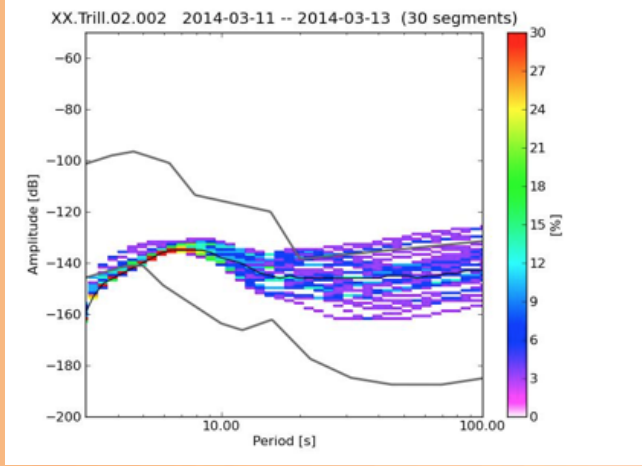
Bucket



Hutt Vault







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