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Southern Great Basin seismic network operations

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Southern Great Basin Seismic Network Operations

PI’s: John Anderson - Glenn Biasi – Ken Smith

Review: January 18, 2007
Subtasks

1. **Record and archive data** from the permanent seismic network.
2. **Process seismic data** into a preliminary earthquake bulletin.
3. (* Maintain the seismic stations, the strong-motion stations, the telemetry network, and the computing lab.
4. (* Prepare and submit a **seismicity report** on a yearly basis
5. (* Maintain and collect data from 3 north-portal boreholes.
6. (* Report on **borehole accelerometers**.
7. **Estimate Kappa** at network stations.
8. (* Implement a recording system at **borehole UZ16**.
9. (* Prepare and submit high-quality papers to peer-reviewed journals on seismic data and interpretations in the YM region.
10. Perform a multi-year **telemetry and station upgrade**.
2004-2006 Preliminary Earthquake Locations within 65 km of YM

- 5413 earthquakes located
- Complete to ~M -0.5 near YM
- LSM aftershock sequence primary source area
- Similar to historical patterns
- Seismicity rates decreasing to pre-LSM levels
- Some small events in YM block

Largest Events 2004-2006

<table>
<thead>
<tr>
<th>M</th>
<th>Location</th>
<th>Date/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2.8</td>
<td>36.49 -116.58</td>
</tr>
<tr>
<td>2.</td>
<td>3.2</td>
<td>36.40 -116.90</td>
</tr>
<tr>
<td>3.</td>
<td>3.3</td>
<td>36.71 -116.05</td>
</tr>
</tbody>
</table>
Seismic Network IP Upgrade and Network Subtasks:
- Existing network communications frequencies could be auctioned
- 1980's seismic instrumentation no longer supported by vendor
- Implement IP communications
- Replace data loggers
- Install 3 ESF/Surface pairs
- Instrument 3 Pad boreholes
- Install data acquisition system at borehole UZ-16

Network Status:
- IP communications from UNR to Skull Mountain, Yucca Mountain, ESF
- 23 new data loggers in place; 23 older instruments in operation
- 11 instruments are prepped to install
- Angel Peak to Skull Mountain link in place
- UZ-16 data acquisition system operational
- Borehole accelerometers in operation
- ESF/Surface Pairs in operation

Planned:
- Shoshone Peak Harris IP radio for access to northern NTS stations
- Angel Peak to UNLV Canopy backhaul 30 Meg radio
- Sober Peak IP Harris radio
- Priority - all stations in Yucca-Skull com-link
Antelope Seismic Software Application

- Receives “live” data from YM stations
- 2-3 Gigabytes per day of waveform data
- Automatic real-time locations and magnitudes
- Relational database data management system
- Interactive event location tools for event review
- Event and continuous waveform archives
- Preliminary auto-event locations are broadcast via email and posted on the web

- Data submittals to the project under IPR-001
- Software qualification for version 4.8 underway
- Developing remote communications tools for some routine maintenance and network operations activities under PHP
- Procedures are being rewritten to adapt to new IP environment and new technologies
Analysis Results

- Tomography
- Backwall
- UZ16
- Kappa
Analysis Results

• Tomography
• Backwall
• UZ16
• Kappa
Unfiltered Backwall Recordings

1-2 Hz

0.5-1.0 Hz

2.0-4.0 Hz
Coherence
(record similarity with phase lag)

Backwall Verticals 60 m Spacing
Cross Correlations with Zero Lag

Backwall Verticals
60 m Spacing
Analysis Results

• Tomography
• Backwall
• **UZ-16**
• Kappa
P-wave velocity

UZ-16 Earthquake Records

S-wave velocity
Analysis Results

- Tomography
- Backwall
- UZ16
- Kappa

Japanese Borehole Strong Motion Records

$\sim e^{-\pi \kappa f}$
Preliminary, non-Q kappa estimates, for constrained stress drop and specialized assumptions

<table>
<thead>
<tr>
<th>Station</th>
<th>Model 9</th>
<th>Time (ms)</th>
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</thead>
<tbody>
<tr>
<td>AL5</td>
<td>30.1</td>
<td>36.3</td>
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<tr>
<td>AMD</td>
<td>36</td>
<td>31.5</td>
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<tr>
<td>BTW</td>
<td>15.4</td>
<td>33.8</td>
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<tr>
<td>BYMS</td>
<td>28.8</td>
<td>22.9</td>
</tr>
<tr>
<td>CAF</td>
<td>25.1</td>
<td>13.8</td>
</tr>
<tr>
<td>CRF</td>
<td>42.1</td>
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<tr>
<td>DOM</td>
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<td>47</td>
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<tr>
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<td>33.7</td>
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<tr>
<td>FOCS</td>
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<tr>
<td>FRG</td>
<td>30.5</td>
<td>33.7</td>
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<tr>
<td>LEC</td>
<td>33.9</td>
<td>27.5</td>
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<tr>
<td>LSC</td>
<td>38.7</td>
<td>23.2</td>
</tr>
</tbody>
</table>

Kappa is in units of milliseconds
Testing different ways to measure kappa.
It is difficult for small earthquakes
Some Issues

• Is there magnitude dependence?
• Does smaller kappa --> larger ground motions?
• Is there a source term?
• Are we measuring the same thing at M~1,4,7?
• Relationship to site conditions
Vs30 Results for YM Area Locations

- Web display and mapping of results
  - [http://mapserver.library.unr.edu/website/seismoweb/VS30/viewer.htm](http://mapserver.library.unr.edu/website/seismoweb/VS30/viewer.htm)
**Summary**

- Seismic network data allows us to obtain results that are important for seismic design of the repository

- Network upgrade is on schedule; dependent on yearly funding
- UZ-16 and borehole accelerometer activities are complete and Q
- Data has been submitted to project
- Consolidation of seismic network software QA is underway
- Procedures are being adapted to new network environment