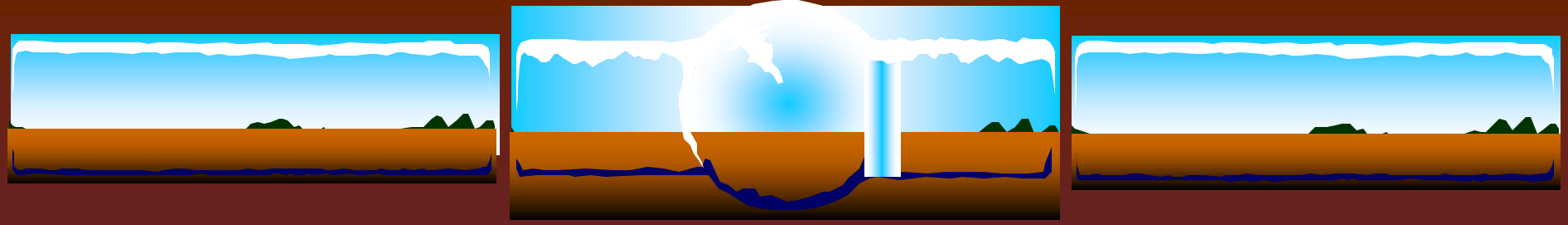


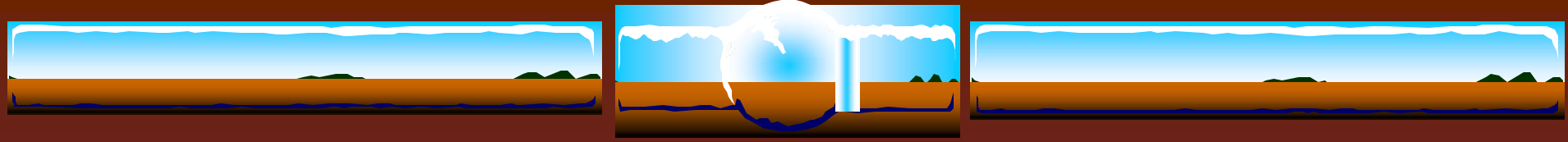
DOE's EGS Program Review

- **Evaluating and Managing the Impact of Induced Seismicity on EGS**

- E. L. Majer
- LBNL
- 510 486 6709, fax 510 486 5686
- elmajer@lbl.gov

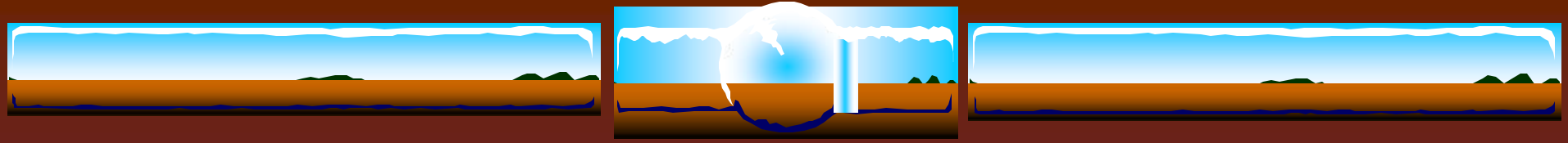
July 18, 2006

Marriott Hotel
Golden, CO



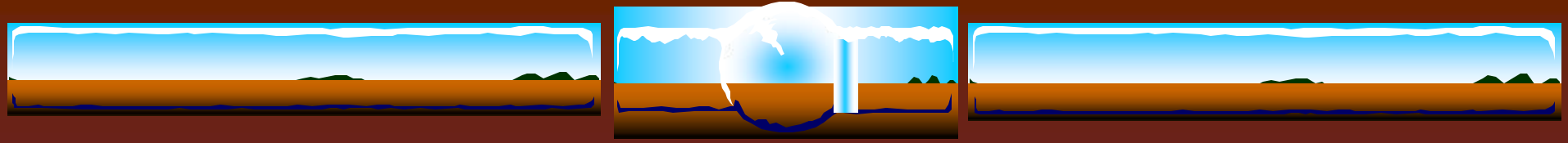
Project Objective

- Provide information to evaluate and manage the effect of induced seismicity from EGS activities.
  - Will induced seismicity concerns prevent EGS from reaching its goal?
- Provide high quality comprehensive data base.
  - To public as well as to the scientific community
- Provide critical parameters to monitor in order to to optimize production as well as control seismicity.
    - Implications for injection and production strategy
    - Impact on local community
    - Impact on operations
- Interface with other EGS projects to accelerate knowledge and results.



EGS Problem

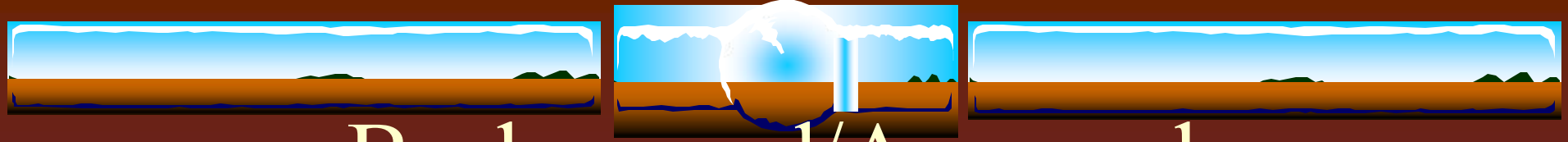
- Seismicity may be Achilles' heal, addressing this issue now is required for EGS to be successful
- Identify gaps in knowledge on EGS induced seismicity
  - Mitigation
  - Reservoir management
- Need to establish a consensus opinion of mitigation and monitoring protocols



Seismicity and Geothermal Areas

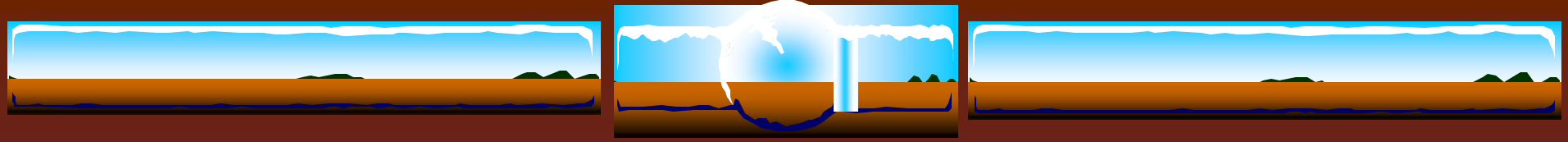
- Seismicity has been shown to be associated with many geothermal areas
  - Injection and production
  - "natural" and artificial (hydrofracture)

- Are there different criteria for different EGS applications.
  - Naturally fractured systems
  - Artificially fractured systems (hydrofractured systems)



Background/Approach

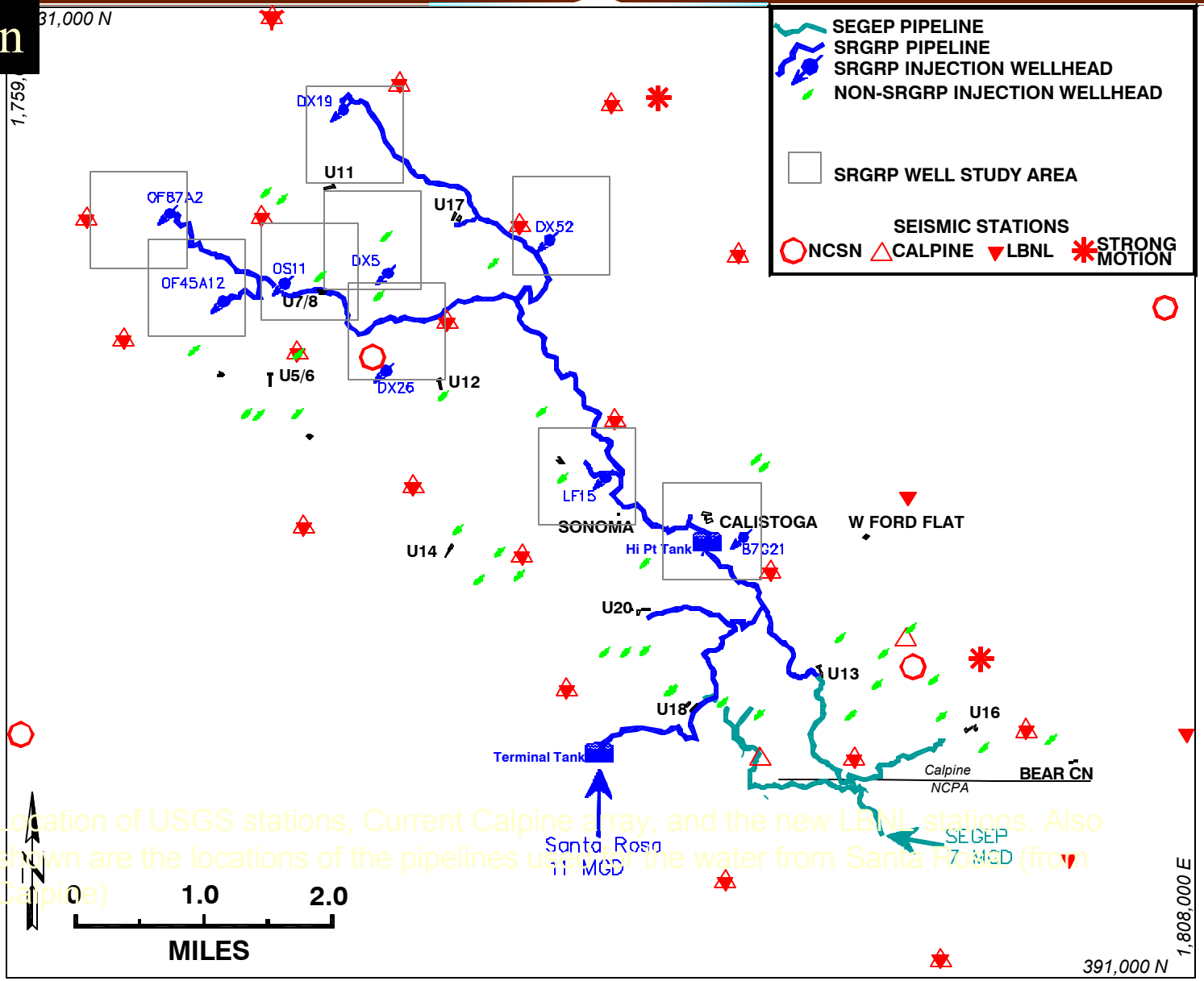
- Initial focus was on The Geysers.
  - Large background data base
  - NW Geysers a large potential source of EGS production (Aidlin/Ottobani Ridge area)
  - Utilize and expand existing LBNL array for providing data to the community and other researchers
  - Leverage DOE project with CEC project
  - Investigate underlying cause and utility of seismicity as well as ability to mitigate seismicity
- Current Focus on Desert Peak
  - Integrate and apply results to other EGS projects.
- Gather resources, input and expertise from international community
  - Workshops, meetings and shared data and experience.



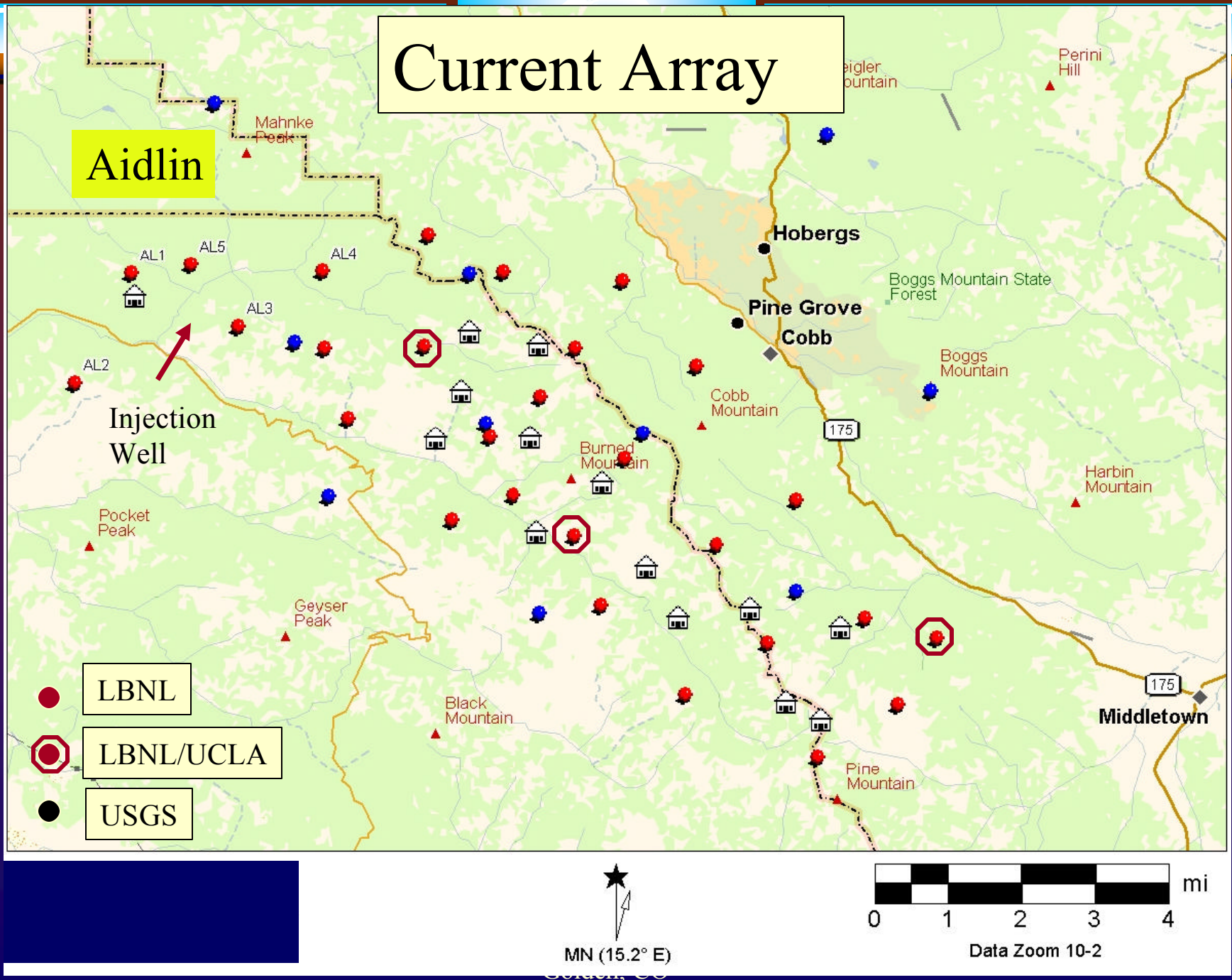
Results/Accomplishments

- New information on induced seismicity will be generated for mitigation purposes and reservoir management
  - Broad band (<1 sec to 100 hz), Source mechanisms and parameters
  - Correlation with geomechanical, geochemical and Res Eng studies
- Unique data sets
  - Research community
  - Public
- Comprehensive white paper developed with international cooperation (EGS seismicity not a barrier)
  - Three workshops and IEA participation
- Have formed a basis for a protocol to be used in EGS applications

Aidlin

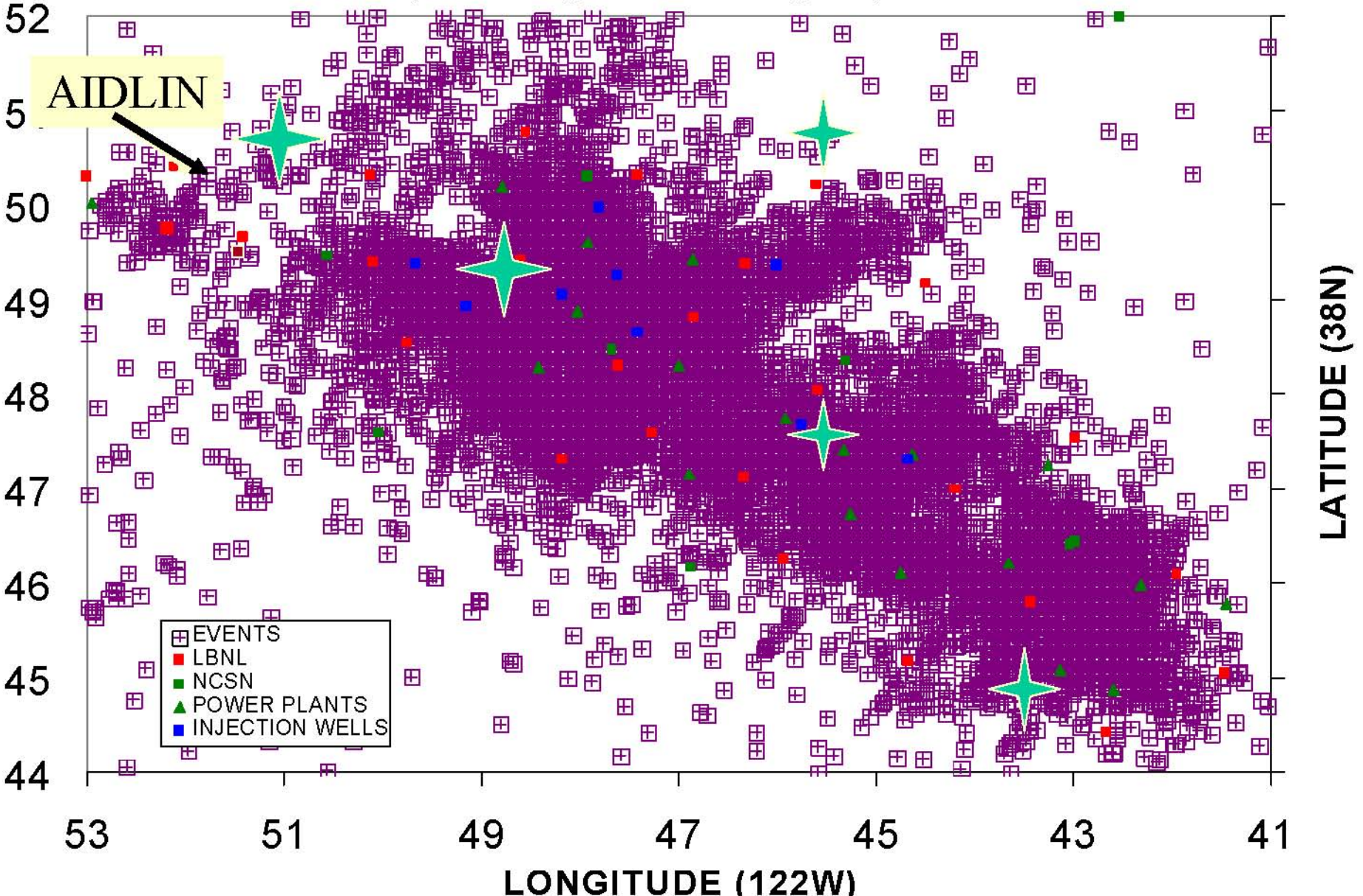


Location of USGS stations, Current Calpine array, and the new LBNL stations. Also shown are the locations of the pipelines used for the water from Santa Rosa (from Calpine)


Current Array
Aidlin
Mahnke Peak
Perini Hill
Hobergs
Boggs Mountain State Forest
Pine Grove
Cobb
Boggs Mountain
Cobb Mountain
AL1
AL5
AL4
AL3
AL2
Injection Well
175
Burned Mountain
Harbin Mountain
Pocket Peak
Geyser Peak
Black Mountain
Pine Mountain
Middletown
LBNL
LBNL/UCLA
USGS
MN (15.2° E)
0 1 2 3 4
mi
Data Zoom 10-2

All events Oct 2003 - June 2006

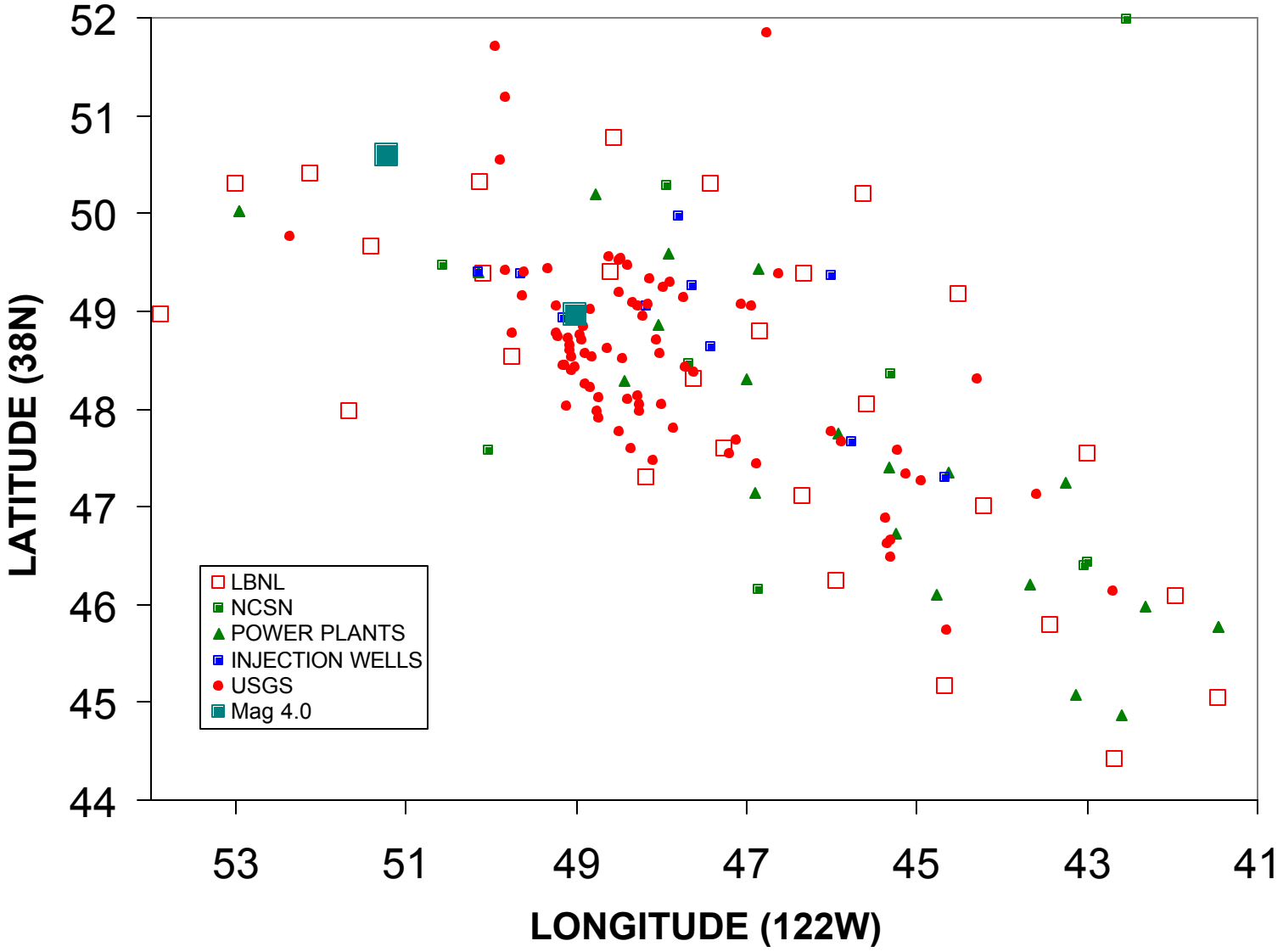
(310 Mag >2, 23 mag >3)



2006

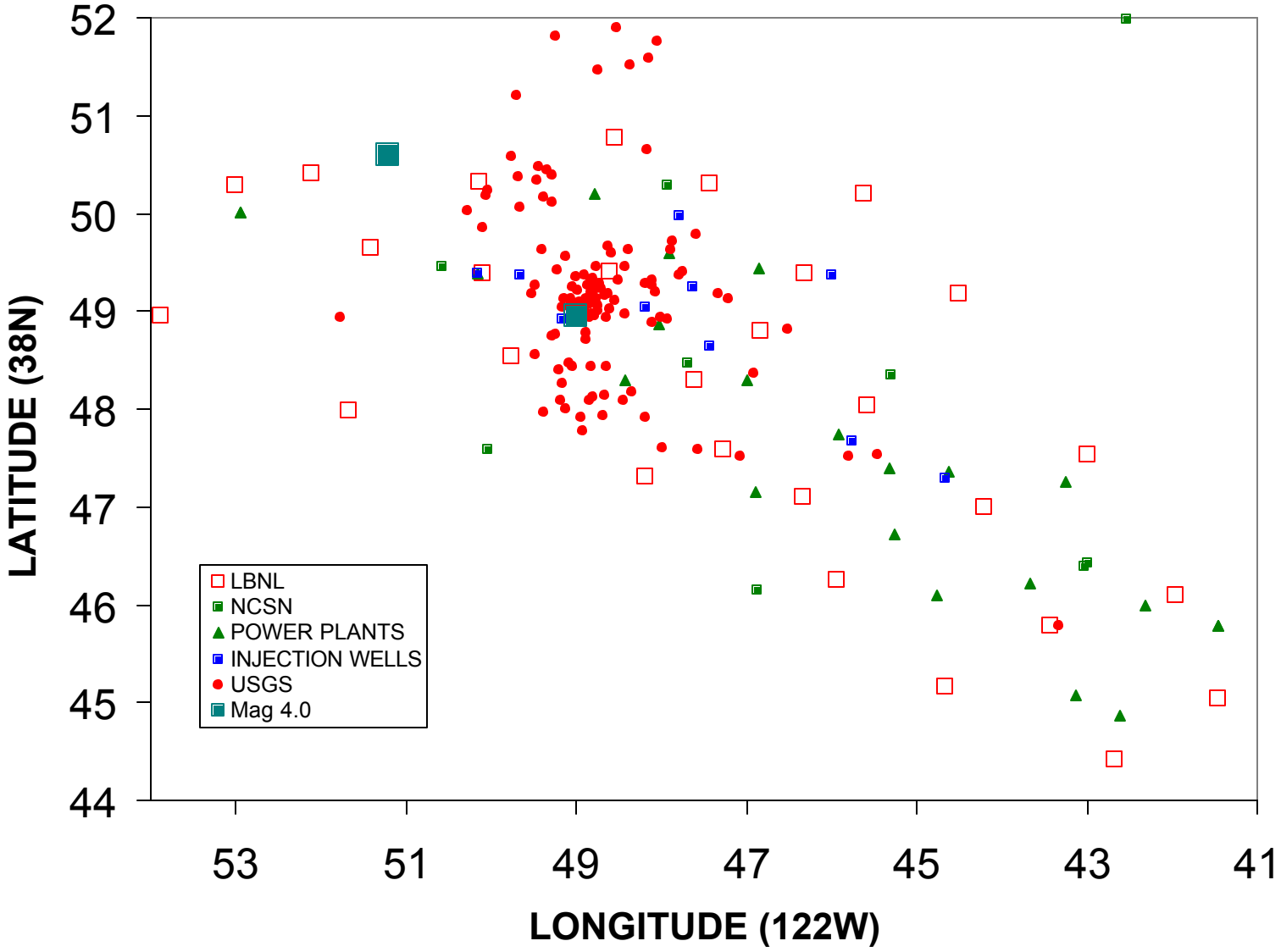
May 10, 0:00 - May 12, 10:37

Before



May 12, 10:37 - May 13, 16:00

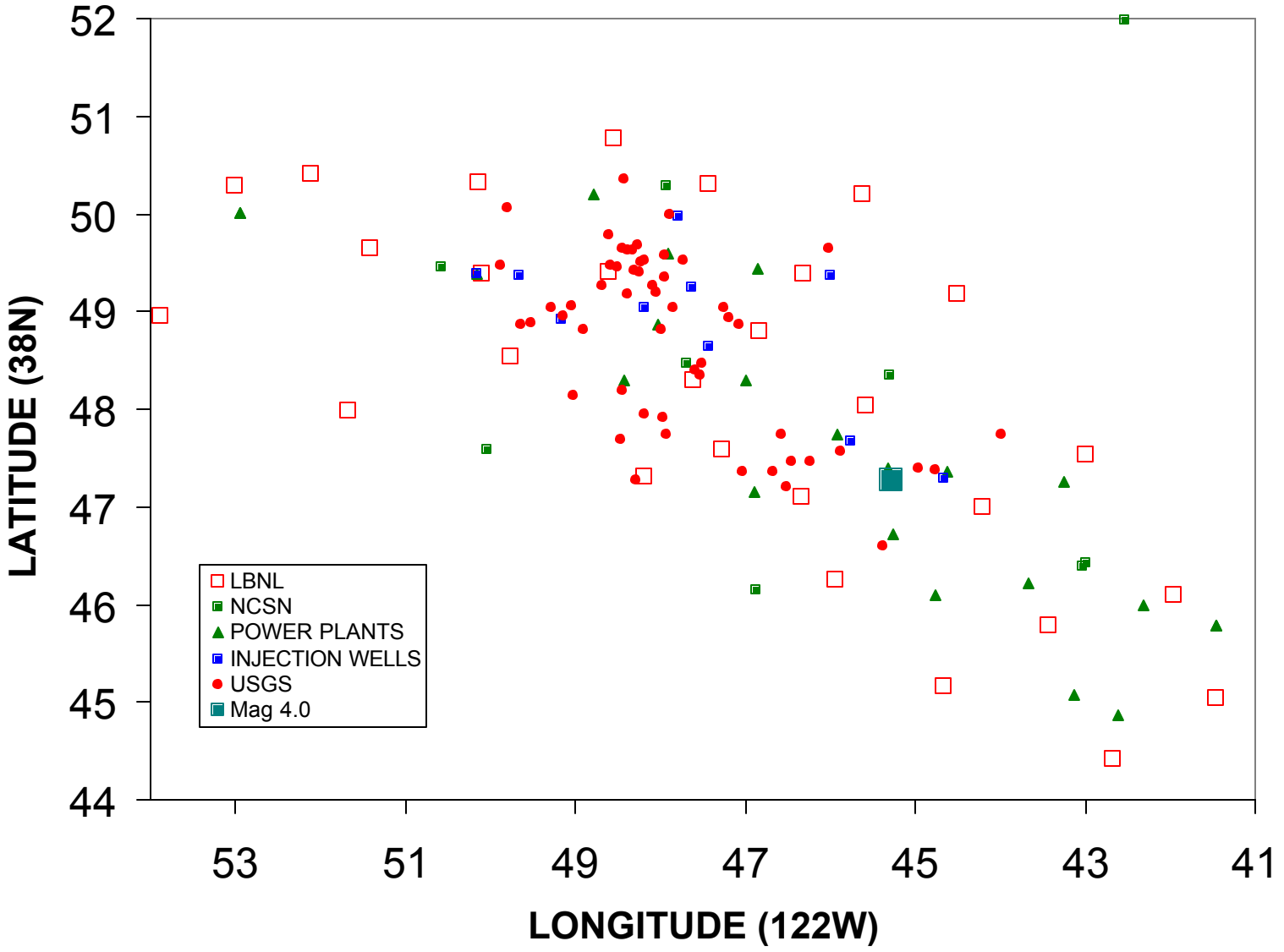
After



2005

May 7, 0:00 - May 9, 22:37

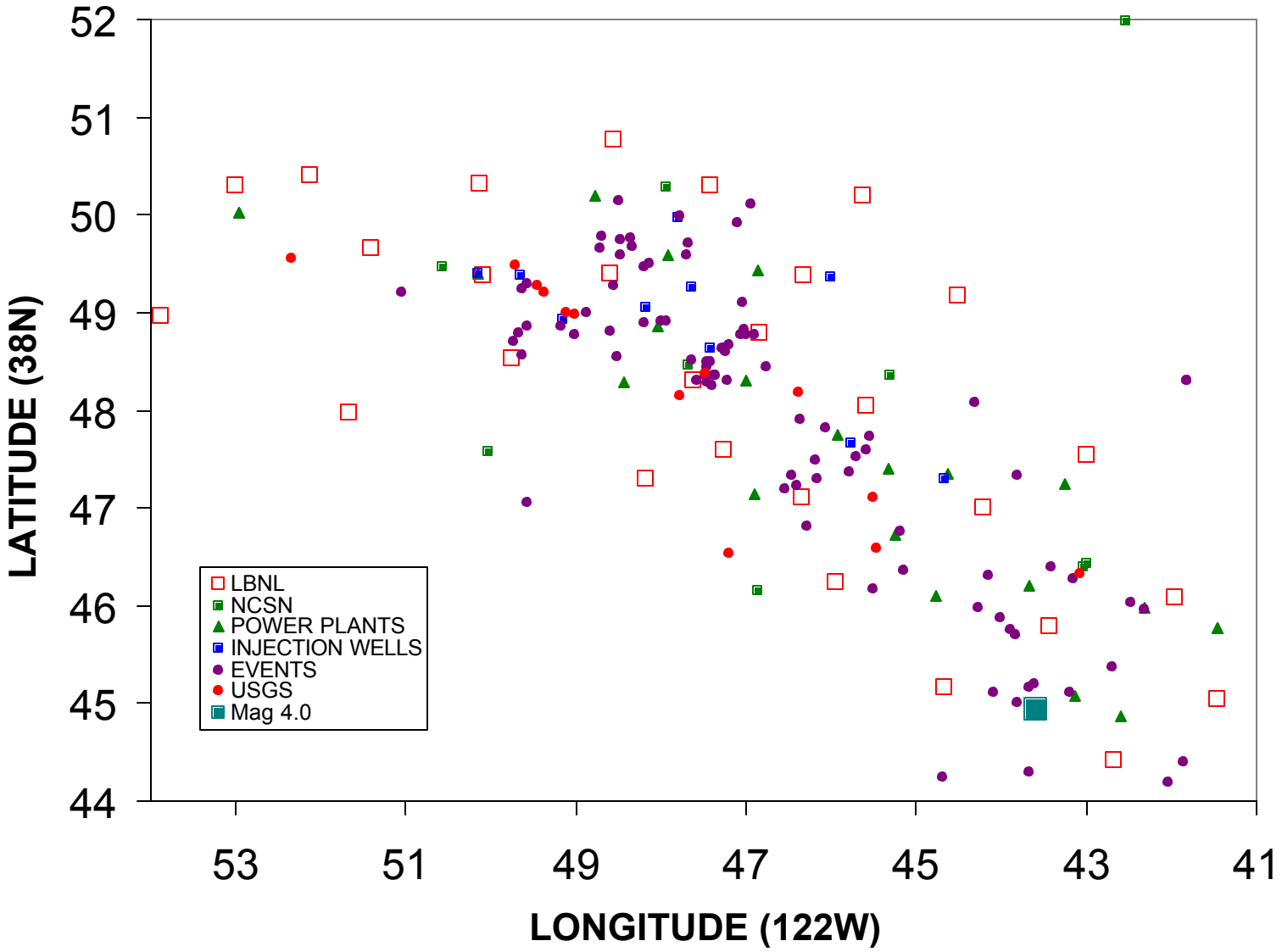
Before



2004

Dec 26, 0:00 - Dec 27, 10:37

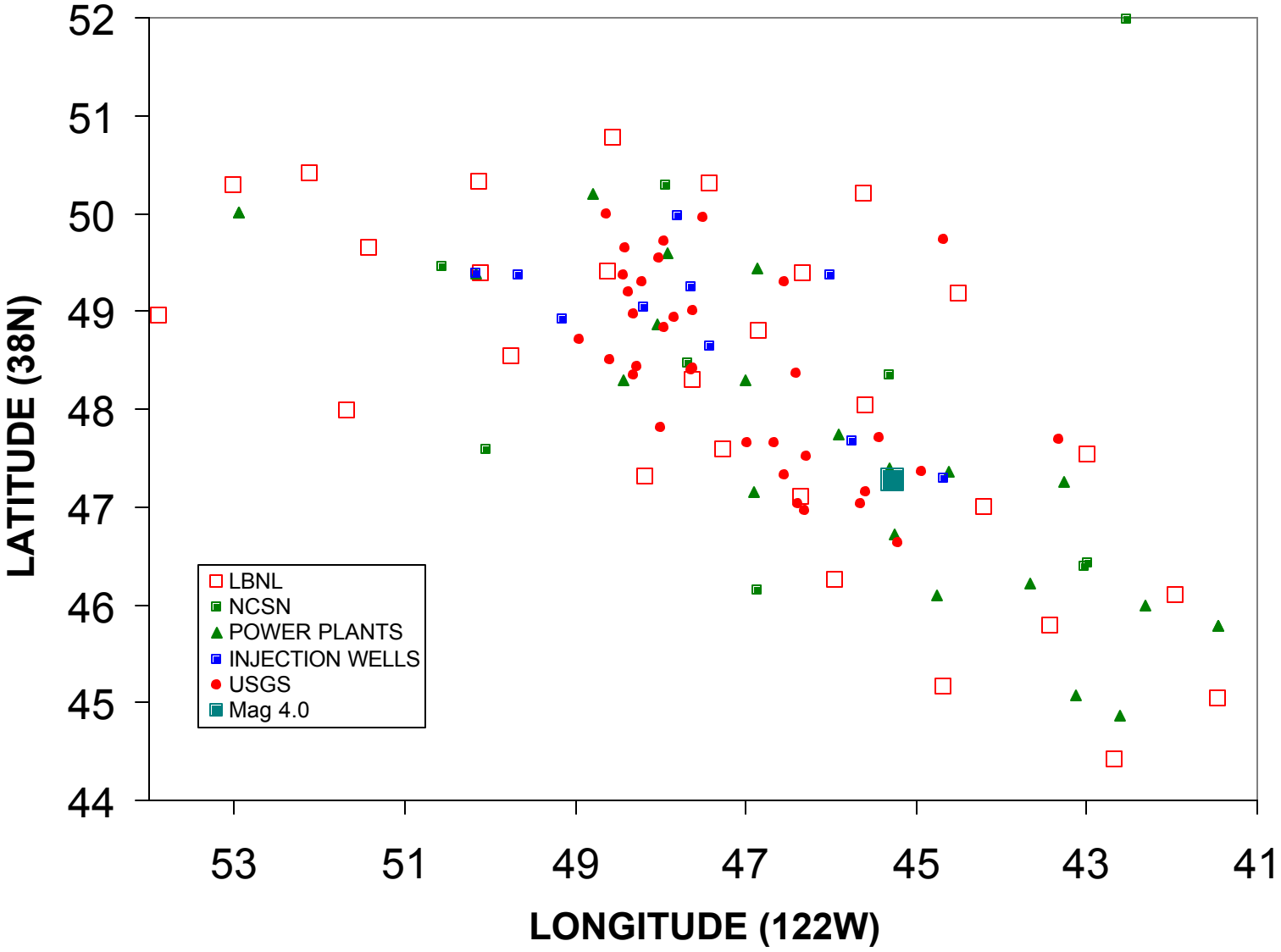
Before



2005

May 9, 22:37 - May 12, 00:00

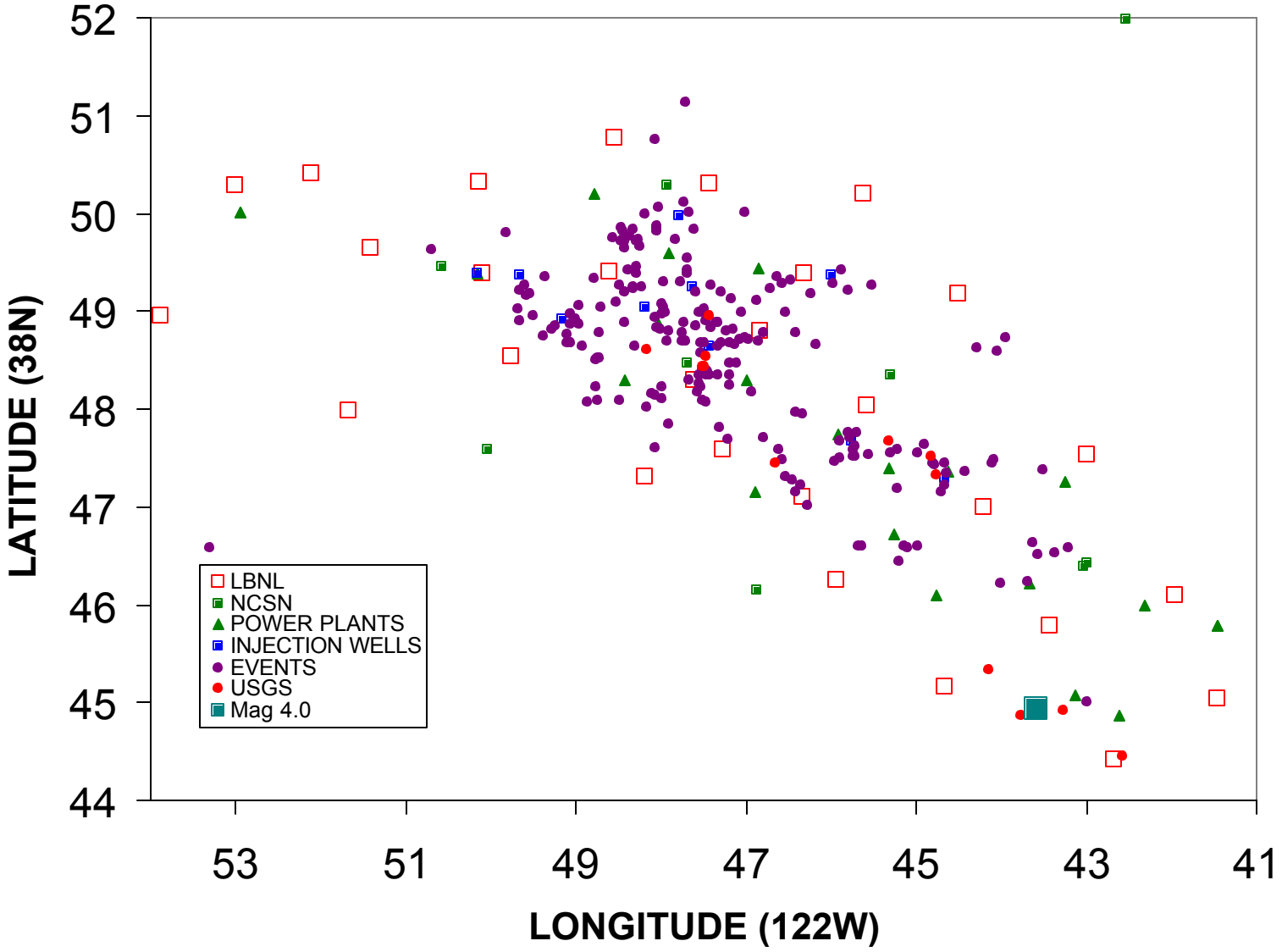
After



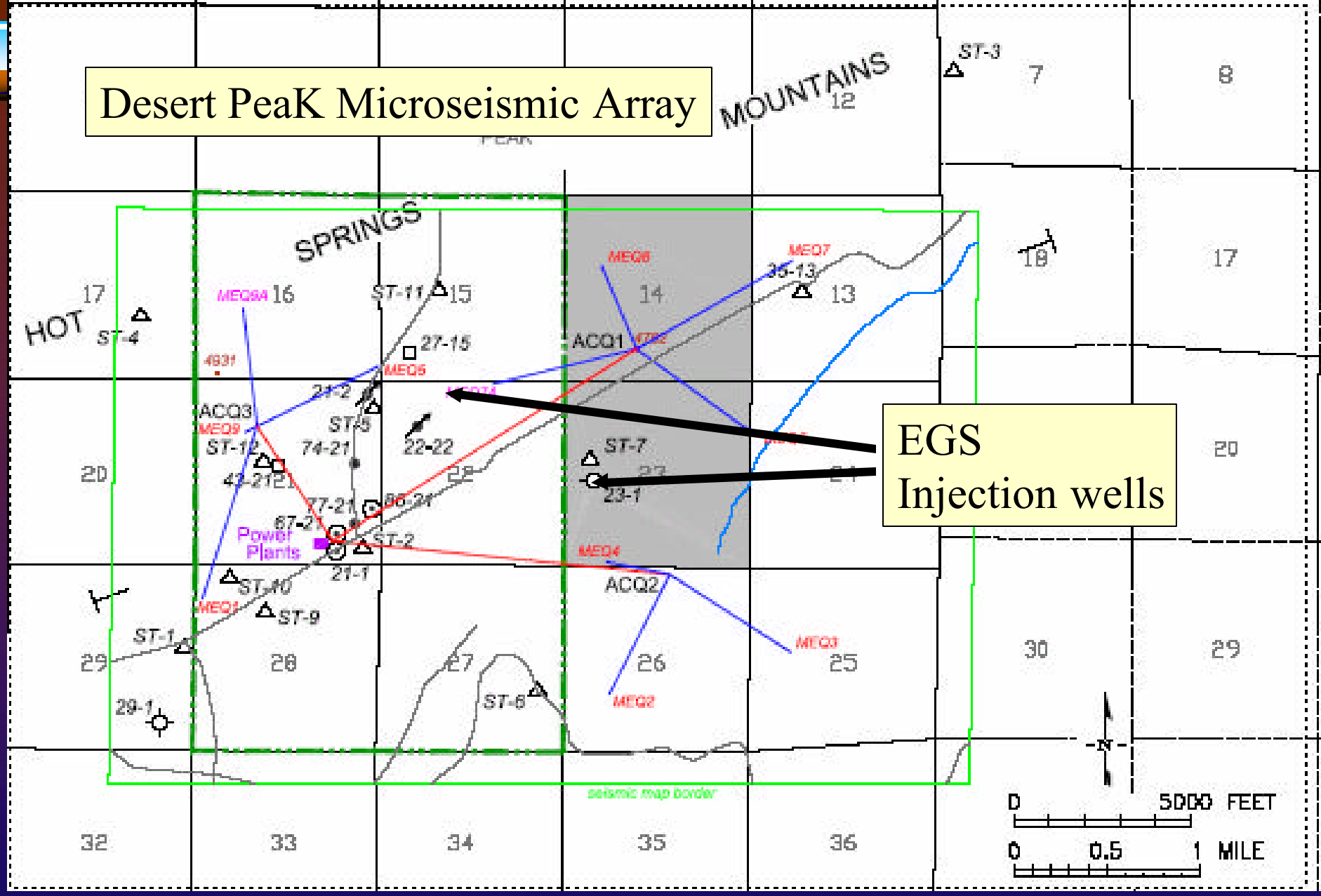
2004

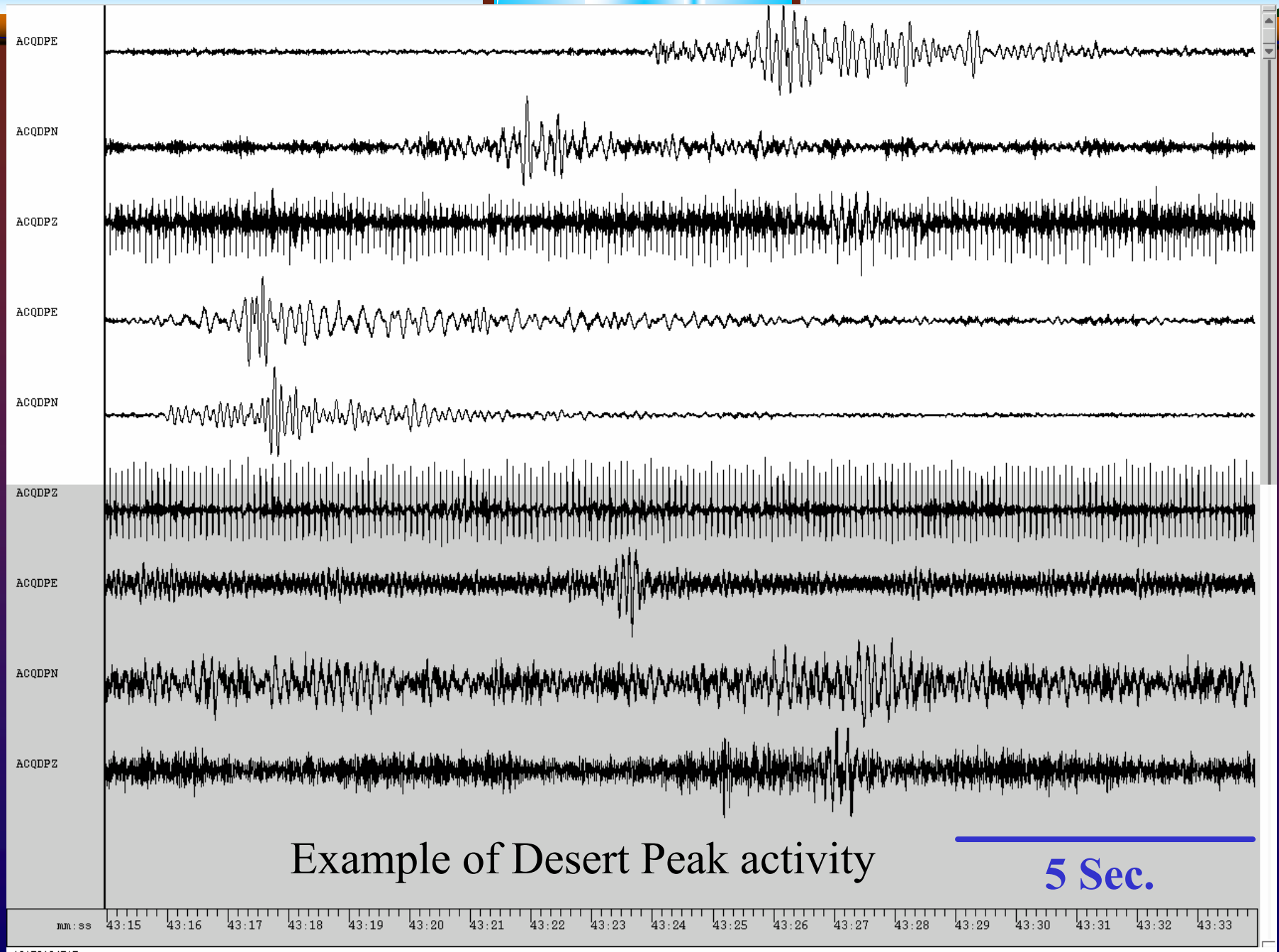
Dec 27, 10:37 - Dec 29, 00:00

After



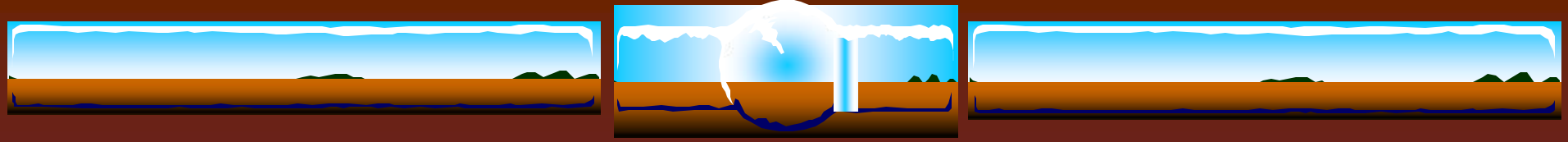
Desert PeaK Microseismic Array





Example of Desert Peak activity

5 Sec.



Conclusion

- Yes, project objectives will be reached
  - Prevent induced seismicity from becoming a roadblock to EGS
  - Real Time publicly available dataset
  - Improved understanding of induced seismicity mechanisms will allow not only mitigation but improved reservoir management