

EDGES MEMO #012

RFI MEMO #027

**MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886**

November 2, 2006

Telephone: 781-981-5407

Fax: 781-981-0590

To: RFI Group
From: Judd D. Bowman
Subject: RFI Scout Trip to California and Nevada

A short expedition was conducted May 28 through May 31, 2006, to visit various locations in east-central California and central Nevada in order to acquire basic RFI measurements. The goal was to access the general applicability of the locations as potential sites for the EOR global signature experiment, EDGES. The target frequencies were roughly 100-200 MHz. Over the three days, about 20 regions were visited for brief durations.

All locations were in remote regions, and in many cases were 10-100 miles from the nearest (even modestly) populated area. Valleys were targeted due to the hypothesis that the mountains surrounding them would offer natural RFI protection. In the case of at least three locations: Deep Springs CA, Monitor Valley NV, and Panamint Valley CA, the surrounding mountain ranges reached ~11,000 feet above sea level and were at least 5,000 feet above the valley floors. It was found that, even in these remote areas, radio and microwave repeater stations were present on the mountaintops around most of the valleys. Nevertheless, each location had better RFI characteristics than Haystack. The initial target of interest, Deep Springs CA, may not be the best site from an RFI perspective. Panamint Valley CA and Joshua Tree CA emerged as potentially better sites. Figures 1 – 3 show the locations of the sites and Figures 4-8 are photographs.

A portable spectrum analyzer (Spectrum Master) was used in conjunction with a small, handheld disc-cone antenna. In some cases, an additional single-pole antenna (~1 m) was also used. At a minimum, spectra were acquired at each location from 50 to 250 MHz with 10 kHz resolution bandwidth. The spectra were saved to memory in the spectrum analyzer and downloaded to a laptop at a later time. Unfortunately, the bulk of the downloaded spectra appear to be decimated to ~500 kHz resolution. The Joshua Tree CA data, however, were saved in 30 MHz windows and offer a good example of the RFI properties of these sites at better than 500 kHz resolution bandwidth. Plots of all spectra are attached.

I believe it remains unclear whether a location in this region will be sufficient for the final EDGES measurement.

Additional images and raw data can be found at:
<http://web.mit.edu/jdbowman/www/eor/edges/>

A summary of the sites follows:

Death Valley, CA

- **Site 1 (2006-05-30, 10:30 AM):** Along HWY 190 W at mile marker 93. By dunes, a few miles from Stove-pipe Wells.

Data:

DEATH VALLEY 1 -- disc-cone antenna
DEATH VALLEY 2 -- single-pole antenna

- **Site 2 (2006-05-30, 1:40 PM):** About 2 miles south of Mormon Point.

Data: DEATH VALLEY 3 -- disc-cone antenna

- **Site 3 (2006-05-30, 2:20 PM):** Leaving Death Valley on HWY 178 at intersection with Furnace Creek Wash Road (dirt), shortly before intersection with HWY 127.

Data: DEATH VALLEY 4 -- disc-cone antenna

Deep Springs, CA

- **Site 1 (2006-05-28, 5:45 PM):** Located on the southwest side of the valley. Somewhat above the valley floor, at mile marker 39 along HWY 168. An electric fence was about 100 ft away.

Data: Deep Springs 1

- **Site 2 (2006-05-28, 6:00 PM):** Located on the floor of the valley at mile marker 42.5 along HWY 168, shortly after descending in from the southwest. Three FM radio stations were easily found by the car radio: 92.5, 93.3, and 96.1. An electric fence was also within 100 feet from this site.

Data: Deep Springs 2

- **Site 3 (2006-05-28, 6:10 PM):** Located on the northeast side of the valley floor, directly in front of the Deep Springs Ranch, about 0.5 miles off HWY 168. No electric fence was nearby and the measurement was performed about 50 feet from the car.

Data: Deep Springs 3

- **Site 4 (2006-05-28, 6:30 PM):** Located on the floor of the valley directly under power lines to the northeast. A residential house was within a few hundred feet.

Data: Deep Springs 4

Monitor Valley, NV

- **Site 1 (2006-05-29, 11:00 AM):** At southern mouth of Monitor Valley, about 1 mile after the junction with HWY 377. Not the actual large basin, yet, just a (comparatively) narrow passage shielded on most sides by mountains and hills.

Data:

MONITOR VALLEY 1 -- single-pole antenna
MONITOR VALLEY 2 -- disc-cone antenna

- **Site 2 (2006-05-29, 11:45 AM):** On the main dirt road running through the valley, at intersection with Meadow Canyon Mountain Bike Trail, about 5 miles from Belmont, NV.

Data:

MONITOR VALLEY 3 -- disc-cone antenna

- **Site 3 (2006-05-29, 12:20 PM):** By the lake in the north-central region of the valley.

Data:

MONITOR VALLEY 5 -- single-pole antenna
MONITOR VALLEY 6 -- disc-cone antenna

Panamint Valley, CA

- **Site 1 (2006-05-30, 11:20 AM):** Along HWY 190, mile marker 58. A large valley just west of Death Valley. One small settled area at western edge along road. Nice, soft sand dry-lake bed.

Data:

PANAMINT VLY 1 -- single-pole antenna
PANAMINT VLY 2 -- disc-cone antenna
PANAMINT VLY 3 -- disc-cone antenna, away from car
PANAMINT VLY 4 -- single-pole antenna, away from car

Other: California Sites

- **Lone Pine, CA (2006-05-28, 3:30 PM):** At the Lone Pine visitors' center along HWY 395, just before entering town from the south. The first scan was without the pre-amp.

Data: LONE PINE 1, LONE PINE 2

- **Big Pine, CA (2006-05-28, 4:30 PM):** At the intersection of HWY 168 and Death Valley Road, about 2 miles east of HWY 325.

Data: BIG PINE 1, BIG PINE 2

- **Mono County, CA (2006-05-28, 7:00 PM):** Mile marker 1 on HWY 168 in Mono county, California.

Data: MONO 1, MONO 2

- **Highway 127 (2006-05-30, 3:00 PM):** At Dumont Dunes about 30 miles north of Baker, CA along HWY 127.

Data: HWY127 1 -- single-pole antenna

- **Kelso Station (2006-05-30, 5:15 PM):** Along road by Kelso Dunes, about 2 miles from the Kelso Station and railway.

Data: KELSO 1 -- single-pole antenna

- **Site 3: Joshua Tree National Park (2006-05-31, 1:00 PM):** Pretty much at the center of the park, which is a big basin. Only one FM radio station was picked up by the car radio so we decided to stop.

Data:

JOSHUA TREE 1 -- disc-cone (50 - 250 MHz)
JOSHUA TREE 2 -- disc-cone (80 - 110 MHz)
JOSHUA TREE 3 -- disc-cone (110 - 140 MHz)

JOSHUA TREE 4 -- disc-cone (140 - 170 MHz)
JOSHUA TREE 5 -- disc-cone (170 - 200 MHz)

Other: Central Nevada

- **Highway 266 - 1 (2006-05-28, 7:20 PM):** At approximately mile marker 10 along HWY 266 in Nevada. Beside the car, just off the road. A small valley-like region with some construction equipment nearby.

Data: NV 266 1

- **Highway 266 - 2 (2006-05-28, 7:45 PM):** At mile marker 29 on HWY 266 in Nevada. Beside the car, about 200 feet off the roadway. A nice big basin possibly with some mining operations and various other buildings scattered around. Power lines ran about 500 feet from the site of the observation.

Data: NV 266 2

- **Smoky Valley, NV (2006-05-29, 2:30 PM):** Outside the Hadley Airport. This was a big valley with a highway running through, power lines, a small town (about 1 mile away from the site), and a large strip mine (about 2 miles from the site).

Data: SMOKY VALLEY 1 -- disc-cone antenna

- **Highway 6 - 1,2 (2006-05-29, 4:50 PM):** Outside a rest area along HWY 6, east of Tonopah, NV, at mile marker 25. In a large valley with power lines on the other side of the road.

Data:

HWY6 1 -- disc-cone antenna
HWY6 2 -- single-pole antenna

- **Highway 6 - 3 (2006-05-29, 5:15 PM):** A nice, remote valley along HWY 6 at mile marker 42. Turned out to be directly in line with repeaters visible on the surrounding mountain tops. About 1000 feet away from the highway on a dirt road. Power lines along the highway.

Data: HWY6 2 -- single-pole antenna

- **Extraterrestrial Highway - 1,2 (2006-05-29, 5:40 PM):** At intersection of HWY 375 and unnamed road. Probably repeaters on mountain tops.

Data:

ET 1 -- single-pole antenna
ET 2 -- disc-cone antenna

- **Extraterrestrial Highway - 3,4,5,6 (2006-05-29, 6:00 PM):** At mile marker 18 on ET HWY. Around a bend into another valley.

Data:

ET 3 -- disc-cone antenna
ET 4 -- single-pole antenna
ET 5 -- single-pole antenna (40 - 400 MHz)
ET 6 -- disc-cone antenna (40 - 400 MHz)

- **Highway 374 (2006-05-30, 9:45 AM):** At mile marker 3 along HWY 274 from Beatty, NV to Death Valley, CA. Amorgosa Desert (Valley). A mine was in the valley and construction equipment was up ahead on the road.

Data:

HWY374 1 -- single-pole antenna
HWY374 2 -- disc-cone antenna



Figure 1 – Map of sites in south-central California.

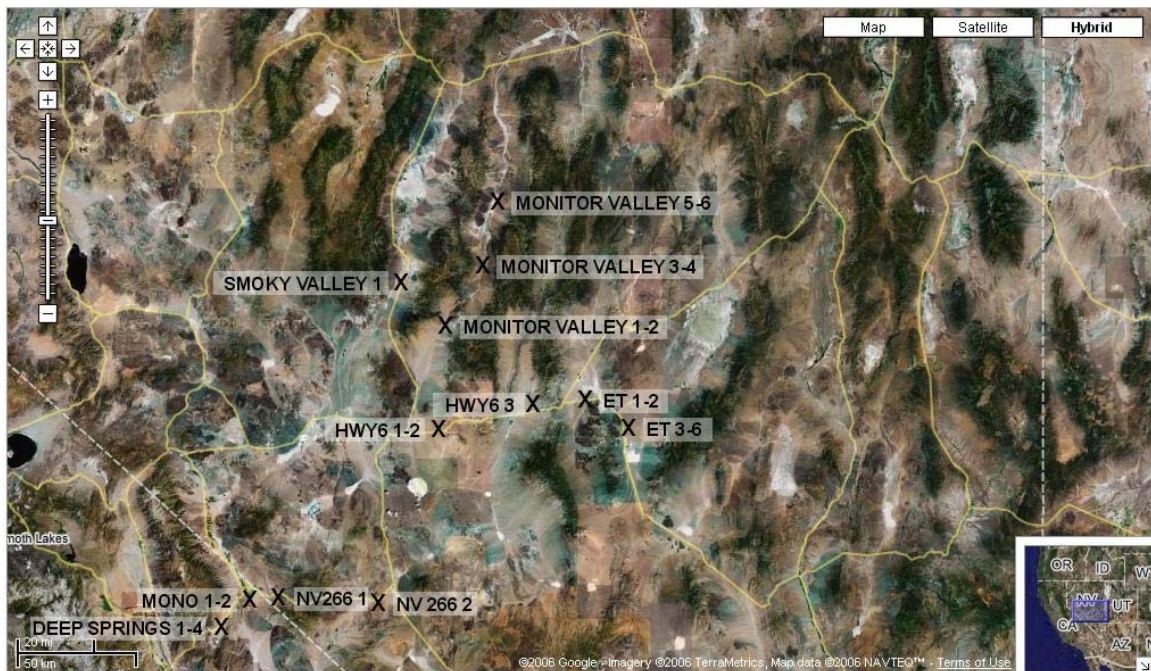


Figure 2 – Map of sites in central Nevada.

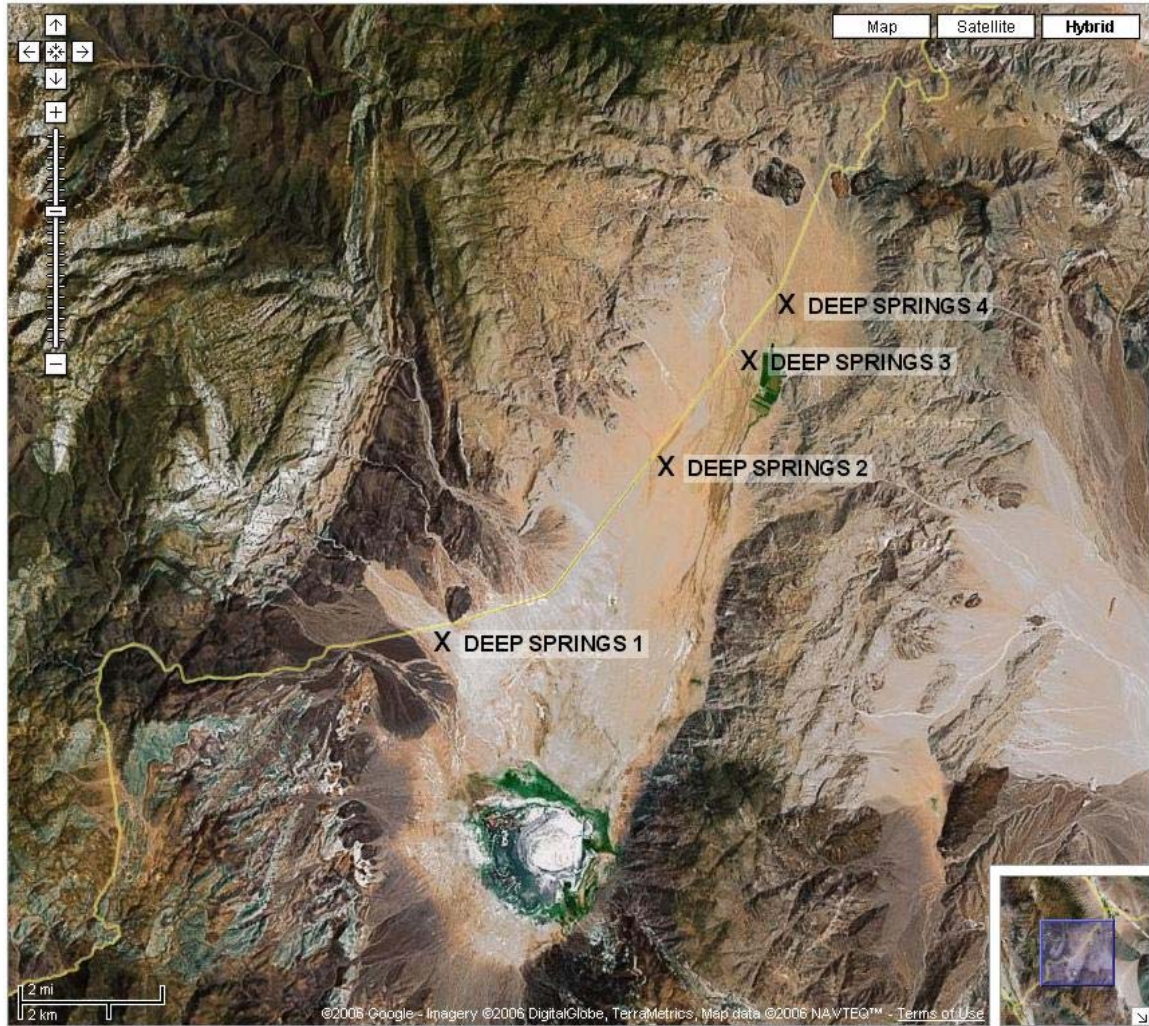


Figure 3 – Expanded map of sites in Deep Springs, CA.



Figure 4 – Panorama from within Deep Springs, CA.



Figure 5- Looking down on Deep Springs, CA, from the northeast.



Figure 6 – Panorama from within Monitor Valley, NV.



Figure 7 – Panorama from within Panamint Valley, CA.



Figure 8 – Repeater stations outside Tonopah, NV

