

SCRUZ

THE 1991 SANTA CRUZ MOUNTAINS, CALIFORNIA, DENSE ARRAY, CONTROLLED SEISMIC SOURCE EXPERIMENT

Submitted by:
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for the
PROJECT SCIENCE TEAM

PASSCAL Data Report 92-005



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ABSTRACT

This report describes data collected during the May 1991 Santa Cruz Mountains dense array, controlled seismic source experiment. An array of 20 elements with average spacing of 15 meters was deployed at the Zayante (ZAYA) station, occupied during the 1989 Loma Prieta aftershock experiment. This array consisted of 3-component short period sensors and recorded 5 chemical explosions ranging in size between 1000 and 3000 pounds located between 10 to 40 km from the array. Motivation for this project, the field deployment, and data format are discussed.

1. Introduction

The 1991 Santa Cruz Mountains, Dense Array, Controlled Seismic Source Experiment was conducted from May 18 to May 25, 1991. This experiment consisted of recording 5 chemical explosions detonated by the US Geological Survey at a 20 element array of seismic instruments deployed at Zayante Vineyards (ZAYA) in the Santa Cruz Mountains. The site chosen for the array was occupied by a single station and a six element array during the PASSCAL 1989 Loma Prieta aftershock experiment. Analysis of data collected at the 6 element ZAYA sub-array during the Loma Prieta aftershock sequence showed that in the frequency range between 1 and 20 Hz, different sites amplified ground motion in preferred directions that varied greatly between sub-array elements located only tens of meters apart (Bonamassa et al., 1991). To further evaluate this phenomena, to investigate the relationship between the amplification and directionality of weak ground motions and microtremor at the same sites, and to study the scattering properties of the shallow crust, we deployed a dense array of 20 elements at the ZAYA site (Figure 1) and recorded five controlled source explosions in May of 1991. Table 1 lists the times and locations of the 5 chemical explosions.

2. Field Deployment and Instrument Parameters

The ZAYA dense array consisted of 20, 3-component, L-22 (2 Hz) sensors and 10 PASSCAL data recorders, each recording 6 channels. Each sensor was oriented, leveled and buried in .5 -1 meter of unconsolidated surface soil. The array configuration is shown in Figure 1. Precise locations of each element relative to station 264-A at approximately 37.131° N and 122.025° W and 370 meters above sea level, were determined using a theodolite and are listed in Table 2. Stations are labeled with the Digital Acquisition System (DAS) number and a letter A or B indicating the channels recording data from that station. Stations with the letter A following the DAS number have vertical, north-south and east-west components of ground motion recorded on channels 1-3 while stations labeled with letter B have these components of motion recorded on channels 4-6. Each DAS was equipped with an OMEGA clock and antennae to ensure precise timing.

Trigger times were set beginning 3 seconds before the planned explosion time and a total of 28 seconds of data with a sampling rate of 200 samples per second and a gain of 36 db were recorded for each explosion. Data were recorded to RAM and downloaded to exabyte tape immediately following the last explosion detonated on each of the 2 days.

3. Data Distribution Format

The data for this experiment were provided to the IRIS data management center in segy format which was produced using the PASSCAL program ref2segy. The file structure consists of

2 directories for data collected on each of 2 Julian days, 142 and 144. Within each Julian day directory are directories containing data for the shots that occurred on those days along with the log files for each of the 10 DAS's. Within the individual shot directories, the data files have the original convention produced by using ref2segy format, i.e., hour.min.sec.DAS.component. An example of the directory structure giving the location of a file containing data for the north component of ground motion from shot 3 on Julian day 142 recorded at station 444A is:

JD142/shot3/06.03.56.0444.2

The location and name of the log file containing the state of health and clock information for the time period of shot 3 would be:

JD142/I0444.log

This log file is in the original format that results from extraction of the data using the program ref2segy. Important information on whether an individual DAS clock locked during each explosion, as well as information on dead channels or missing data are supplied in Table 1. The data collected in this experiment have not been corrected for sensor characteristics.

4. Acknowledgments

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5. References

Bonamassa, O., J.E. Vidale, H. Houston, and S.Y. Schwartz, 1991. Directional site resonances and the influence of near-surface geology on ground motion, *Geophys. Res. Lett*, 18, 901-904.

Table 1. Calibration Shot Parameters

Julian Day	Shot time GMT	Shot #	Lat.	Long.	Burial Depth	Notes
144	08:04:00	1	37.021353	-121.902786	79 m	DAS 439 clock unlocked DAS 264 no data
144	07:04:00	2	37.105612	-121.847205	1034 m	DAS 439 clock unlocked DAS 264 no data
142	06:04:00	3	37.172819	-121.791568	175 m	DAS 264 clock unlocked DAS 445 no data DAS 282 Ch. 1-3 no data DAS 268 Ch.5 no data
144	07:00:00	5	37.085045	-121.861415	530 m	DAS 439 clock unlocked DAS 264 no data
144	07:02:00	6	36.857161	-121.561372	122 m	DAS 439 clock unlocked DAS 264 no data

Table 2. Array Element Locations

Station	DAS #	Channels	x	y (meters)	z
264-A	264	1-3	0	0	0
264-B	264	4-6	15.0	0.1	0.4
444-A	444	1-3	-29.8	59.2	8.9
444-B	444	4-6	-14.8	58.7	8.9
319-A	319	1-3	0.0	58.7	8.9
319-B	319	4-6	14.3	58.1	8.8
441-A	441	1-3	-30.0	44.7	3.3
441-B	441	4-6	-14.6	44.9	5.0
439-A	439	1-3	-.2	43.7	5.5
439-B	439	4-6	15.3	43.4	6.2
445-A	445	1-3	-30.0	29.3	-.7
445-B	443	4-6	-14.4	30.3	1.6
440-A	440	1-3	0.3	29.3	3.0
440-B	440	4-6	15.2	29.6	3.4
282-A	282	1-3	-30.1	14.5	-2.8
282-B	282	4-6	-14.6	14.4	-.3
268-A	268	1-3	0.2	14.9	1.0
268-B	268	4-6	15.0	15.0	1.6
437-A	437	1-3	-30.0	-.8	-2.3
437-B	437	4-6	-15.2	-.5	-.9

x, y, and z are distances in the east, north and vertical directions from the reference station 264-A.

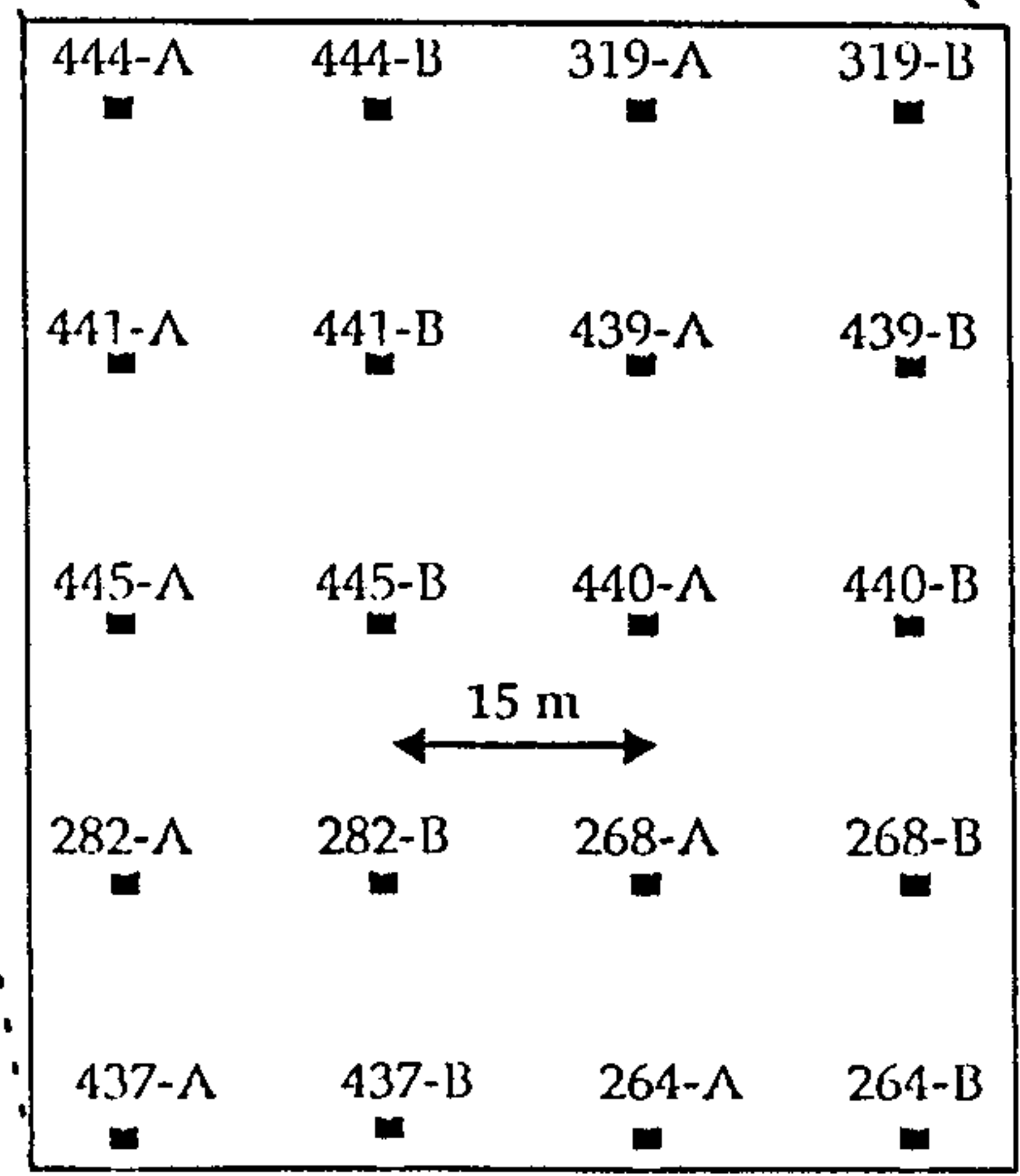
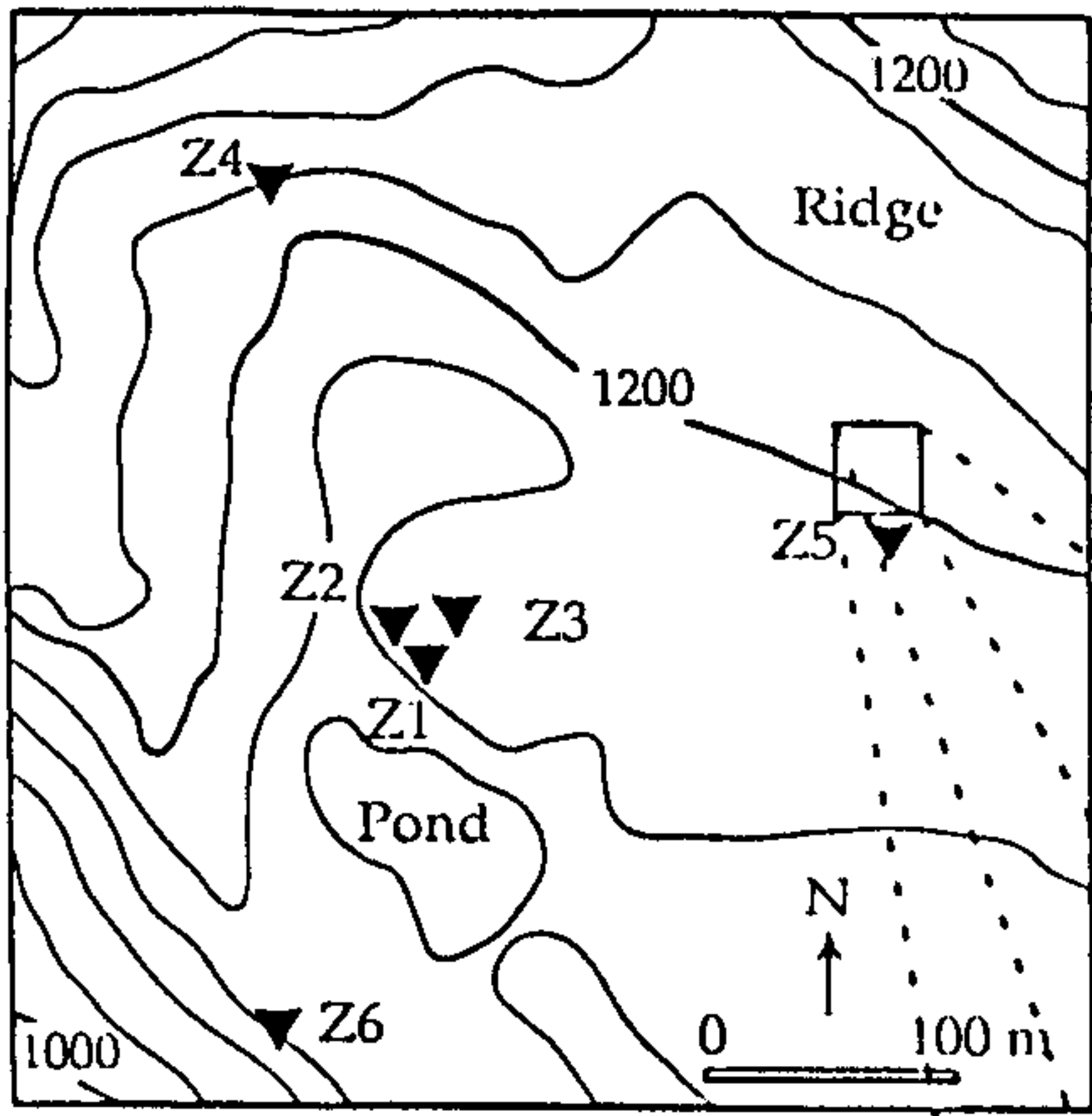


Figure 1. Map of the 6 station array deployed at the ZAYA site during the PASSCAL 1989 Loma Prieta aftershock experiment (top) and the location of the dense array deployed in this experiment. Orientation of the 20 elements of the array and their station names are indicated in the blow-up (bottom) and precise locations are provided in Table 2.