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MENDOCINO TRIPLE JUNCTION SEISMIC EXPERIMENT: 1994 ONSHORE-OFFSHORE AND HIGH DENSITY LAND RECORDINGS

Submitted By

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Introduction

The Mendocino Triple Junction (MTJ), presently in northern California, is formed where the Pacific, North American, and Gorda plates meet. South of the triple junction, motion between the Pacific and North American plates is taken up within the San Andreas system of strike-slip faults. To the north of the MTJ the Gorda plate is subducted beneath North America, with Pacific-Gorda relative motion taken up on the Mendocino Transform Fault (Figure 1). Since its formation at about 25-30Ma offshore southern California, the MTJ has migrated northward along the North American margin at about 40mm/yr. Many of the processes associated with the migration can be understood, at least qualitatively, in terms of removal of the Gorda slab northward from beneath North America. This causes volcanism associated with the subduction to stop, changes the predominant mode of deformation from SW-NE directed compression to N-S right-lateral strike-slip, and is associated with small volumes of bimodal volcanism caused by the upwelling of asthenosphere into the 'window' behind the slab. However, the initial and boundary conditions for these processes are not well-known. Crustal and upper mantle structures in the region 100-200 km around the MTJ are known primarily from teleseismic and regional seismicity and from potential field studies, so have only poor lateral resolution and are subject to ambiguity.

The Mendocino Triple Junction Seismic Experiment (MTJSE) was designed to determine the detailed crustal structure to the north of the MTJ (ie the initial condition for subsequent processes), through the region of the MTJ (giving boundary conditions for processes in that region as well as a much more detailed picture than can be obtained from natural seismicity), and to the south of the MTJ (giving a final condition for some processes, and boundary conditions for the slab-window). A two-year field program was planned, with acquisition of three land refraction profiles in 1993, to be followed by marine and onshore-offshore recording in 1994. The land profiles ran E-W north (WA6) and south (WA1) of the MTJ, with a third line (WA9) running SE-NW across the southern edge of the Gorda slab. In 1994 two land shots were also fired into high-density spreads to further investigate some anomalously bright near-vertical reflections observed in the 1993 experiment.

This report describes the onshore-offshore and land recording from 1994. The onshore-offshore technique involves the use of land seismographs recording airgun shots offshore. The modern interpretation of traditional marine refraction work uses a small number of ocean-bottom seismometers or hydrophones to record signals from large arrays of airguns. This high density of shots and low density of receivers is somewhat equivalent to land refraction studies in which the low density of shots is compensated for by a high density of receivers. Recording airgun shots onshore gives the potential for large numbers of both shots and receivers; shot spacings from the R/V Maurice Ewing in this study were 50m or 125m, with receiver spacings that varied between 100m and 10km. We will first describe the acquisition parameters used during the experiment, then the data reduction, and finally give summary details about the individual deployments.

Data acquisition

Onshore-Offshore Recording

The onshore-offshore recording was again designed to investigate structure north, south and near to the MTJ. Instruments were re-deployed along the WA6 and WA1 refraction lines shot during the 1993 MTJSE (see PASSCAL data report by Godfrey et al.) , using the original station locations for WA6, although WA1 was improved near to the coast by access to private timber company roads. An additional pair of lines was set up in the vicinity of the MTJ, deployment WA3. One arm of the pair ran NE and one SE from Cape Mendocino, while ship-tracks offshore formed a complementary pair of lines. This was shot continuously so that only one deployment was possible and half the Refteks were deployed along each line. The deployments were designed with instrument spacings of 1km so that every third site from the land recording would be re-occupied. During the field program extra instruments became available and were deployed at 500m intervals between the existing sites. Two additional lines used only a small number of instruments, deployed at 8-15km intervals. WA2 ran parallel to and 30km north of WA1 (between WA1 and the MTJ), while WA8 ran parallel to and about 80km north of WA6 across the Cascadia subduction zone.

PASSCAL Reftek model 06 and 07 instruments were used onshore, with either a 3-component, 4.5Hz L28 geophone, or a short cable with 3 strings of vertical component 8Hz phones deployed at 100m intervals moving away from the Reftek recorder. The deployments lasted up to 24 hours, during which time the instruments recorded data continuously in 3602s records that overlapped by 2s with 8ms samples and no compression. A number of the instruments were equipped with internal or external Global Positioning System (GPS) receivers to enable more accurate time-keeping than is permitted by the Reftek clock as well as giving additional location fixes. All instruments were pulse time set in the field at the beginning and end of each deployment. Shots on the Ewing were timed and located using GPS.

High-density land recording

The high density land recording used two shots at SP106 between Willits and Lake Pillsbury, which was the region of highest amplitude reflections seen in the 1993 land program. Two deployments of instruments were used, one with instruments to the N and SE of SP106, the other E from SP106 along the original WA1. Reftek channels had a spacing of 66m, with additional channels provided by a 48-channel Bison seismograph from Lehigh University and a 60-channel Bison seismograph from Rice University. To achieve the maximum number of recording locations all the short cables were used in the Reftek recording so that only about 50 instruments had 3-component phones.

The deployment strategy was changed due to the high visibility of this part of the experiment. Two-thirds of the personnel deployed geophones at all the sites to be occupied for the land shots. The remaining deployers took out Refteks for deployment in the late afternoon, and retrieved the instruments immediately after the shots. Timing control was all carried out at the instrument center, with the instruments running the whole time they were in the field but set to record specific windows only. Due to the small volume of data, a 4ms sample interval was used.

Data Reduction

Timing corrections and diagnostics

The Reftek field tapes were translated to disk using the ref2segy software, and the status of each instrument was determined using the logview utility. Where the cause of instrument failure during deployment was obvious this was noted in downloading logs. Clock performance was also analyzed at this stage by looking at the pulse time sets, and for the instruments equipped with GPS, the timing errors during the deployment. A number of problems recurred commonly:

1. The largest cause of instrument failure was the battery; although fully charged going into the field many of the battery units were old and did not retain enough power for a 24 hour deployment. This particularly affected GPS-equipped units.
2. Some of the GPS units drew power continuously, particularly if they failed to get a GPS fix. This would inevitably cause the instrument battery to fail.
3. The GPS software in use was susceptible to 1s timing errors. This affected the pulsers and both internal and external GPS units.
4. Some of the GPS units used returned whatever time was in their clock register as soon as power was applied without waiting to get a GPS fix.

The strategy for dealing with timing corrections was as follows:

1. If a GPS instrument worked correctly apply the drift corrections generated by refrate.
2. If a GPS instrument generally worked correctly but had 1s time jumps, apply rateclean to the drift corrections first. This may not be the correct course of action in cases where the initial time was 1s in error, but will leave the instrument with at most a single time correction for the deployment.
3. If a GPS instrument suffered power failure the GPS performance typically became erratic in the late stages of operation. In this case base judgments on the clock up to that time only. Generally only small amounts of data could be retained after these errors became significant.
4. If two pulse time sets were present on an instrument without GPS, calculate a drift rate using refrate.
5. If the drift rate was less than 5×10^{-7}, apply it unconditionally. If the drift rate was higher than 5×10^{-7} make some judgment noted in the logs. Generally drift rates up to 10^{-6} were applied, but higher drift rates implied an error of more than one sample per hour and were not applied.
6. If the drift showed as 1s plus a reasonable error (less than 40ms) assume that one or other of the pulse time sets was incorrect by 1s and apply a drift correction for the residual amount. There is no way to a priori determine which pulse was incorrect, so these cases are all noted in the logs. Generating shot gathers allows anyone using the data to determine whether additional 1s shifts are required.
7. If an instrument without GPS suffered power failure, no drift correction was applied, but these cases are noted in the logs.

Some cases fell outside any reasonable error bounds. Where GPS units were consistently giving spurious times the data were discarded. Where pulse time sets showed very high drift rates (up to 20 minutes over a 24 hour deployment in one case) the data were discarded. In most cases instruments showing drift rates of more than 1E-6 were clearly useless.

Data formatting and software development

The wide-angle data were formatted using the segygather utility, which generates a SEGY receiver gather from the PASSCAL disk files. For each instrument in turn a 60s trace was generated starting at each shot instant. This is a long enough time period to ensure that all P-wave and converted S-wave arrivals from each shot are on the correct trace even at the farthest offsets used in the experiment, although it obviously leads to duplication of data when shots are fired more frequently than once per minute.

The segygather software was under development during the formatting of the data from this experiment and a number of bugs were fixed while data were being reduced; the major profiles therefore used a number of different versions of the code. However, no bugs were discovered that were not fatal to the formatting process so it is unlikely that any of the final data are affected by these, and the output data format was not changed during this process. Due to the large volume of data recorded (more than 35Gb in the original Reftek format, corresponding to 100Gb in SEGY format) receiver gathers were generated in the order in which instruments were downloaded in the field. The data were subsequently reordered after geometry assignment. Clock drift corrections were applied within segygather, which assumes a linear drift between time fixes, but assigns a single correction for each hour of recording. The 8ms sample rate of the field recording was preserved, with a 60s trace generated starting at each shot instant. This means that energy from several shots will be present on each trace but that no data reduction or truncation of arrivals was required.

Instrument location and geometry assignment

Instrument locations come from a number of sources. Sites that were reoccupied from 1993 use the original locations. Other sites were located in order of priority from:

1. Differentially corrected GPS locations acquired during or immediately following the field program.
2. Average locations recorded by instruments deployed with GPS units.
3. Locations from USGS 1:24000 topo sheets corrected to match the GPS coordinates.

The locations of geophones deployed on cables near to the Refteks were determined by interpolation along the line. Locations and numbers of the shots for geometry assignment were taken from the locations supplied by the Ewing and back-projected 98m along track to take account of the offset between the airguns and the GPS antenna. Land stations were fixed as ten times the stake number with appropriate increments for sites with cables. For WA3 and the western part of WA1 this gives a nominal coordinate in hundreds of meters along the line.

Geometry assignment linked the appropriate shot and receiver locations with each trace, followed by calculation of offset and binning information. Shot and receiver locations are in the final trace headers in UTM coordinates. Common midpoint numbers were assigned based on binning the surface midpoint location along the profile in 100m increments. Final data tapes were generated in the form of receiver or shot gathers with offset increasing within each gather. Details of the SEGY trace header mappings are given in a table at the end of this report.

Quality control

After geometry assignment the geometry information and data were checked visually by plotting traces with reduced travel time and generating maps from the trace header values. No detailed checks of timing corrections or removal of bad traces have been carried out. The trace headers of data tapes were also verified.

WA1 Summary:

121 Refteks with nominal 1km station spacing recorded WA1, with 754 shots at nominal 125m shot interval (Figure 2). Offsets range from 15km to 220km. The data are recorded on tape as shot gathers with geometry in the trace headers and PASSCAL extensions to SEGY.

Deployment details:

121 Refteks were deployed along the line of WA1 between Fort Bragg near the coast and the western edge of the Great Valley. In the eastern part of the line every third station from the 1993 experiment was reoccupied, but to the west of Willits new sites were used to avoid poor road conditions, and close to the coast stations were located every 500m. Both Reftek-07 instruments (24-bit A/D converter, deployed near the coast) and -06 instruments (16-bit A/D converter, deployed inland) were used, with 19 of the -07s having an external GPS clock. 70 instruments were deployed with cable units to give 3-8Hz vertical components; these were biased to coastal locations for optimal imaging potential. The remaining instruments used a 4.5Hz 3-component geophone. Instrument clocks were set using GPS pulsers at deployment and at pickup.

Data reduction:

Reoccupied receiver locations were taken from the 1993 Stanford data (see data report by Godfrey et al.), with cable sites linearly interpolated. The new stations in the western part of the line were located using differentially-corrected GPS. Station numbers have been multiplied by ten, with channels 2 and 3 of the cables given +-1 and +-2 compared with the instrument site depending on the cable orientation. Linear clock drift corrections were applied provided that GPS time sets were available, with 24 instruments uncorrected since their clocks were not running at the pickup time. In addition a number of timing problems are associated with the GPS pulsers, which proved susceptible to 1s errors. These cases are noted in the full data reduction log. Common-midpoint locations are calculated as the mean of the source and receiver positions, with CMPs binned in 100m increments from SP108, the westernmost shot in the 1993 experiment. Positive CMP numbers are located east of SP108.

Summary of data reduction parameters

	No. instruments	Data recovered /Mb	Mean data /Mb	No. time corrected
06-no GPS	59	3153	53.4	51
06-GPS	0	0	-	-
06 total	59	3153	53.4	51
07-no GPS	43	3872	90.1	33
07-GPS	19	1470	77.4	13
07 total	62	5342	86.2	46
Total	121	8495	70.2	97

WA2 Summary:

8 Refteks with a nominal station spacing of 10km recorded WA2, with 1904 shots at 50m shot spacing (Figure 3). Offsets ranged from 10km to 160km. The data are recorded on tape in 3 files, one for each instrument channel, with geometry in the trace headers.

Deployment details:

All instruments used for this deployment were Reftek-07 series, with 24-bit A/D converters. 6 of the instruments were deployed during the period of shooting only and had 4.5Hz 3-component geophones. Stations 2002 and 2004 use the data from the areal array sites 4 and 5, so only the vertical component was recorded (see PASSCAL data report by Beaudoin). 3 instruments, at station numbers 2002, 2003, 2004 were equipped with GPS clocks and appear to have minimal timing drift. None of the other instruments suffered from excessive drift, although station 2005 was out of the quoted specifications with a drift rate of about 2ms/hour.

Station	Instrument no.	UTM-X	UTM-Y	Elevation
2001	7091	435311	4389721	240
2002	7281	442573	4390781	473
2003	7294	452502	4385606	529
2004	7282	460821	4393086	738
2005	7116	470184	4395748	320
2006	7113	477793	4398658	554
2007	7112	493402	4405123	914
2008	7114	501323	4407756	1126

Data reduction notes:

Data reduction used segygather version 209/94. Shot point numbers were fixed from the original file which had SP's 554 and 555 repeated, although times and locations were different. Receiver locations were taken from 7.5' quad sheets, with lat-long values converted to UTM zone 10 using the same algorithm applied to the navigation data.

Common-midpoint locations are calculated as the mean of the source and receiver positions, with binning to 100m intervals based on the distance from the midpoint to the most westerly shot. The archive tape has 3 SEGY 'reels', one for each channel. Each has its own reel header, and has been sorted into receiver gathers (ie each ensemble has 1904 traces). No filtering, resampling, or time shifts have been applied to the data. Note that 'reels' 2 and 3 have only 6 ensembles in each.

WA3 Summary:

Data were recovered from 128 Refteks (from 136 deployed) with a nominal 1km station spacing along two lines oriented SW-NE and NW-SE out from Cape Mendocino (Figure 4). 4125 shots at nominal 50m spacing were recorded from the Ewing airgun array. The data are on tape as receiver gathers in the PASSCAL extended SEGY format, after geometry assignment.

Deployment details:
128 Refteks were deployed along the lines of WA3 at a nominal 1km station spacing. 31 GPS-equipped instruments were deployed at intervals along the line for additional timing and location control. 61 instruments were deployed using cables to give 3-8Hz vertical components at 100m trace spacing to optimize near-coast imaging. The remaining instruments used a single 4.5Hz 3 component geophone. Instrument clocks were set using GPS pulsers at deployment and at pickup.

Data reduction:

Receiver locations were taken from differentially corrected GPS (or in 3 cases from 24-hour averages of the Reftek clock locations), with cable sites linearly interpolated. Stake numbers were multiplied by ten, with channels 2 and 3 of the cables given +-1 and +-2 compared with the instrument site depending on the cable orientation. Station numbers increase from north to south: station 31520 is the northernmost of the southern line of receivers and 31650 is the southernmost of the northern line. Over most of the array, stake numbers increased regularly in 1km increments along the line. Linear clock drift corrections were applied provided that GPS time sets were available, with 24 instruments uncorrected since their clocks were not running at the pickup time. In addition a number of timing problems were associated with the GPS pulsers, which proved susceptible to 1s errors. These cases are noted in the full data reduction log. During geometry assignment the data were split into 4 segments, two containing inline data and two containing fan data, depending on the relative shot and receiver locations. WA3NN and WA3SS are the two fan profiles, north and south of Cape Mendocino respectively. WA3shNrecS is the inline profile with shots to the north of Cape Mendocino and receivers to the south, WA3shSrecN is the inline profile with shots south of Cape Mendocino and receivers to the north. For the two inline profiles CMP numbers were generated based on the distance of the geometric midpoint from the western end of the line, binned in 100m increments. For the fan profiles, the CMP locations have a large areal scatter so that a single CMP number is not as appropriate.

Summary of data reduction parameters:

	No. instruments	Data recovered /Mb	Mean data /Mb	No. time corrected
06-no GPS	38	2472	65.1	31
06-GPS	13	702	54.0	5
06 total	51	3174	62.2	36
07-no GPS	59	7127	120.8	42
07-GPS	18	1859	103.3	10
07 total	77	8986	116.7	52
Total	128	12159	95.0	88

WA6 Summary:

Data were recovered from 129 Refteks (from 144 deployed) with a nominal 1km station spacing along an east-west line. 2468 shots at nominal 50m spacing were recorded from the Ewing airgun array (Figure 5). The data are on tape as receiver gathers in the PASSCAL extended SEGY format, after geometry assignment.

Deployment details:
144 Refteks were deployed along the line of WA6, reoccupying every 3rd site from the 1993 experiment to give a nominal 1km station spacing. 16 GPS-equipped instruments were deployed at intermediate locations that had not previously been used. 36 instruments were deployed using cables to give 3-8Hz vertical components at 100m trace spacing, although the terrain prevented a higher number of these deployments. The remaining instruments used a single 4.5Hz 3 component geophone. Instrument clocks were set using GPS pulsers at deployment and at pickup.

Data reduction:

Receiver locations were taken from the 1993 Stanford data (see data report by Godfrey et al.), with cable sites linearly interpolated. Station numbers have been multiplied by ten, with channels 2 and 3 of the cables given +-1 and +-2 compared with the instrument site depending on the cable orientation. Linear clock drift corrections were applied provided that GPS time sets were available, with 30 instruments uncorrected since their clocks were not running at the pickup time. In addition a number of timing problems are associated with the GPS pulsers, which proved susceptible to 1s errors. These cases are noted in the full data reduction log. Common-midpoint locations are calculated as the mean of the source and receiver positions, with CMPs binned in 100m increments from the west of the line. Note that receiver station numbers exceed 65536 at the west end of the line, so the standard SEGY header for stake number (only 2 bytes) is incorrect and should have 65536 added to values less than 2000. The value in the trace header starting at byte 171 has 4 bytes for storage and should be correct.

Summary of data reduction parameters:

	No. instruments	Data recovered /Mb	Mean data /Mb	No. time corrected
06-no GPS	50	2646	52.9	38
06-GPS	3	156	52.0	3
06 total	53	2802	52.9	41
07-no GPS	63	6254	99.3	47
07-GPS	13	1253	96.3	11
07 total	76	7507	98.8	58
Total	129	10309	79.9	99

WA8 Summary:

10 Refteks with a nominal station spacing of 6km recorded WA8 with 1808 shots at 50m shot spacing (Figure 6). Offsets range from 10km to 150km. The data are recorded on tape in 3 files, one for each instrument channel with geometry information in the trace headers. The standard PASSCAL extensions to the SEGY format are retained.

Deployment details:

This deployment used a mixture of 06- and 07-series Refteks. The 5 sites nearer to the coast used Reftek-07s with a 24-bit A/D converter giving better dynamic range than the 16-bit A/D in the Reftek-06s deployed further inland. All of the instruments recorded 4.5Hz, 3-component data. No instruments were equipped with GPS clocks because of battery problems experienced throughout the experiment, but two 07 instruments (7107 and 7114) still suffered from power failure and are missing the near-offset traces. 6 of the remaining 8 instruments were within specification for clock drift rates; instrument 6111 was out of specification, drifting 2.5ms/hour, but instrument 6112 suffered from a very high drift rate of 15ms/hour. No other problems could be identified with 6112, so a drift correction was applied to the data, but due to the method of drift correction used in the PASSCAL software there may be artifacts at the edges of the field recording blocks (every hour).

Station	Instrument no.	UTM-X	UTM-Y	Elevation
8010	7114	413105	4595735	49
8020	7112	418765	4597749	229
8030	7107	423627	4598400	914
8040	7109	429688	4600423	1033
8050	7108	436397	4600740	1390
8060	6115	442960	4602835	1487
8070	6109	447760	4603828	634
8080	6114	453505	4599475	829
8090	6111	456813	4603671	268
8100	6112	461088	4608034	366

Data reduction:

Data reduction used segygather version 209/94. Receiver locations were supplied by Anne Trehu, digitized from 7.5' quad sheets, with lat-long values converted to UTM zone 10 using the same algorithm applied to the navigation data. Linear clock-drift corrections were applied except for instruments 7107 and 7114 since no reliable estimate of the clock drift while recording could be made. Common mid-point locations have been calculated as the mean of the shot and receiver positions, with binning to 100m intervals based on the distance from the midpoint to the most westerly shot. The archive tape has 3 SEGY 'reels', one for each of the three components. Each has its own reel header, and has been sorted into receiver gathers (1808 traces per ensemble). No filtering, resampling, or time shifts have been applied.

High-density recording summary

Two shots were fired at the site of SP 106 into arrays including Reftek and Bison seismographs. The deployments were designed to give dense near-vertical coverage of unusually bright reflections observed during the 1993 MTJSE in the region of Lake Pillsbury (Figure 7). Offsets ranged from 2km to 28km. Data are recorded on tape in six files, one for each shot and component. Note that the number of horizontal components is much less than the number of vertical components.

Deployment details:

Each of the two shots was fired into a mixed array of Reftek and Bison instruments. 79 Refteks were deployed with cables and 8Hz geophones to give 3 vertical channels, with the remaining Refteks having three-component 4.5Hz geophones. Two Bison seismographs were used: a 60-channel instrument with 24 bit A/D converters and a 48-channel instrument with 16 bit A/D converters. The Bisons were used with 8Hz vertical component geophones. To maximize the coherence of arrivals, instruments of a given type were deployed in contiguous blocks. For shot 1 137 Refteks were deployed, and for shot 2 141 Refteks were deployed. Technical problems (mostly power and timing errors) meant that 23 instruments failed to record shot 1 and 21 instruments failed to record shot 2. Reftek clocks were pulse time set in the instrument center immediately before and after deployment; the Bison instruments were triggered from GPS clocks at the time of the shot. The spacing between Reftek vertical channels was 66m, and between Bison vertical channels 33m. Station numbers increment by 10 every 66m along the line.

Station numbers	Bison	Reftek 8Hz	Reftek 4.5Hz
Shot 1	25740-26275	22390-22660 22790-22810 22920-23840 25410-25720 26290-27260	21940-22360 22670-22780 23970-24650
Shot 2	10605-11150	9880-10590 11340-11500 12700-12870 13590-15000	11160-11330 12280-12690

Data reduction:

Data from the Refteks were reduced to SEGY using segy2sierra, with linear clock drift corrections being applied. Data from the Bisons were written directly to SEG-2 files on exabyte, and read into ProMAX in that form. Station locations were taken from differentially corrected GPS measurements made every 4 to 6 stations along the line, with linear interpolation between these control points. Shot and receiver locations were converted to UTM zone 10 before geometry assignment, and are stored in the SEGY trace headers. The archive tape is in standard SEGY with the addition of station number stored as a 4-byte integer starting at byte 171, and instrument number stored as a 4-byte integer starting at byte 225 in the trace headers.

Table: SEGY trace header mapping

Starting byte	Format	Description
1	INT*4	Trace sequence in line
5	INT*4	Trace sequence in reel
9	INT*4	FFID
13	INT*4	Field recording channel number
17	INT*4	Shot point number
21	INT*4	CMP number (see text for calculation)
25	INT*4	Trace within ensemble (shot or receiver)
29	INT*2	Trace identification code (1=seismic data)
33	INT*2	Trace fold (always 1 since not stacked data)
37	INT*4	Signed source-receiver offset
41	INT*4	Receiver station elevation
45	INT*4	Source surface elevation
49	INT*4	Source depth below surface
69	INT*2	Scalar for elevations
71	INT*2	Scalar for X/Y coordinates
73	IBM Real*4	Source X coordinate/UTM
77	IBM Real*4	Source Y coordinate/UTM
81	IBM Real*4	Receiver X coordinate/UTM
85	IBM Real*4	Receiver Y coordinate/UTM
89	INT*2	Flag for coordinate units
103	INT*2	Total static applied to trace, ms
111	INT*2	Start of top mute taper, ms
113	INT*2	Full amplitude time after top mute, ms
115	INT*2	Number of samples in trace
117	INT*2	Sample interval, microseconds
157	INT*2	Year of trace start
159	INT*2	Day of trace start
161	INT*2	Hour of trace start
163	INT*2	Minute of trace start
165	INT*2	Second of trace start
167	INT*2	Time basis code
171	INT*4	Receiver surface location
181	CHAR*6	Station name code
187	CHAR*7	Sensor serial code
195	CHAR*4	Channel name code
201	INT*4	Sample interval, microseconds
205	INT*2	Original data format: 0=16 ibt, 1=32 bit
207	INT*2	ms of trace start
209	INT*2	Year of trigger
211	INT*2	Day of trigger
213	INT*2	Hour of trigger
215	INT*2	Minute of trigger
217	INT*2	Second of trigger
219	INT*2	ms of trigger

221	IEEE Real*4	Scale factor
225	INT*4	Instrument serial number
229	INT*4	Maximum count
237	INT*4	Minimum count

References:

N.J. Godfrey, B.C. Beaudoin, C. Lendl, A. Meltzer, and J.H. Luetgert, Data report for the 1993 Mendocino Triple Junction seismic experiment, USGS Open File Report 95-275.

B.C. Beaudoin, J.A. Hole, and S.L. Klemperer, Data report for the Mendocino array experiment, PASSCAL dataset 96-008

Figures:

Figure 1: Mendocino Triple Junction Region

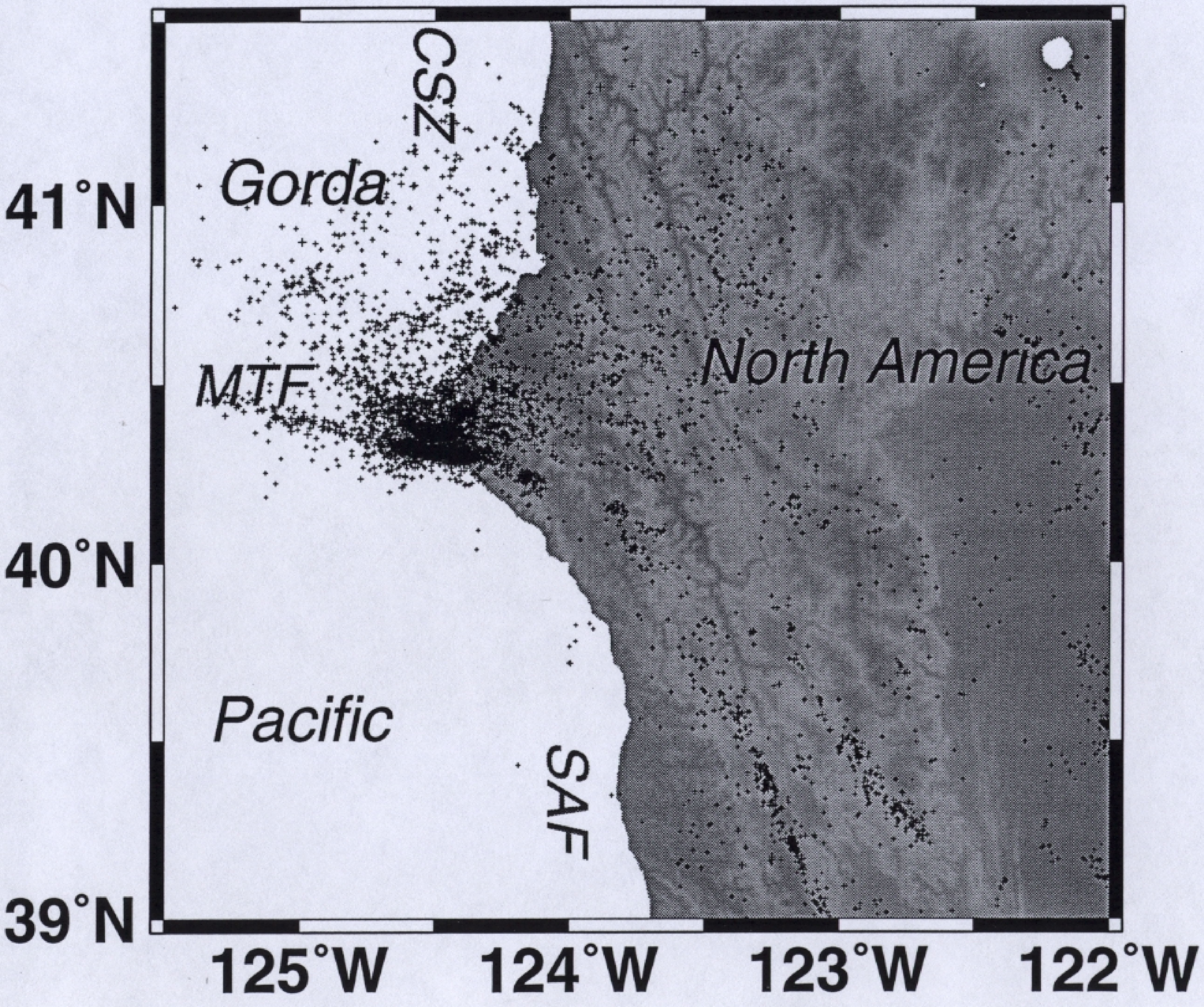

Figure 2: Line 1 geometry

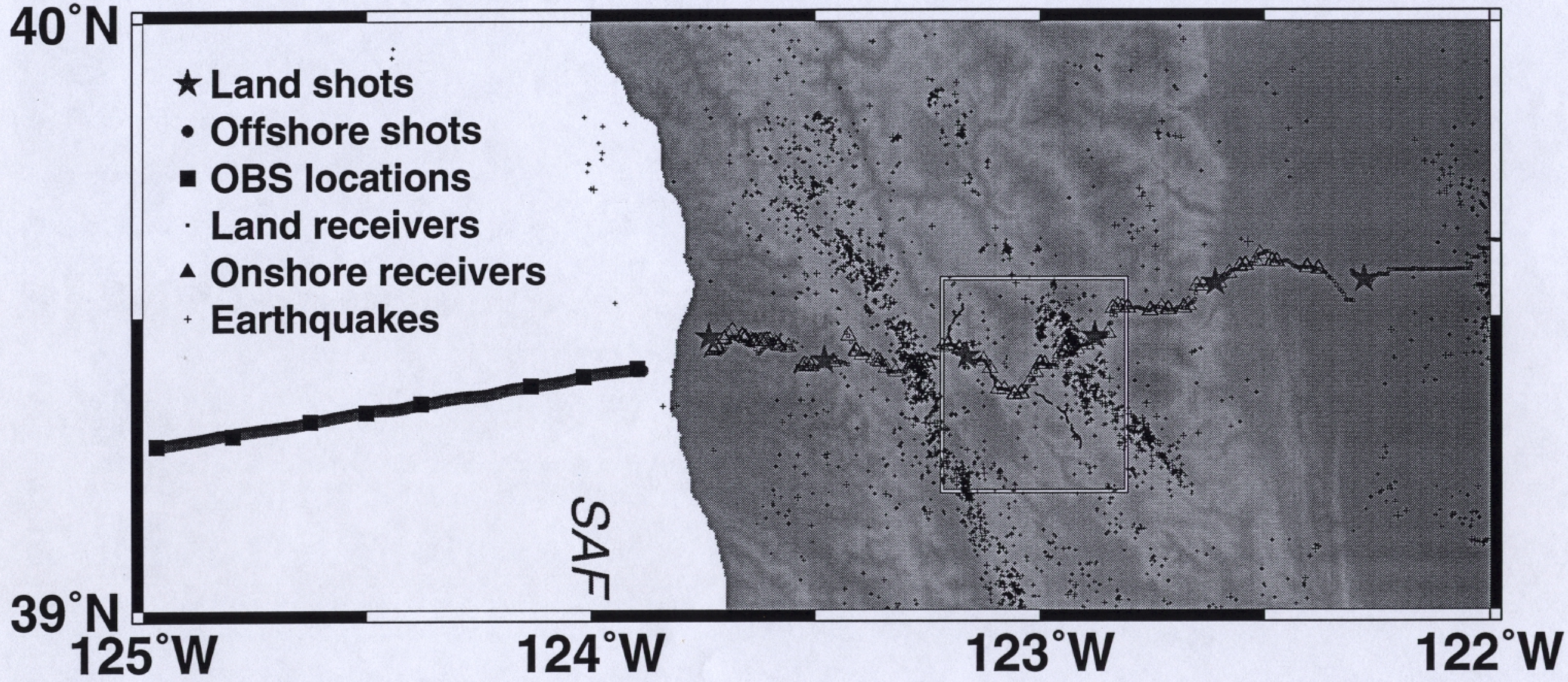

Figure 3: WA2 Onshore-offshore geometry