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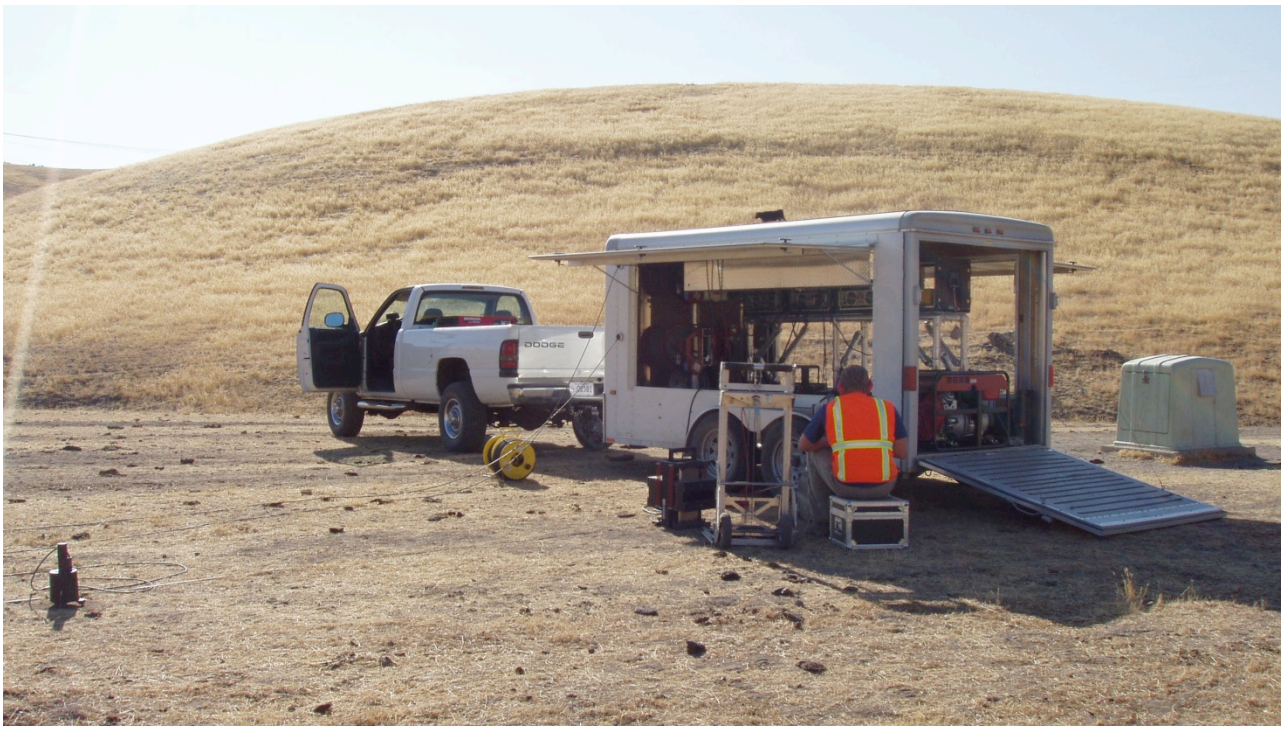
Surface-Wave Site Characterization at 52 Strong-Motion Recording Stations Affected by the Parkfield, California, M6.0 Earthquake of 28 September 2004

By Eric M. Thompson, Robert E. Kayen, Brad Carkin, and Hajime Tanaka



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Contents

Figures

Tables

Surface-Wave Site Characterization at 52 Strong-Motion Recording Stations Affected by the Parkfield, California, M6.0 Earthquake of 28 September 2004

By Eric M. Thompson[1], Robert E. Kayen[2], Brad Carkin[2] and Hajime Tanaka[1]

Abstract

We present one-dimensional shear-wave velocity (V_S) profiles at 52 strong-motion sites that recorded the 28 September 2004 Magnitude 6.0 Parkfield, Calif., earthquake. We estimate the V_S profiles with the Spectral Analysis of Surface-Waves (SASW) method. The SASW method is a noninvasive method that indirectly estimates the V_S at depth from variations in the Rayleigh wave phase velocity at the surface. To address the uncertainty associated with these measurements, we compare the SASW profiles to surface-source downhole-receiver (SSDR) profiles at four sites. Three of the four SSDR sites are in close agreement with the adjacent SASW site, while the SASW profile is considerably slower than the SSDR profile at one site.

Introduction

The goal of this project is to measure the shear-wave velocity (V_S) profile of the near-surface materials at strong-motion stations that recorded the 28 September 2004 Magnitude (M) 6.0 Parkfield earthquake. The Parkfield section of the San Andreas Fault is densely instrumented with strong-motion stations because moderate magnitude earthquakes have ruptured at regular intervals at approximately the same location on the fault (Bakun and Lindh, 1985). Thus, the hope was to record numerous ground motions at short epicentral distances, where few records had previously been obtained (Shakal and others, 2006). Although the Parkfield earthquake occurred years later than expected, the extensive instrumentation eventually provided a spatially dense suite of recordings at very small distances from the fault. The large variability of the intensity of the shaking at these sites is striking, and is a complex function of finite fault source process, path effects, and local site conditions (Harris and Arrowsmith, 2006).

The V_S profiles presented in this report are useful for studies of the local site conditions on the ground motions recorded at short epicentral distances in Parkfield. Recordings from the 1983 M6.5 Coalinga earthquake indicate that the site effects are highly variable at the Parkfield stations (Liu and others, 2006).

We use the Spectral Analysis of Surface Waves (SASW) method to measure the V_S profile. SASW is an inexpensive and efficient means for noninvasively estimating the subsurface V_S. Prior to the development of noninvasive surface-wave methods for estimating V_S, shear-wave travel times were measured inside cased boreholes or penetration tests, which are both relatively costly by comparison (see Boore and Thompson (2007) for further discussion of downhole methods). Static penetration tests tend not to be very useful as they routinely cannot reach the depths required for seismic site response analysis because the soil becomes too stiff to penetrate.

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Study Area

The Parkfield study area (fig. 1) is located astride the San Andreas Fault in the Central Coast Range of California. At 52 strong-motion stations, we conducted SASW surveys to estimate the V_S profile. The northwest boundary of our study area is approximately Vineyard Canyon Road at 36° north and 120.5° west (VIN sites on figure 1). The southeast corner of our study area is in the vicinity of Jack Canyon and Red Hills, south of Cholame, at 35.6° and -120.2° (CHO sites in figure 1). Clusters of test sites were centered along the Vineyard Canyon corridor (VIN sites on figure 1), the USGS Parkfield Dense Seismograph Array (UPSAR) sites (UPS sites), along the San Andreas Fault zone (FZ sites), the Gold Hill corridor (GH sites), Stone Canyon corridor (SC sites), and Cholame (CHO sites).

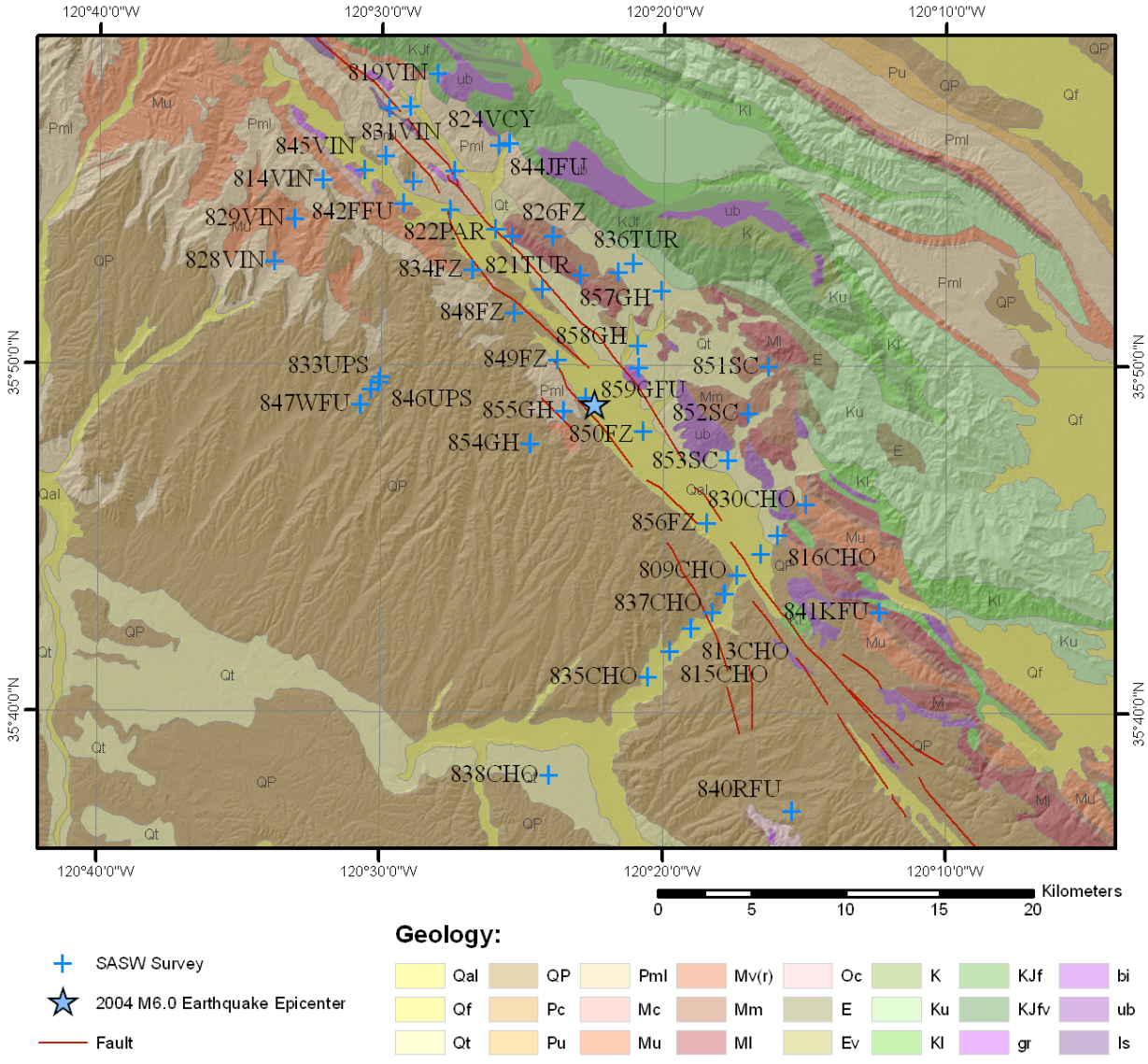

Figure 1. Vicinity map of the Parkfield sites with geology (Jennings, 1958). A web-based map can be found at http://gdcmaps.cee.tufts.edu/parkfield/ where the data can also be downloaded. The data are also available as part of this report at http://pubs.usgs.gov/of/2010/1168/parkfieldSASW.zip

Table 1. Geologic units shown in figure 1, modified from Jennings (1958).

Symbol	Description	Epoch	Period	Era
Qal	Alluvium	Recent	Quaternary	Cenozoic
Qf	Fan Deposits			
Qt	Nonmarine terrace deposits	Pleistocene-Recent		
QP	Plio-pleistocene nonmarine	Pliocene-Pleistocene	- - - - - - - - -	
Pc	Undivided Pliocene nonmarine	Pliocene	Tertiary	
Pu	Upper Pliocene marine			
Pml	Middle and/or lower Pliocene nonmarine			
Mc	Undivided Miocene nonmarine	Miocene		
Mu	Upper Miocene marine			
Mv(r)	Miocene volcanic (rhyolite)			
Mm	Middle Miocene marine			
Ml	Lower Miocene marine			
Oc	Oligocene nonmarine	Oligocene		
E	Eocene marine	Eocene		
Ev	Eocene volcanic			
K	Undivided Cretaceous marine	Undivided	Cretaceous	Mesozoic
Ku	Upper Cretaceous marine	Upper		
Kl	Lower Cretaceous marine	Lower		
KJfv	Franciscan volcanic and metavolcanic			
KJf	Franciscan Formation	Upper Jurassic to Upper Cretaceous		
gr	Mesozoic granitic rocks			
bi	Mesozoic basic intrusive rocks	Upper	Jurassic	
ub	Mesozoic ultrabasic intrusive rocks			
ls	Pre-Cretaceous metamorphic rocks (limestone or dolomite)	Pre-Cretaceous		

Field Methods

Active source SASW testing typically profiles the upper 10s of meters of the ground (for example, the upper 30 meters (m) that is needed to compute the widely used site parameter V_{S30}, defined as 30 m divided by the shear-wave travel time to 30 m depth) by using drop weights or harmonic sources. Deeper shear-wave profiles require longer wavelengths that normally cannot be collected unless a large drop weight such as massive construction machinery is used to produce an ultra-low frequency wave field. For example, Kayen and others (2004) profiled the shear-wave structure of both sides of the Denali Fault by using a 49-ton Caterpillar D9N dozer as an active source. Drop weights and heavy track-mounted machinery are useful tools for generating surface waves where the ground and landowners will support their presence. The two major drawbacks to this approach are that (1) these devices tend to be damaging to the ground surface, and (2) many sites of scientific importance are not easily accessible with such equipment.

The SASW method used by the USGS Coastal and Marine Geology Team is a new technique that uses a parallel array of mass shakers. This method allows for profiling to depths up to several hundred meters without the use of massive drop weights or heavy track-mounted

machinery. In this method, we substitute an array of many ultra-low frequency electro-mechanical shakers for what would traditionally be a large Vibroseis truck. Surface waves are generated with an array of up to eight APS Dynamics Model 400 shaker and amplifier units, powered by two generators and controlled by a spectral analyzer (fig. 2).

The shakers have a long-stroke capable of cycling as low as 1 Hertz (Hz), well below the normal cut-off frequency of a Vibroseis truck at 7 Hz. The output signal from the spectral analyzer is split into a parallel circuit and sent to the separate amplifiers. The amplifiers power the shakers to produce a coherent phase continuous harmonic-wave that vertically loads the ground. Most of this energy result produces Rayleigh surface waves.

Figure 2. 'Velociraptor' Surface wave shaker trailer testing Parkfield Earthquake sites, Cholame, Calif.

For a given frequency, the cross power spectra and phase-angle between the outboard and reference seismometers are computed. The SASW procedure steps through a suite of frequencies, from which phase computations are made. This method, termed swept-sine surface wave testing, sweeps across a range of low frequencies (1-200 Hz) in order to capture the variability of the Rayleigh-wave phase velocity. The shaking equipment is mounted inside a large trailer that includes cable reels to connect up to four seismometers, a low frequency spectrum analyzer, 4 to 8 computer-controlled continuous harmonic-wave sources (shakers) and their amplifiers, cables, and two 4.5 kilowatt (kW) generators.

In order to construct an empirical dispersion profile for the site, several different receiver spacings are used to capture the high, medium, and low frequency ranges. The wavelengths (λ) are computed by relating the seismometer spacing (d) and the phase angle (ϕ), from the cross-power spectra between the seismometers:

$$\lambda = 2\pi d/\phi. \quad (1)$$

The Rayleigh-wave phase velocity, V_r, is computed as the product of the frequency (f) and wavelength(λ):

$$V_r = f\lambda. \quad (2)$$

Inversion Methods

The V_S profiles presented in this paper are computed by using the Fortran routines of SWAMI (Lai and Rix, 1998). The dispersive characteristic of Rayleigh-wave propagation is what allows us to infer the V_S at depth based on measurements at the free surface. The forward problem computes the Rayleigh-wave phase velocity (V_R) from laterally constant layers of an infinite halfspace. The Lai and Rix (1998) code employs the algorithm developed by Hisada (1994) to solve the forward problem by using the method of reflection and transmission coefficients.

The surface-wave inversion problem is an "ill-posed" inverse problem. The term "ill-posed" (in relation to inverse problems) is credited to the French mathematician Hadamard who defined mathematical problems to be "well-posed" if a solution exists, the solution is unique, and the solution is stable (Zhdanov, 2002). According to Hadamard, only "well-posed" problems are physically meaningful. Subsequently, methods have been developed for solving ill-posed problems, termed regularization methods.

The Levenberg-Marquardt method, also called damped least squares, is one example of a regularization method. These and other techniques, such as artificial neural networks and genetic algorithms, are discussed by Santamarina and Fratta (1998). Luke and Calderón-Marcías (2007) use the simulated annealing stochastic inversion technique because it is better at searching through the parameter space. One cost of these stochastic methods is that they often require many more iterations, and so they are much more computationally intensive.

The parameters of the forward problem can be chosen such that the difference between the observation (here, the empirical dispersion curve) and the output of the forward problem are minimized. Such a constraint is insufficient for ill-posed problems because many solutions will fit the data equally well and some of these solutions will be physically unrealistic. The most common approach is to seek a parsimonious solution, such that model simplicity is maximized as the misfit to the data is minimized.

The inversion method that Lai and Rix (1998) apply to this problem was termed "Occam's inversion" by Constable and others (1987). This method attempts to constrain the inversion solution space by selecting the smoothest solution from a suite of solutions that all exhibit a sufficient goodness-of-fit to the observed data, as indicated by a threshold root mean square (RMS) error.

Results

We provide two different inversion solutions at each site to emphasize the nonunique nature of the solution. We typically vary assumptions about the layer thicknesses and the threshold RMS error that determines if the inversion has converged. This process generally yields the two solutions where the smoothness or complexity of the profile is significantly different. The decision as to whether or not the more complex model is warranted by the fit of the theoretical dispersion curve (TDC) to the empirical dispersion curve (EDC) is subjective.

Table 2 summarizes results and provides the SASW site ID, the latitude and longitude of the SASW test, the corresponding strong-motion station ID, the latitude and longitude of the target strong-motion station, the V_{S30} and $Z_{1.0}$ computed from the two different SASW models ($Z_{1.0}$ is the minimum depth where the velocity is greater than 1.0 kilometer per second (km/sec)). It was impossible for us to identify the specific UPSAR stations in the field. We collected two profiles in the vicinity of the UPSAR array but have not indicated a station ID for these because of the uncertainty of the location of the UPSAR stations.

Table 2. Summary information for the 52 Spectral Analysis of Surface-Waves surveys at strong-motion stations. The geographic coordinates are given for the location of the surveys as well as the published location of the stations. V_{S30} and $Z_{1.0}$ are given for the two different Spectral Analysis of Surface-Waves models (M1 and M2).

SASW			Strongmotion station				V_{S30}, m/sec		$Z_{1.0}$, m	
ID	Lat.	Lon.	ID	Lat.	Lon.	Description	M1	M2	M1	M2
807PAR	35.8985	-120.4329	36138	35.9000	-120.4330	Fault Zone 12	261	272		
808PAR	35.8986	-120.4325	36531	35.8980	-120.4310	1-story School Bldg	270	271		
809CHO	35.7328	-120.2894	36228	35.7330	-120.2900	Cholame 02WA	174	173		
810CHO	35.7430	-120.2753	36452	35.7430	-120.2750	Cholame 01E	233	225		
811TUR	35.8779	-120.3599	36529	35.8780	-120.3580	Turkey Flat - No 1(Rock)	907	926		
812CHO	35.8180	-120.3792	36415	35.8180	-120.3780	Gold Hill 1W	214	216		
813CHO	35.7072	-120.3163	36412	35.7070	-120.3160	Cholame 04AW	283	288		
814VIN	35.9220	-120.5348	36176	35.9220	-120.5340	Vineyard Cyn 3W	309	311		
815CHO	35.6963	-120.3288	36227	35.6970	-120.3280	Cholame 05W	237	226		100
816CHO	35.7521	-120.2657	36230	35.7520	-120.2620	Cholame 02E	523	510		
817EAD	35.8952	-120.4229	EFU	35.8942	-120.4212	Eades	384	388		
818PAR	35.9266	-120.4570	FZ16	35.9270	-120.4560	Fault Zone 16	378	384	30	40
819VIN	35.9731	-120.4671	36177	35.9730	-120.4670	Vineyard Cyn 2E	468	465		
820CHO	35.8701	-120.4051	36431	35.8710	-120.4040	Fault Zone 07	297	290		
821TUR	35.8767	-120.3826	36449	35.8780	-120.3810	Fault Zone 08	309	295	45	68
822PAR	35.9080	-120.4595	36456	35.9080	-120.4580	Fault Zone 14	246	258		
823PAR	35.9211	-120.4813	36445	35.9210	-120.4810	Fault Zone 15	310	308	100	90
824VCY	35.9399	-120.4247	DFU	35.9392	-120.4245	Donna Lee	666	657	20	20
825VCN	35.9573	-120.4831	36455	35.9570	-120.4810	Vineyard Cyn 1E	381	373		
826FZ	35.8955	-120.3989	36453	35.8960	-120.3980	Fault Zone 11	545	542	60	80
827SAF	35.9741	-120.5521				SAFOD Drill Site	387	387		
828VIN	35.8829	-120.5629	36440	35.8850	-120.5650	Vineyard Cyn 5W	320	321		
829VIN	35.9033	-120.5513	36446	35.9050	-120.5510	Vineyard Cyn 4W	386	386	90	80
830CHO	35.7671	-120.2488	36450	35.7700	-120.2470	Cholame 03E	396	397		
831VIN	35.9336	-120.4974	36448	35.9340	-120.4970	Vineyard Cyn 1W	284	286		
832UPS	35.8214	-120.5059		35.8210	-120.5070	UPSAR	358	363		
833UPS	35.8248	-120.5011		35.8238	-120.5033	UPSAR	419	417		
834FZ	35.8791	-120.4461	36443	35.8790	-120.4450	Fault Zone 09	372	363	130	120
835CHO	35.6842	-120.3418	36451	35.6840	-120.3420	Cholame 06W	252	253		
836TUR	35.8824	-120.3510	36520	35.8820	-120.3500	Turkey Flat - No 2	489	467	40	40
837CHO	35.7151	-120.3041	36411	35.7171	-120.3050	Cholame 04W	439	410		
838CHO	35.6369	-120.3998	36229	35.6360	-120.4030	Cholame 12W	359	363		
839CHO	35.7239	-120.2970	36410	35.7260	-120.2960	Cholame 03W	241	231		
840RFU	35.6199	-120.2570	RFU	35.6244	-120.2535	Red Hills	240	239		
841KFU	35.7153	-120.2056	KFU	35.7125	-120.2025	Jack Canyon	603	576	20	30
842FFU	35.9108	-120.4873	FFU	35.9111	-120.4855	Froelich	234	227		70
843MFU	35.9564	-120.4959	MFU	35.9576	-120.4956	Middle Mountain	398	417	70	50
844JFU	35.9390	-120.4309	JFU	35.9397	-120.4319	Joaquin Canyon	379	406		
845VIN	35.9268	-120.5100	36447	35.9270	-120.5090	Vineyard Cyn 2W	439	442		
846UPS	35.8277	-120.5001		35.8276	-120.5002	UPSAR10	342	336		

847WFU	35.8145	-120.5118	WFU	35.8145	-120.5111	Work Range	447	474		
848FZ	35.8586	-120.4214	36454	35.8590	-120.4200	Fault Zone 06	267	284		
849FZ	35.8360	-120.3958	36414	35.8360	-120.3950	Fault Zone 04	221	219		
850FZ	35.8019	-120.3450	36408	35.8030	-120.3340	Fault Zone 03	206	212		
851SC	35.8331	-120.2713	36437	35.8330	-120.2700	Stone Corral 3E	606	565	15	20
852SC	35.8105	-120.2831	36422	35.8100	-120.2820	Stone Corral 2E	566	586		
853SC	35.7878	-120.2948	36419	35.7880	-120.2940	Stone Corral 1E	261	261		
854GH	35.7958	-120.4120	36420	35.7960	-120.4110	Gold Hill 3W	511	457		
855GH	35.8113	-120.3922	36416	35.8120	-120.3910	Gold Hill 2W	290	297		
856FZ	35.7581	-120.3075	36407	35.7580	-120.3070	Fault Zone 01	178	180		
857GH	35.8695	-120.3346	36439	35.8700	-120.3340	Gold Hill 3E	442	451	30	45
858GH	35.8428	-120.3485	36421	35.8430	-120.3480	Gold Hill 2E	361	346		
859GFU	35.8324	-120.3477	GFU	35.8331	-120.3464	Gold Hill	583	558	10	20

Appendix A includes plots of the two model profiles and the EDCs and TDCs for each site. These figures also can be found on the interactive map associated with this report. Additionally, two SASW velocity models and the observed dispersion data can be downloaded from the map at http://gdcmaps.cee.tufts.edu/parkfield/ where the data can also be downloaded. The data are also available as part of this report at http://pubs.usgs.gov/of/2010/1168/parkfieldSASW.zip. Appendix A also includes the site photos and a vicinity map for each site. Where possible, we have indicated the location of the strong-motion station in the site photographs and vicinity maps to assess the distance between the SASW survey and the strong-motion station.

Note that the vertical lines on the EDC curves indicate the degree of scatter in the composite dispersion curve (the combination of the dispersion curves from the different receiver spacings). These bars indicate sites where the scatter in the composite dispersion curve is large, which would indicate that the measurement is less certain. However, care must be taken when interpreting these bars as an estimate of the uncertainty of the measurement. Lai and others (2005) assumed that the error of a phase velocity measurement is proportional to the phase velocity and we follow this assumption in the inversion process when the model error must be estimated to determine if the solution has converged. If the vertical bars are interpreted as estimates of the uncertainty, then the opposite conclusion is reached in many cases: the error would appear to be inversely proportional to phase velocity. This is because there is less redundancy of observations (that is overlap of the wavelengths from different receiver spacings) at the longer wavelengths, which are associated with larger phase velocities, thus there is generally less scatter in the composite dispersion curve higher phase velocities. This should not be interpreted as evidence that the longer wavelength measurements are more accurate than the shorter wavelength measurements.

Comparison to Invasive Velocity Profiles

Four of the sites where we measured the spectral analysis of surface waves (SASW) shear wave velocity,(V_S) profiles were previously characterized by the surface- source downhole-receiver (SSDR) method: 814VIN, 815CHO, 840RFU, and 841KFU. Additionally, site 836TUR is located at the Turkey Flat Valley Center site where many previous velocity investigations have been performed (see Kwok and others, 2008 for the comparison of the SASW profile to the numerous downhole profiles). The previous SSDR profiles were published in various USGS OFRs and compiled by Boore (2003). Table 3 gives the correspondence of the SASW site IDs with the USGS OFRs that originally published the downhole profiles. Figure 3 compares the SASW profiles with the downhole profiles at these four sites.

Table 3. Correspondence between SASW IDs and previously published downhole profiles.

SASW ID	USGS OFR	Hole Code	Name
814VIN	Gibbs and others (1990)	205	Vineyard Canyon
815CHO	Fumal and others (1982)	197	Cockrums Garage
840RFU	Gibbs and others (1990)	203	Red Hills
841KFU	Gibbs and others (1990)	202	Jack Canyon

Discussion

Sites 819VIN and 837CHO illustrate the effect of the smoothing parameter. At site 819CHO, model 1 is nearly monotonically increasing while model 2 has a velocity inversion (that is low velocity layer) between 40 to 60 m depth. The inclusion of this low-velocity layer improves

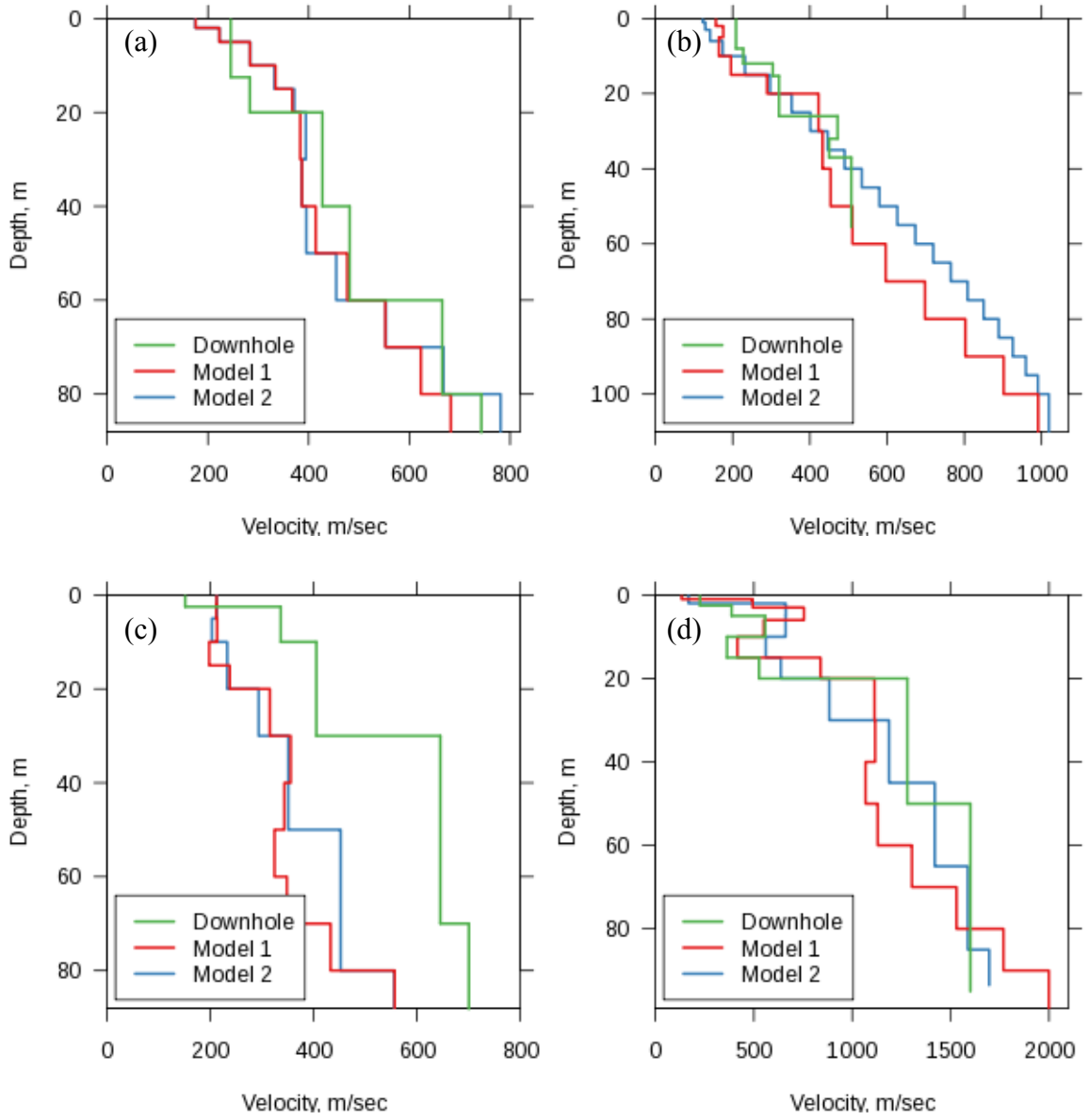

Figure 3. Comparison of the two different spectral analysis of surface waves interpretations to the surface- source downhole-receiver (SSDR) V_S profiles at sites (a) 814VIN, (b) 815CHO, (c) 840RFU, and (c) 841KFU.

the fit to the EDC. Here, we feel that the more complex model may be warranted. In contrast, the more complex solution at 837CHO is less justified by the EDC and it is our opinion that the smoother solution would be appropriate for any analysis.

Resources

We have used the SWAMI Fortran routines that are freely available at http://geosystems.ce.gatech.edu/soil_dynamics/research/surfacewavesanalysis/ (distributed under the terms of the GNU General Public License).

The EDC data and our interpreted velocity profiles are available from the website for this report. One text file for each site contains both types of data along with the site meta information in the header.

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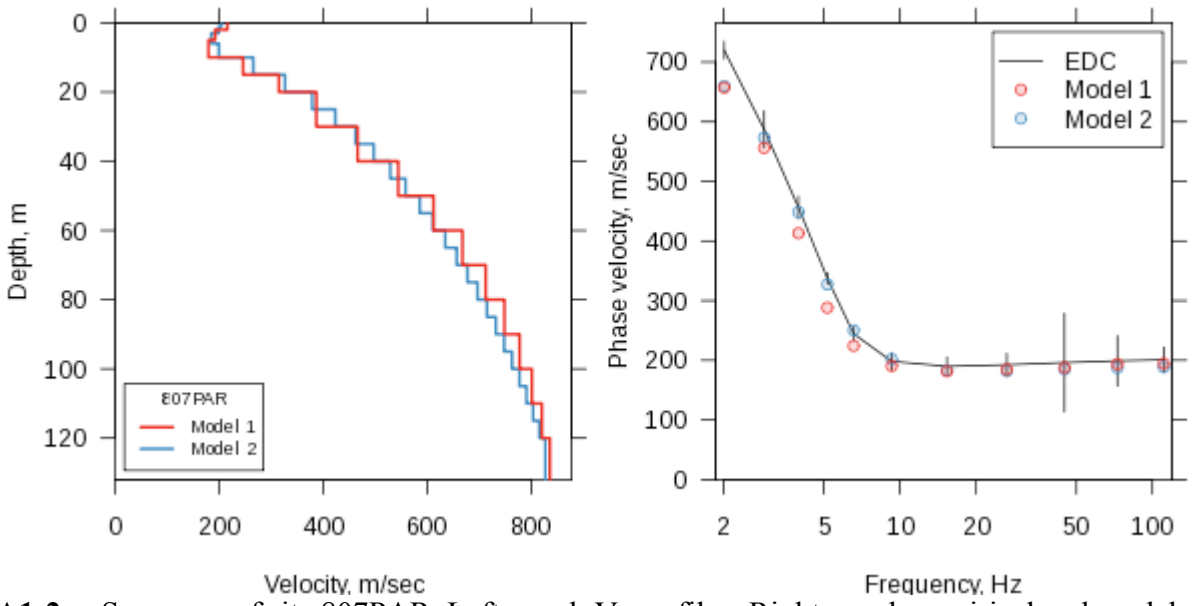
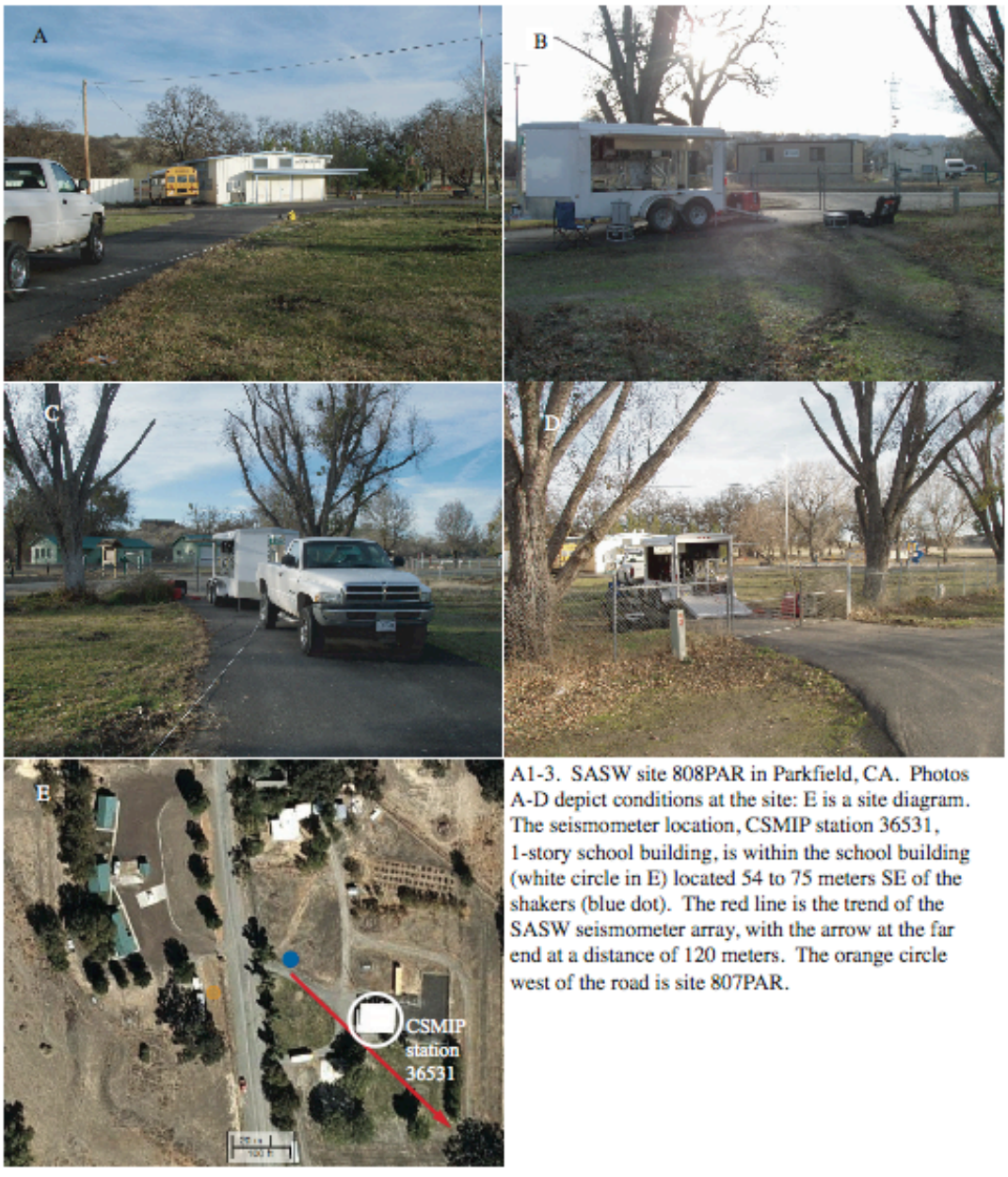
Appendix A:
Site Summaries

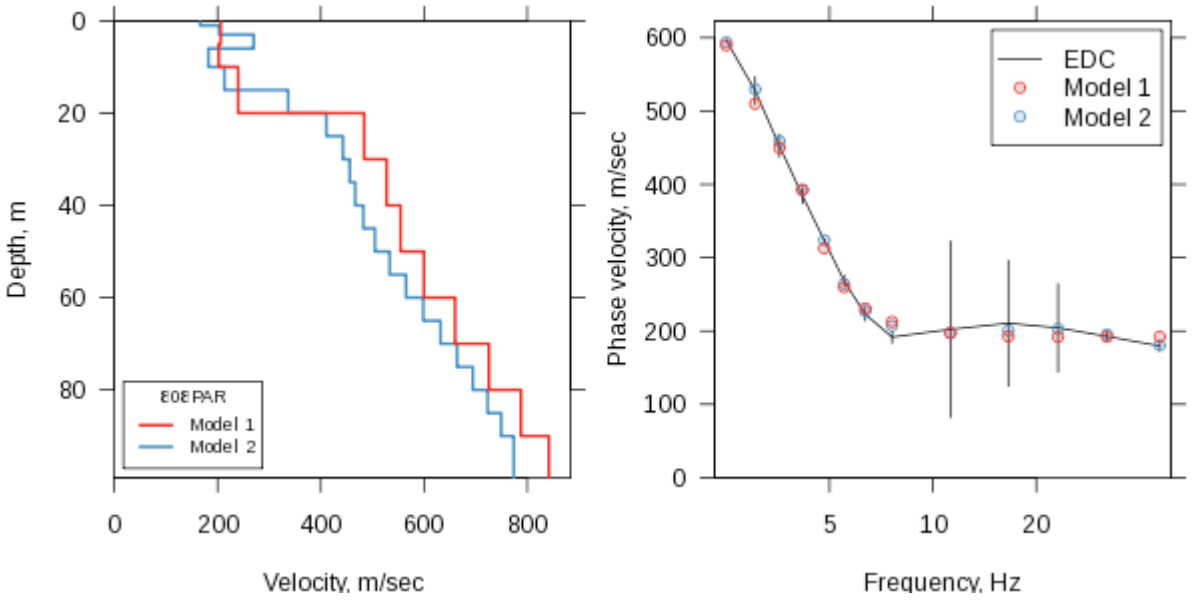
A1-1. SASW site 807PAR in Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36138, Fault Zone 12, is within the white circle in D and E and is located about 44 meters WSW of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 176 meters. The orange circle east of the road is the location of site 808PAR.



A1-2. Summary of site 807PAR. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

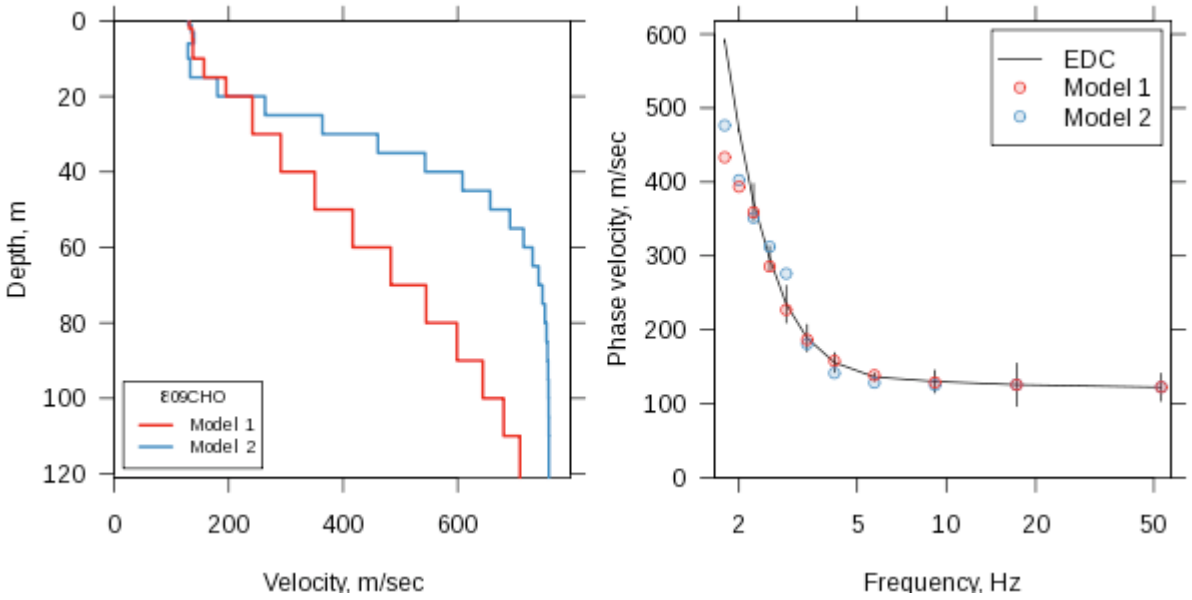


A1-3. SASW site 808PAR in Parkfield, CA. Photos A-D depict conditions at the site: E is a site diagram. The seismometer location, CSMIP station 36531, 1-story school building, is within the school building (white circle in E) located 54 to 75 meters SE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 120 meters. The orange circle west of the road is site 807PAR.



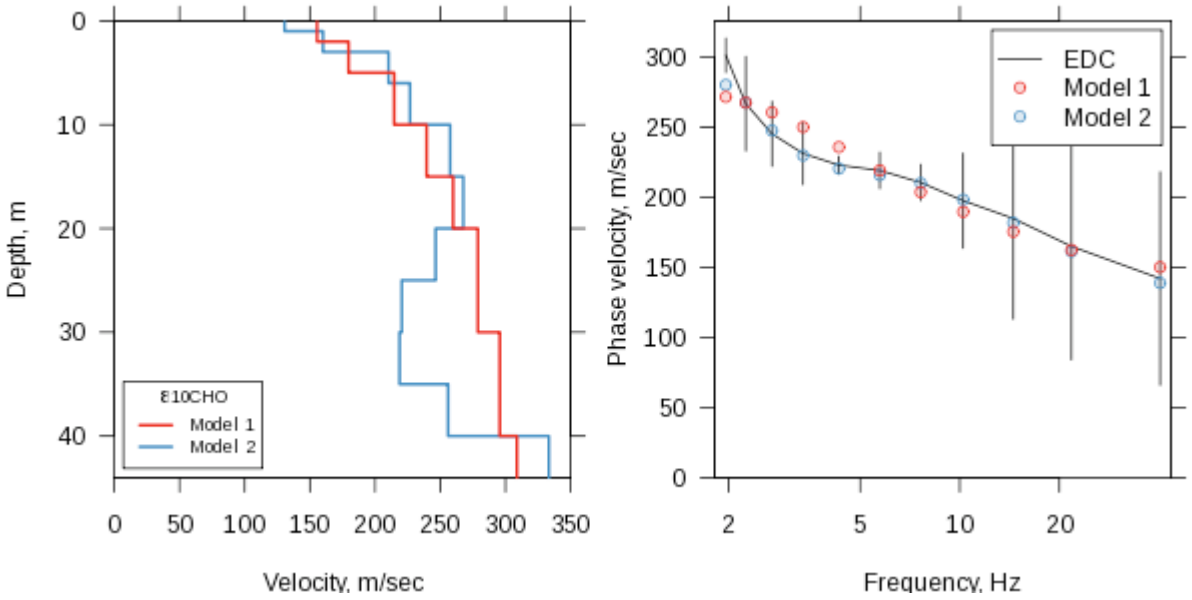
A1-4. Summary of site 808PAR. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

A1-5. SASW site 809CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36228, Cholame 2W (Sta 2), is within the white circle in B and E, situated about 80 meters E-NE of the shakers. The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 170 meters. The green and white symbol in E is the published location of station 26228, 65 meters NW of the shakers.

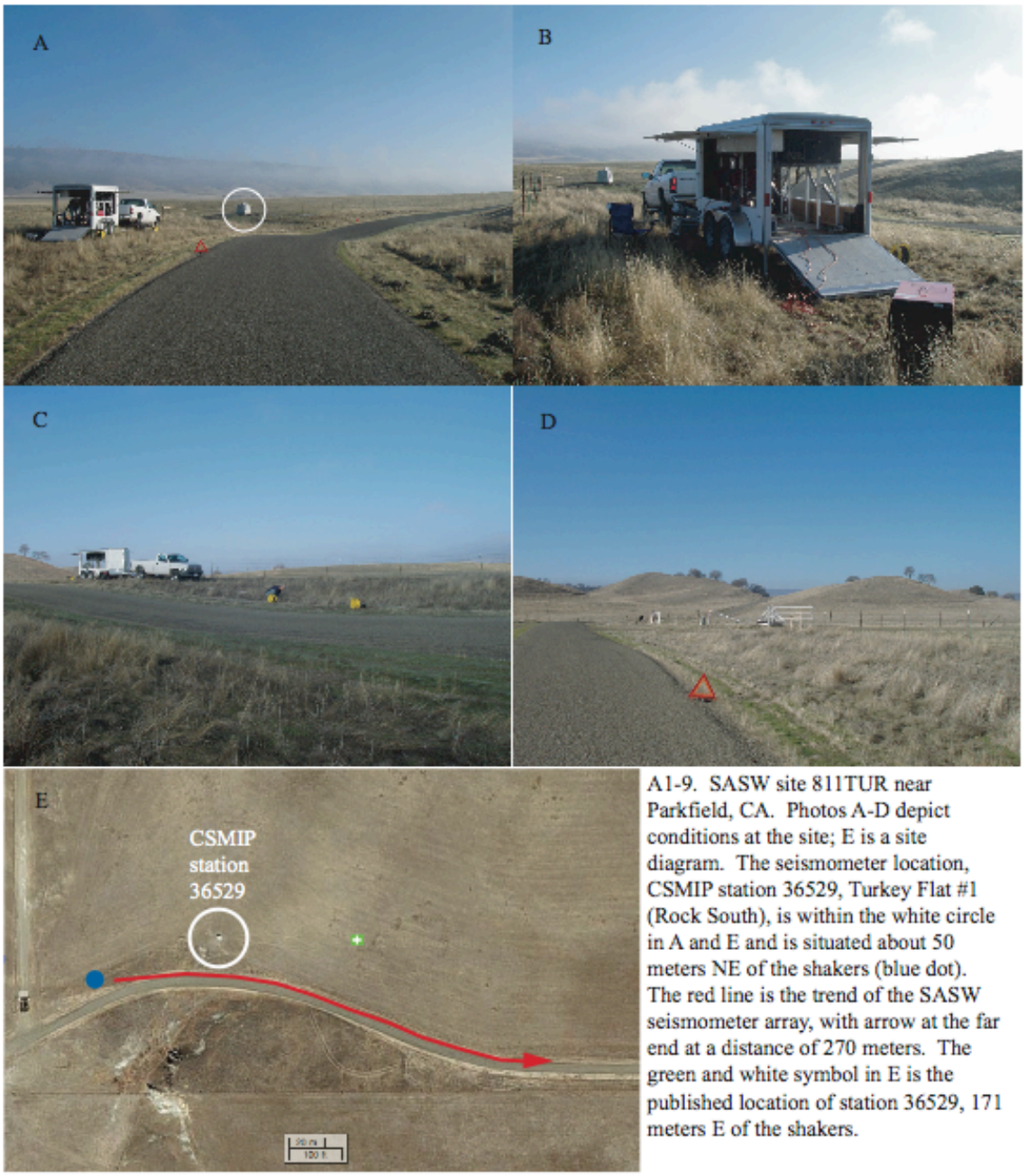


A1-6. Summary of site 809CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

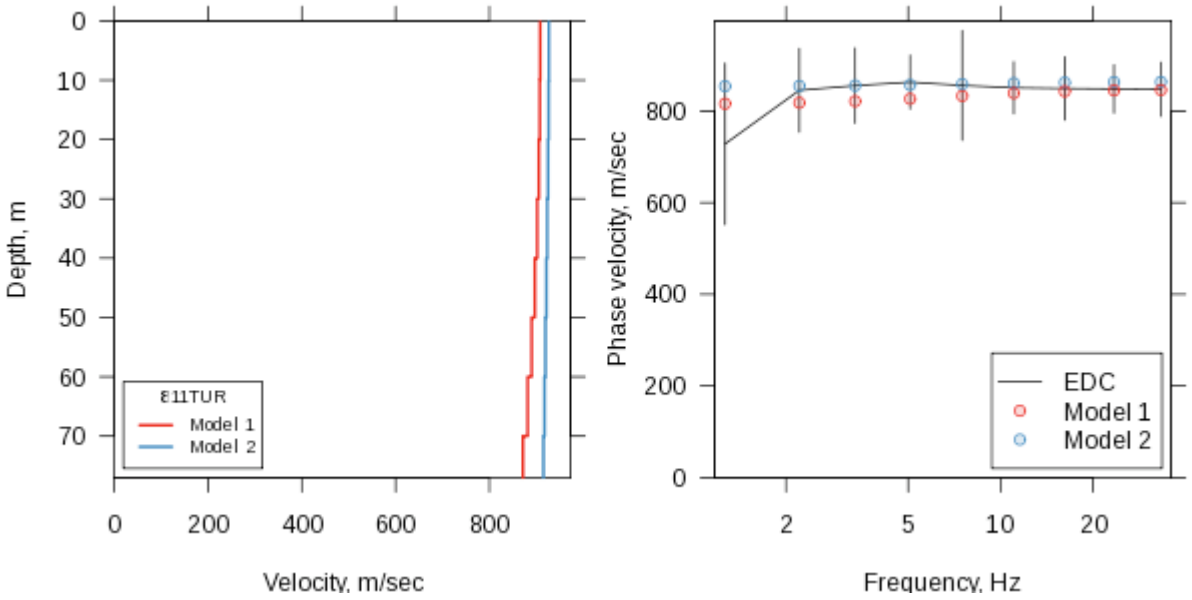
A1-7. SASW site 810CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36452, Cholame 1E, is about 144 meters SW of the shakers (blue dot) across Highway 41. The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 100 meters. The green and white symbol in E is the published location of station 36452, 28 meters E of the shakers. North is up in E.



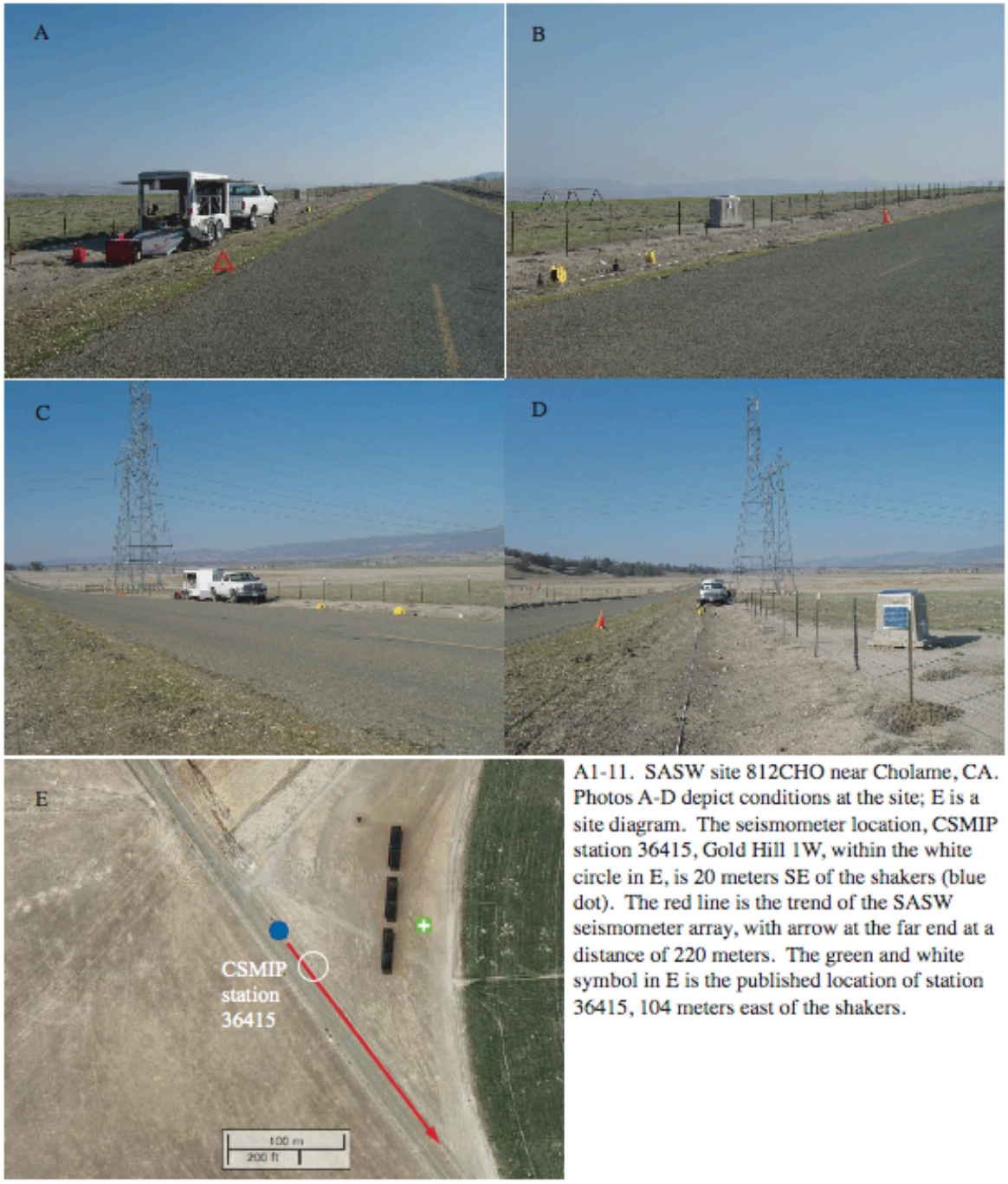
A1-8. Summary of site 810CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



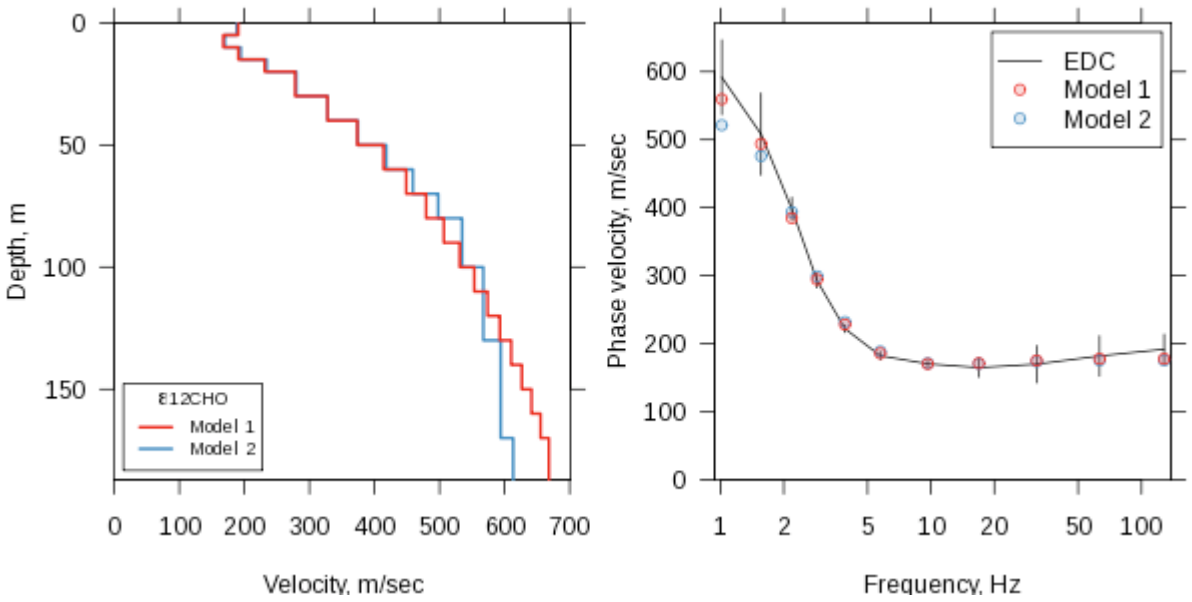
A1-9. SASW site 811TUR near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36529, Turkey Flat #1 (Rock South), is within the white circle in A and E and is situated about 50 meters NE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 270 meters. The green and white symbol in E is the published location of station 36529, 171 meters E of the shakers.



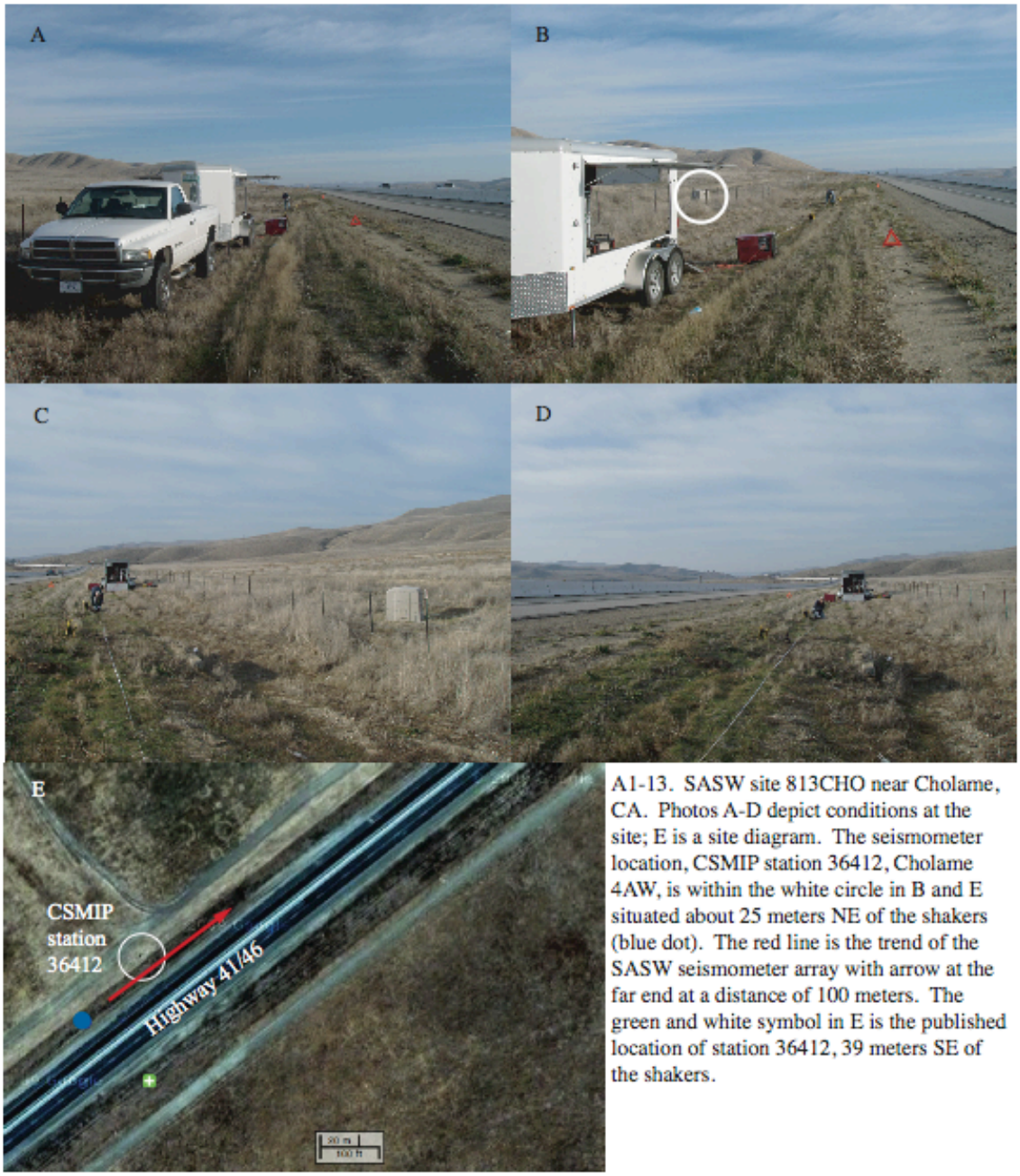
A1-10. Summary of site 811TUR. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



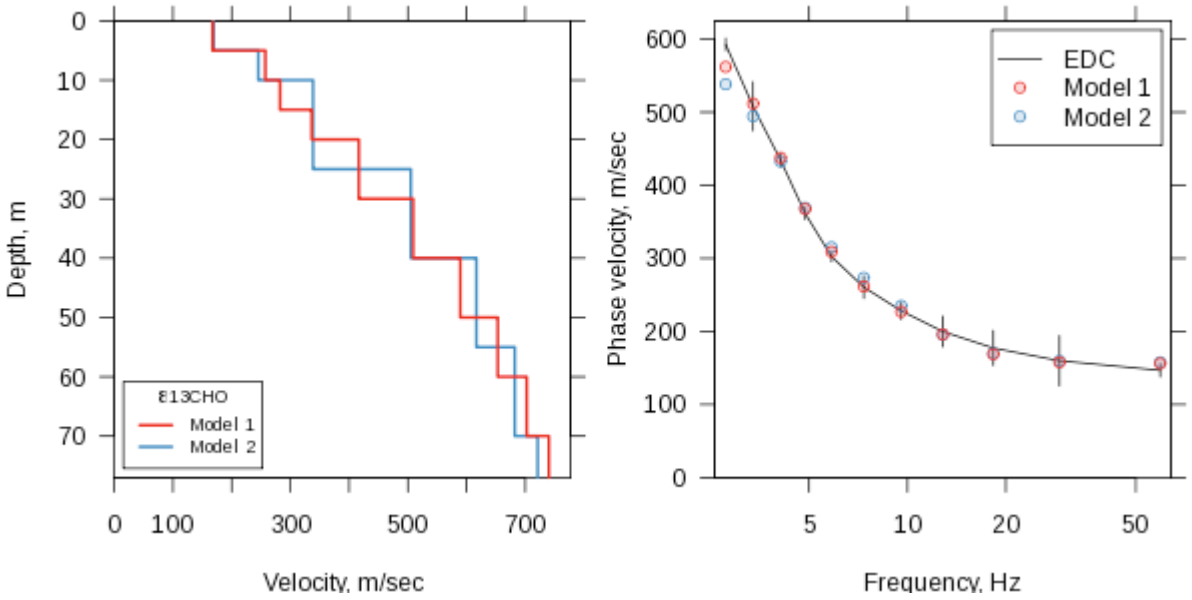
A1-11. SASW site 812CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36415, Gold Hill 1W, within the white circle in E, is 20 meters SE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 220 meters. The green and white symbol in E is the published location of station 36415, 104 meters east of the shakers.



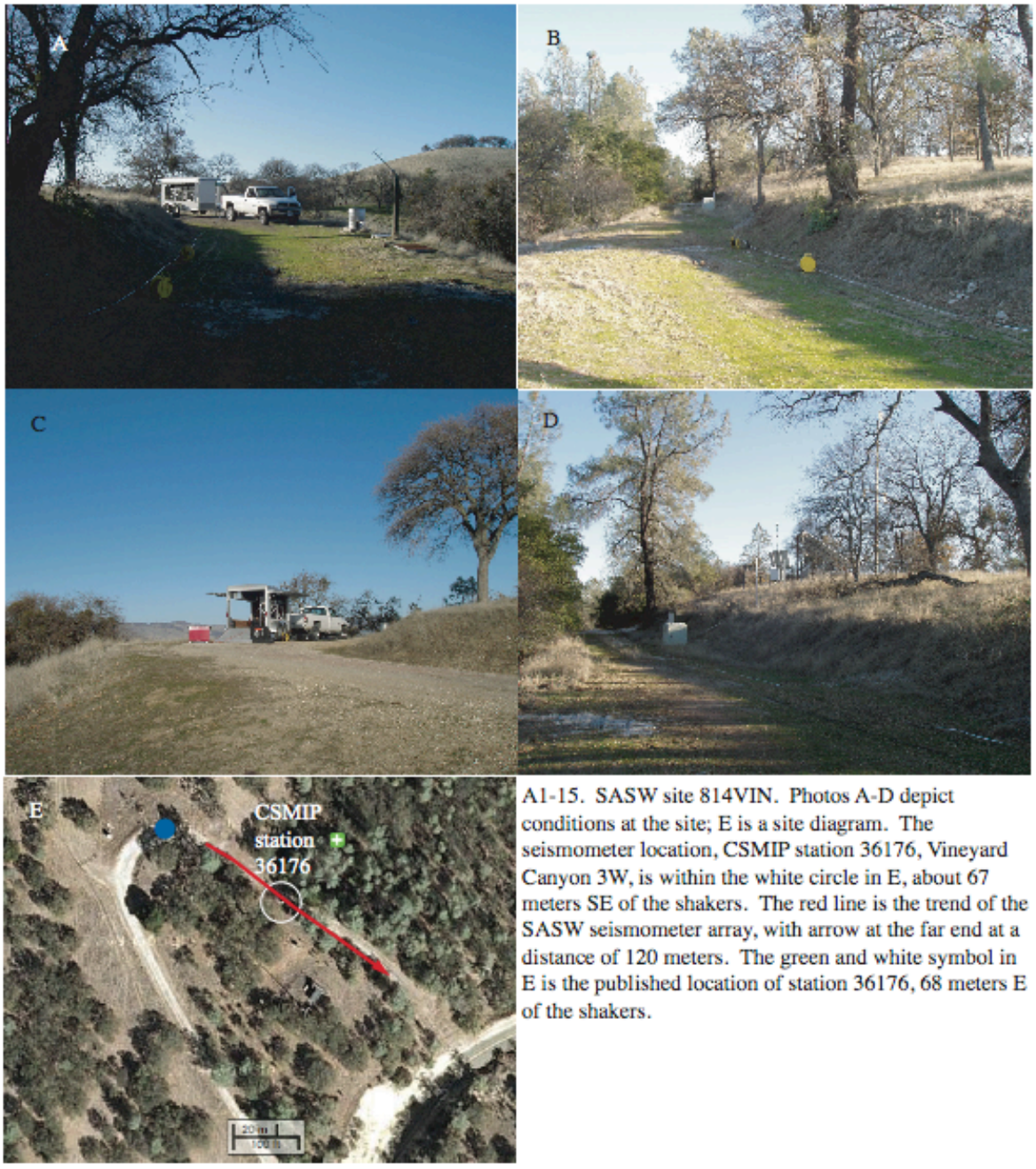
A1-12. Summary of site 812CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



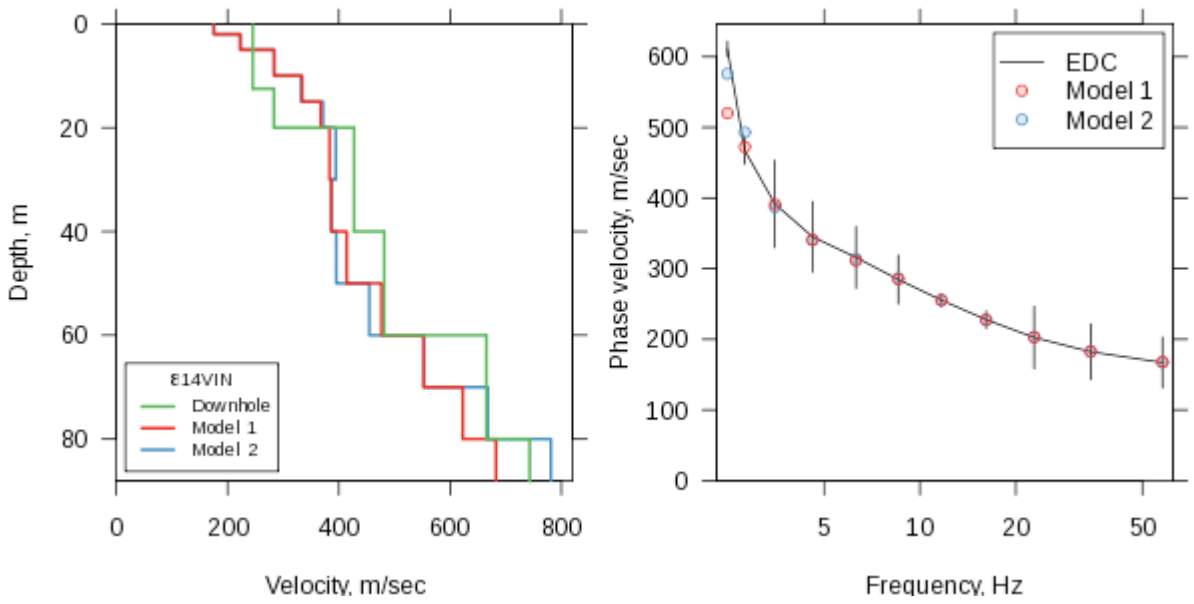
A1-13. SASW site 813CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36412, Cholame 4AW, is within the white circle in B and E situated about 25 meters NE of the shakers (blue dot). The red line is the trend of the SASW seismometer array with arrow at the far end at a distance of 100 meters. The green and white symbol in E is the published location of station 36412, 39 meters SE of the shakers.



A1-14. Summary of site 813CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

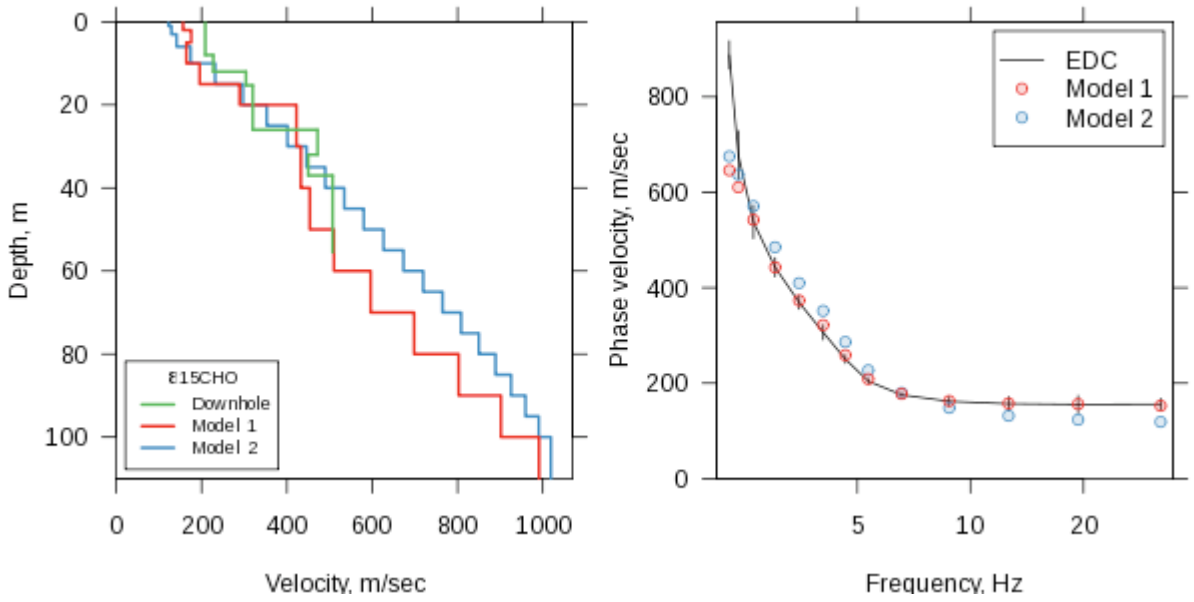


A1-15. SASW site 814VIN. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36176, Vineyard Canyon 3W, is within the white circle in E, about 67 meters SE of the shakers. The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 120 meters. The green and white symbol in E is the published location of station 36176, 68 meters E of the shakers.



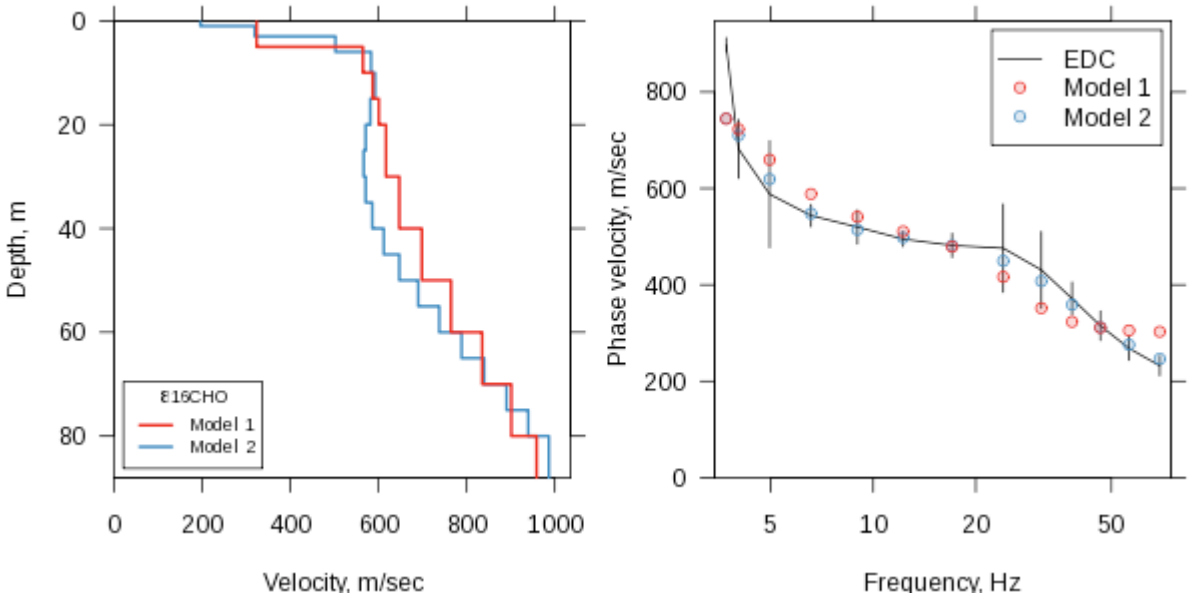
A1-16. Summary of site 814VIN. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

A1-17. SASW site 815CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer, CSMIP station 36227, Cholame 5W, could not be located at this site and has been moved from its original location. The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 175 meters. The blue dot is the location of the shakers. The green and white symbol in E is the published location of station 36227, 107 meters NE of the shakers.

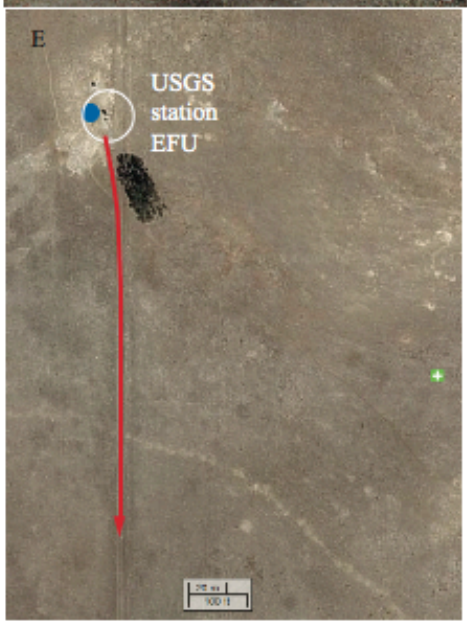


A1-18. Summary of site 815CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

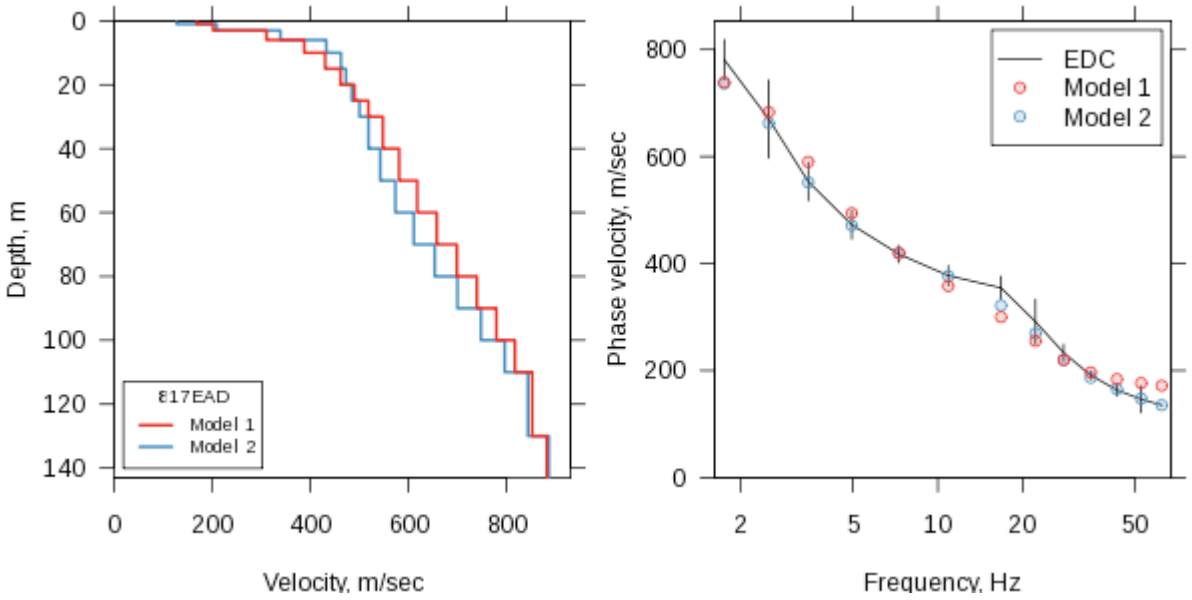
A1-19. SASW site 816CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP site 36230, Cholame 2E, is within the white circle in B and E, and is situated about 47 meters SE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 100 meters.



A1-20. Summary of site 816CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

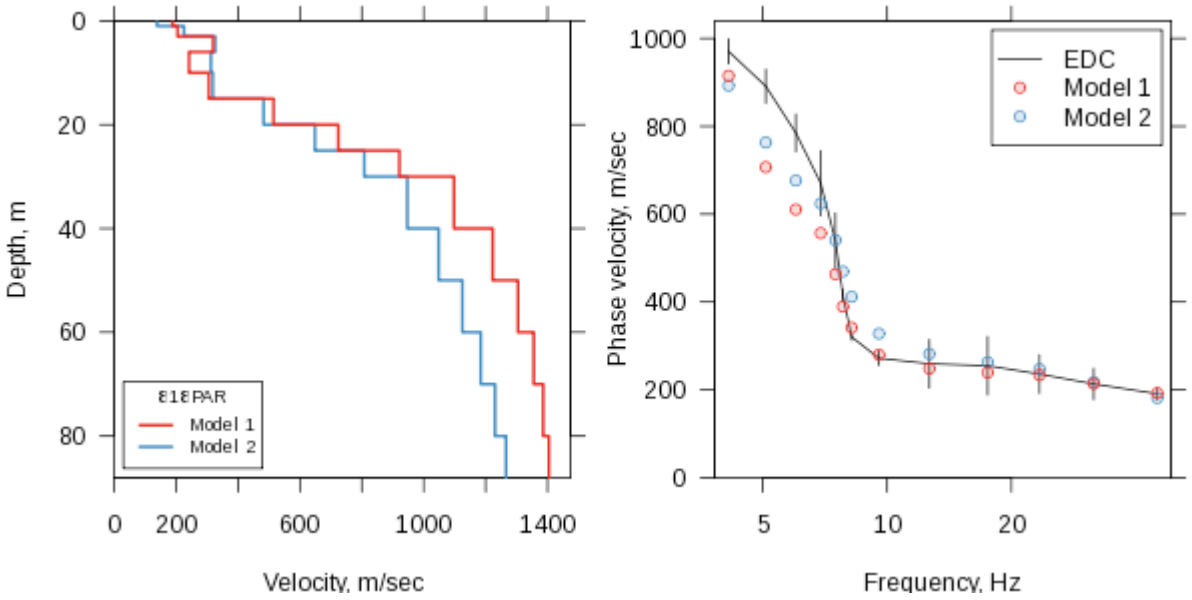


A1-21. SASW site 817EAD near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS station EFU Eades, is within the white circle in E, about 5 meters NE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 220 meters. The green and white symbol in E is the published location of station EFU, 190 meters SE of the shakers.



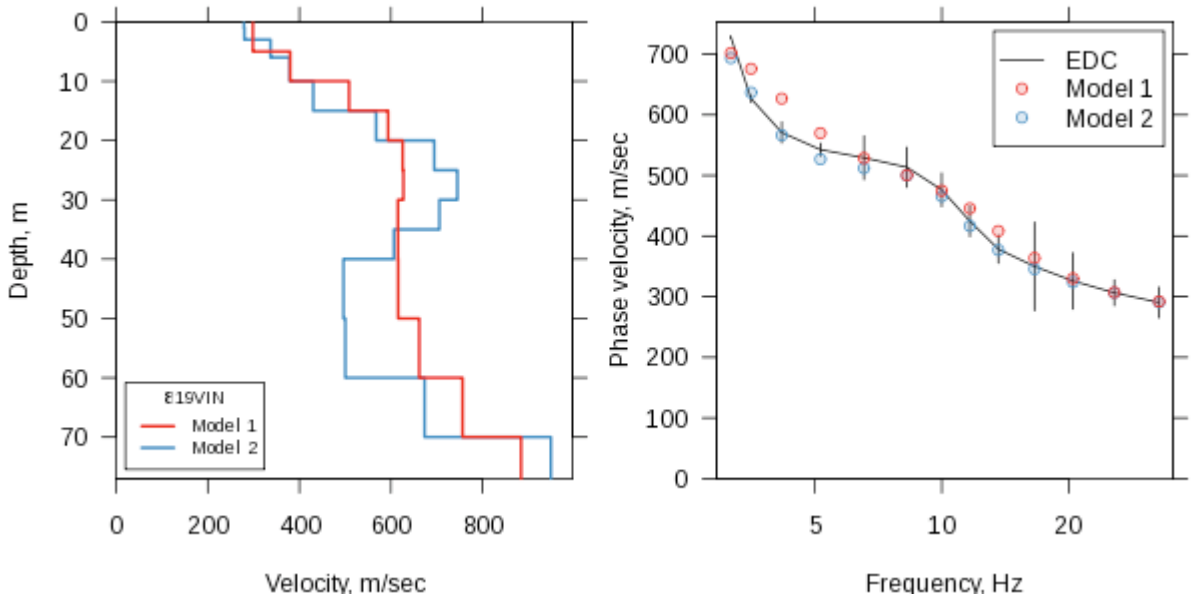
A1-22. Summary of site 817EAD. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

A1-23. SASW site 818PAR near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36457, Fault Zone 16, is within the white circle in E situated about 41 meters SE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 120 meters. The green and white symbol in E is the published location of station 36457, 102 meters NE of the shakers.

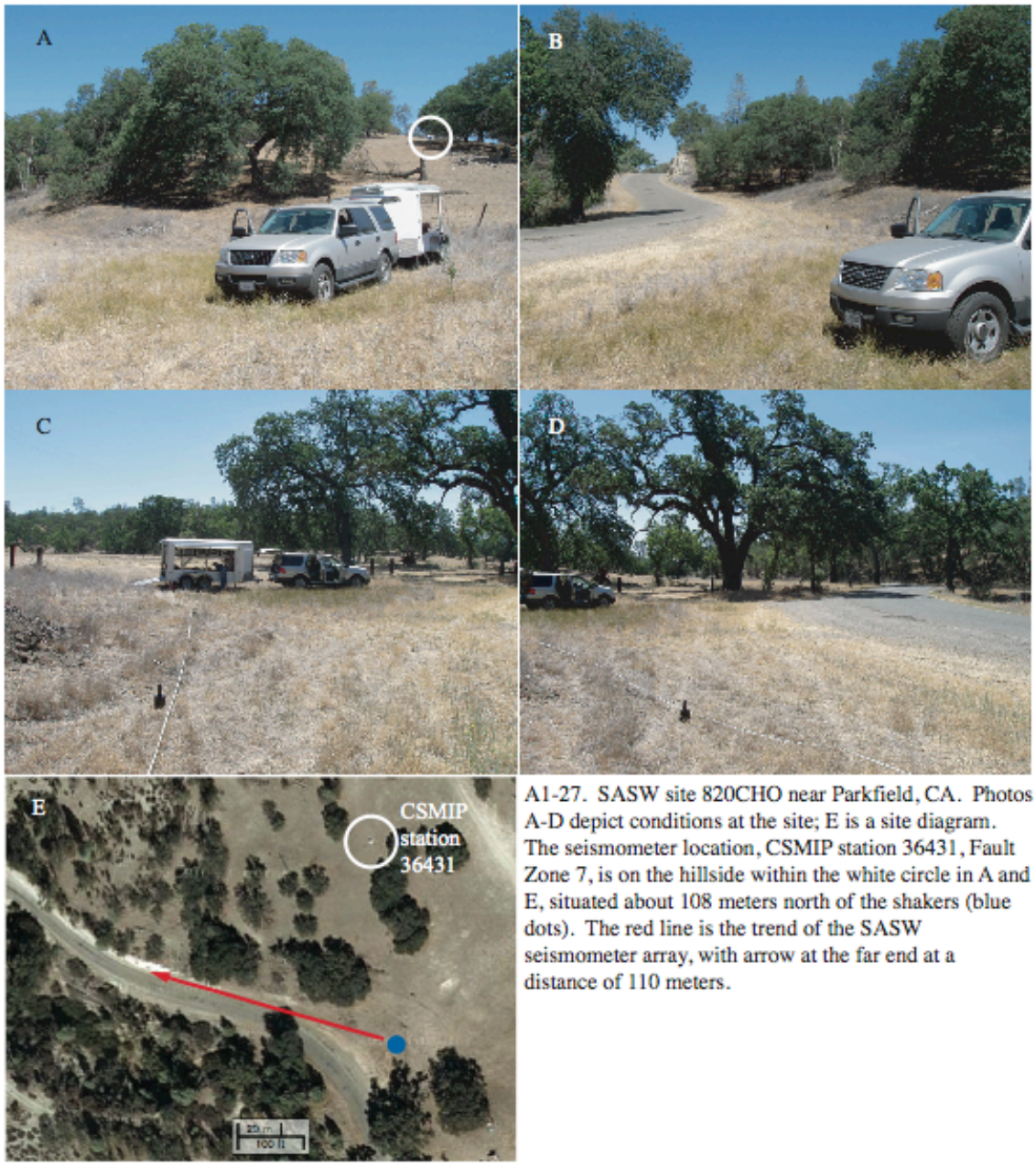


A1-24. Summary of site 818PAR. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

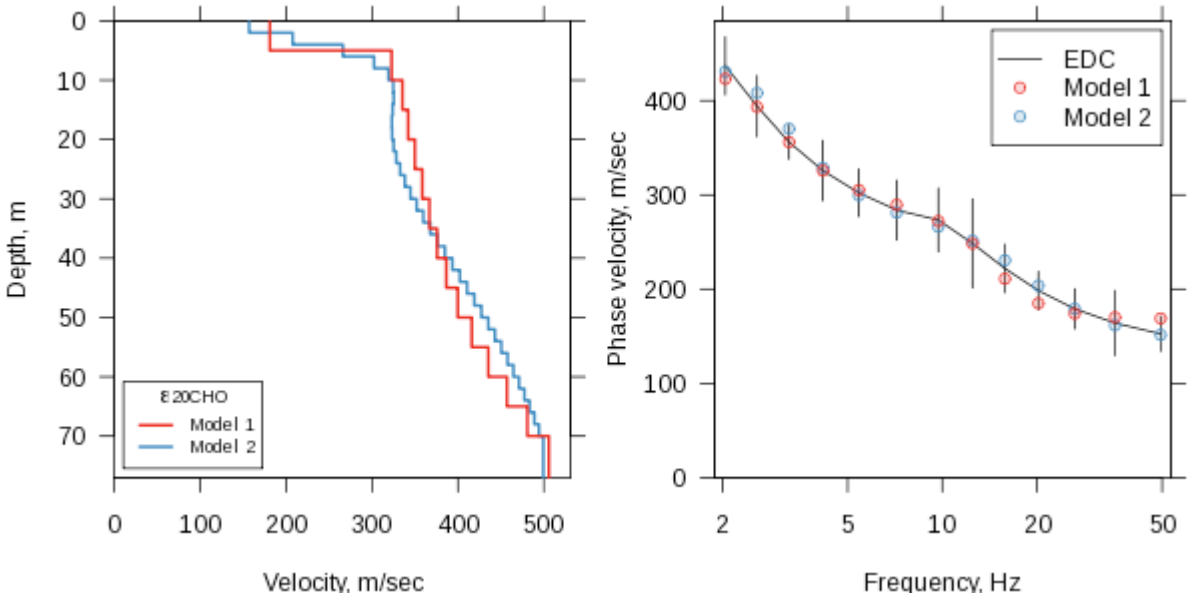
A1-25. SASW site 819VIN near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36177, Vineyard Canyon 2E, is within the white circle in E situated about 50 meters west of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 100 meters. The green and white symbol in E is the published location of station 36177, 13 meters SE of the shakers.



A1-26. Summary of site 819VIN. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

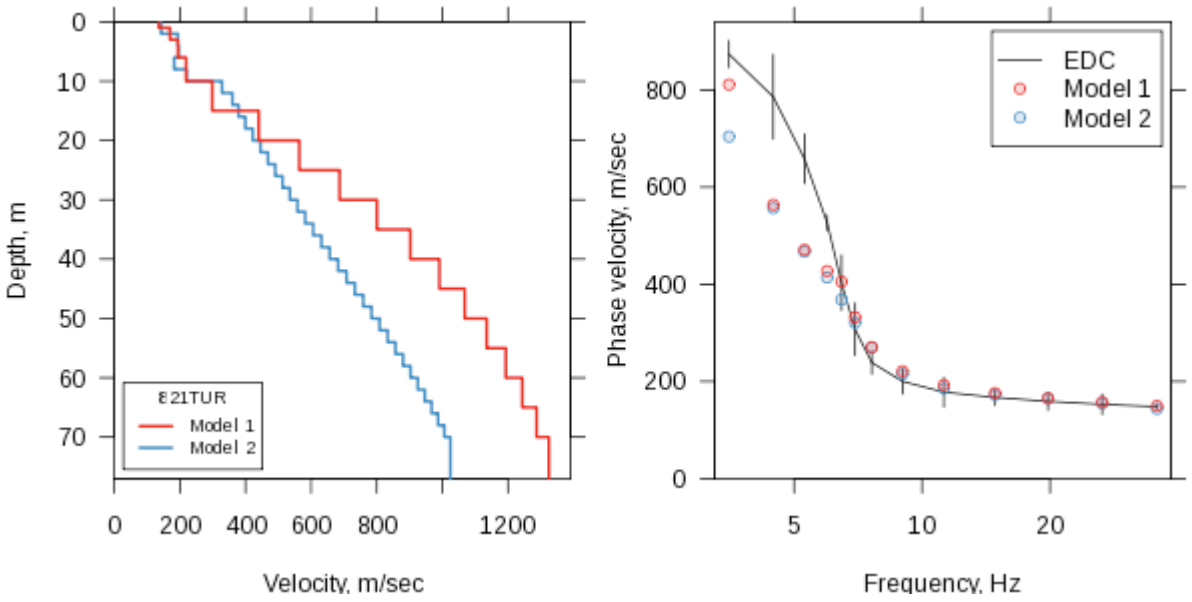


A1-27. SASW site 820CHO near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36431, Fault Zone 7, is on the hillside within the white circle in A and E, situated about 108 meters north of the shakers (blue dots). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 110 meters.

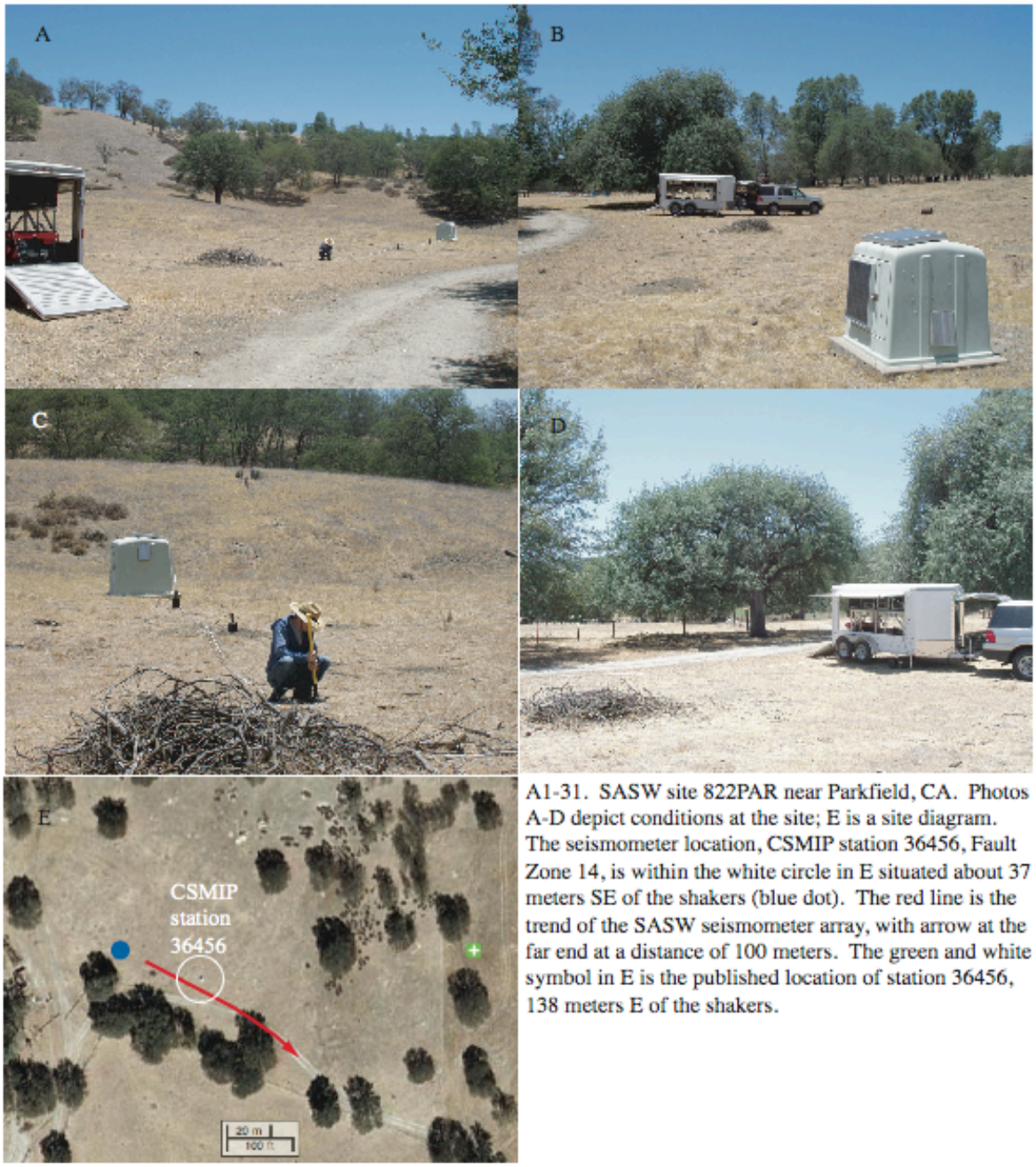


A1-28. Summary of site 820CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

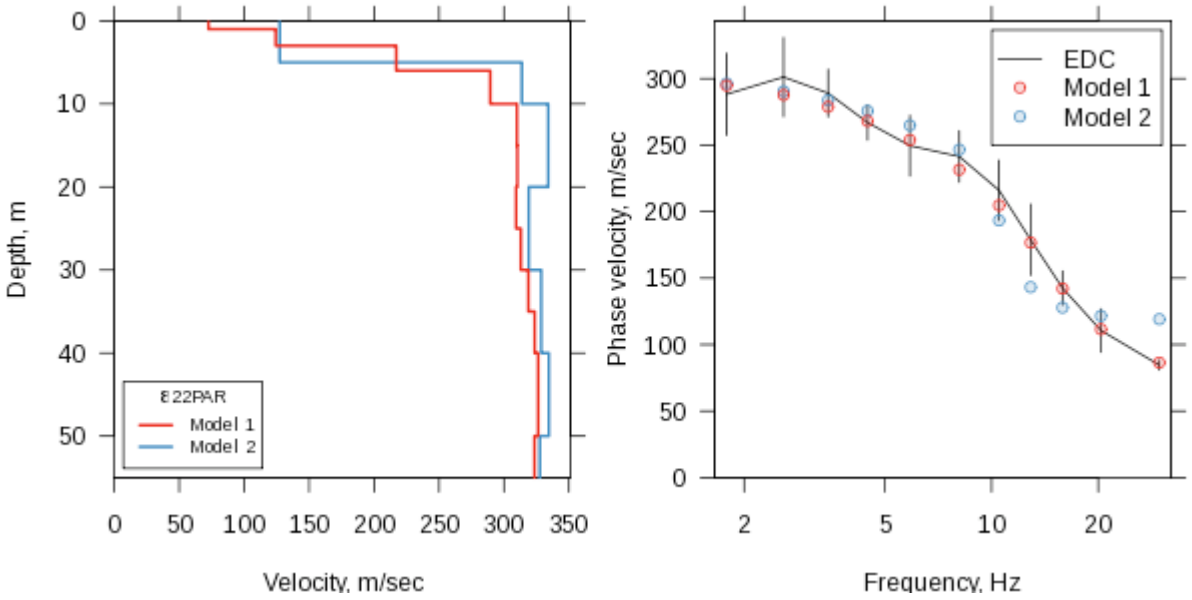
A1-29. SASW site 821TUR near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36449, Fault Zone 8, is within the white circle in C and E and is situated about 180 meters NNE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 150 meters. The green and white symbol in E is the published location of station 36449, 204 meters NE of the shakers.



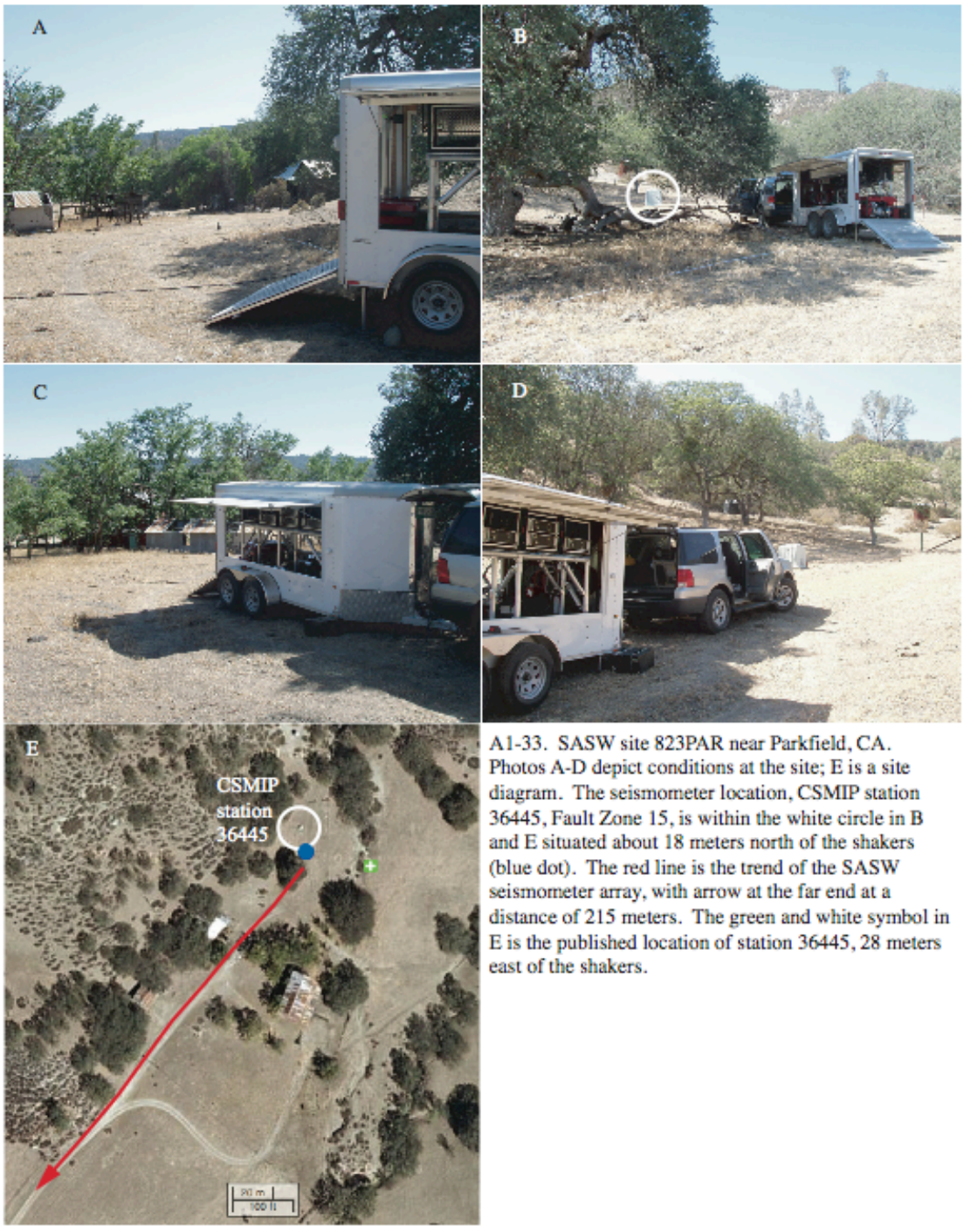
A1-30. Summary of site 821TUR. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



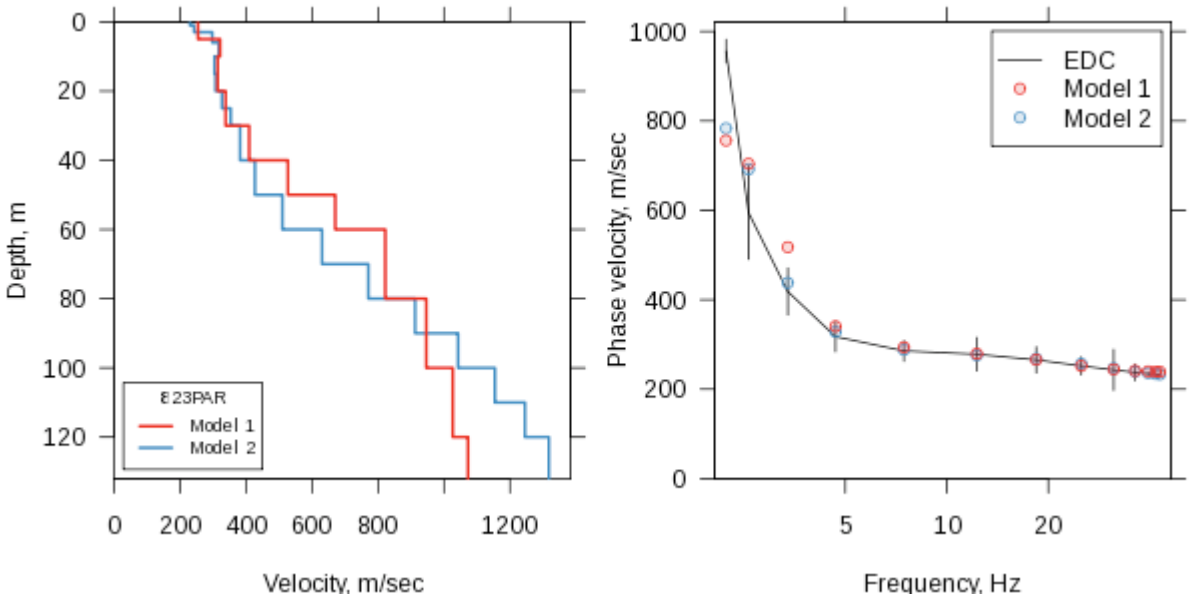
A1-31. SASW site 822PAR near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36456, Fault Zone 14, is within the white circle in E situated about 37 meters SE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 100 meters. The green and white symbol in E is the published location of station 36456, 138 meters E of the shakers.



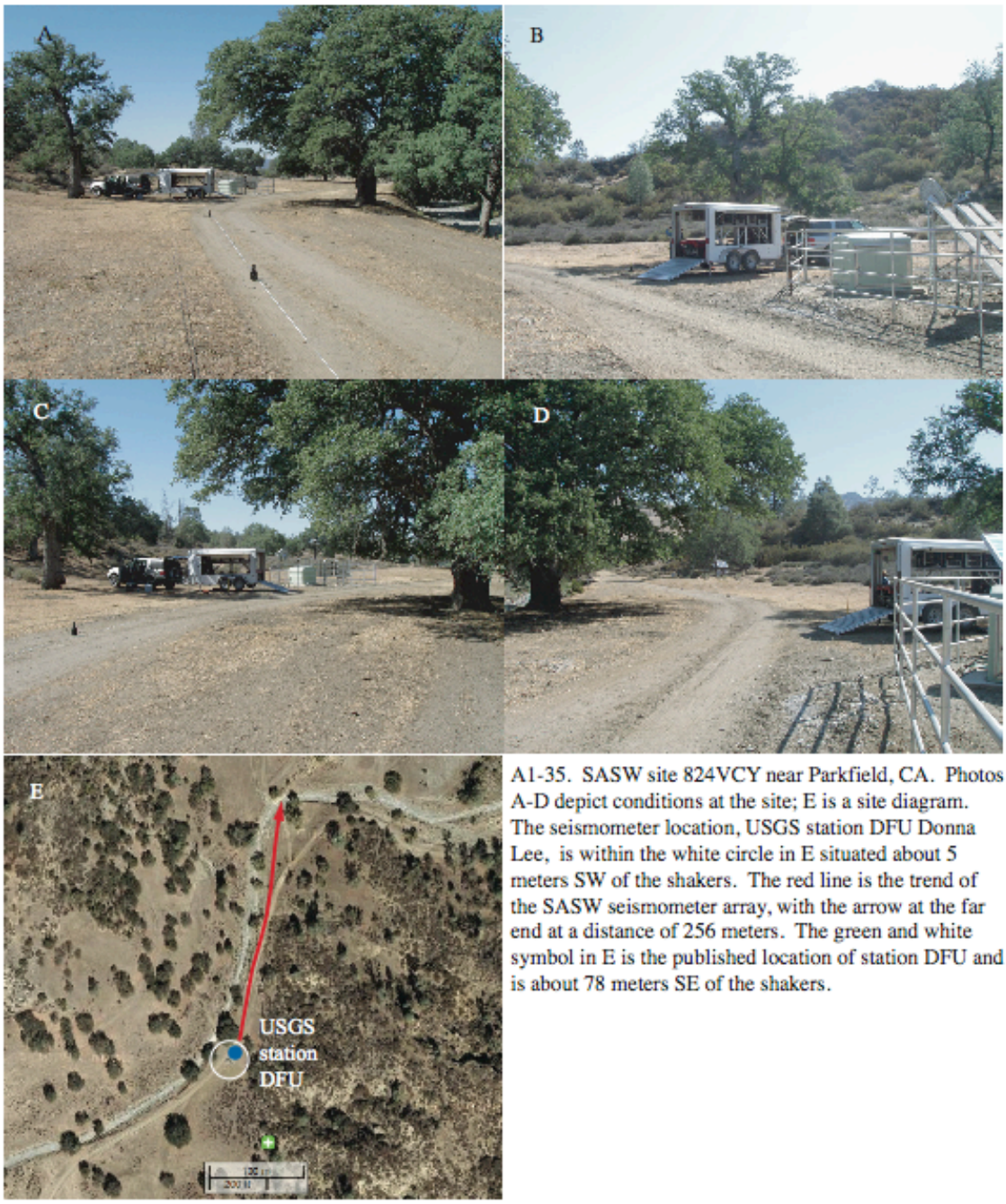
A1-32. Summary of site 822PAR. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



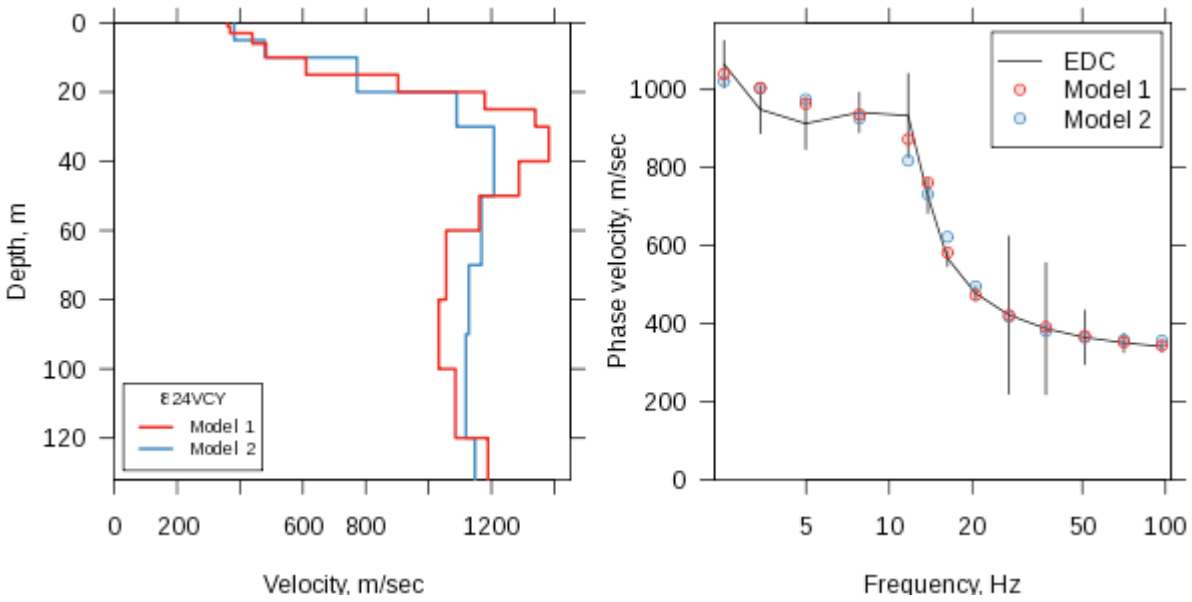
A1-33. SASW site 823PAR near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36445, Fault Zone 15, is within the white circle in B and E situated about 18 meters north of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 215 meters. The green and white symbol in E is the published location of station 36445, 28 meters east of the shakers.



A1-34. Summary of site 823PAR. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

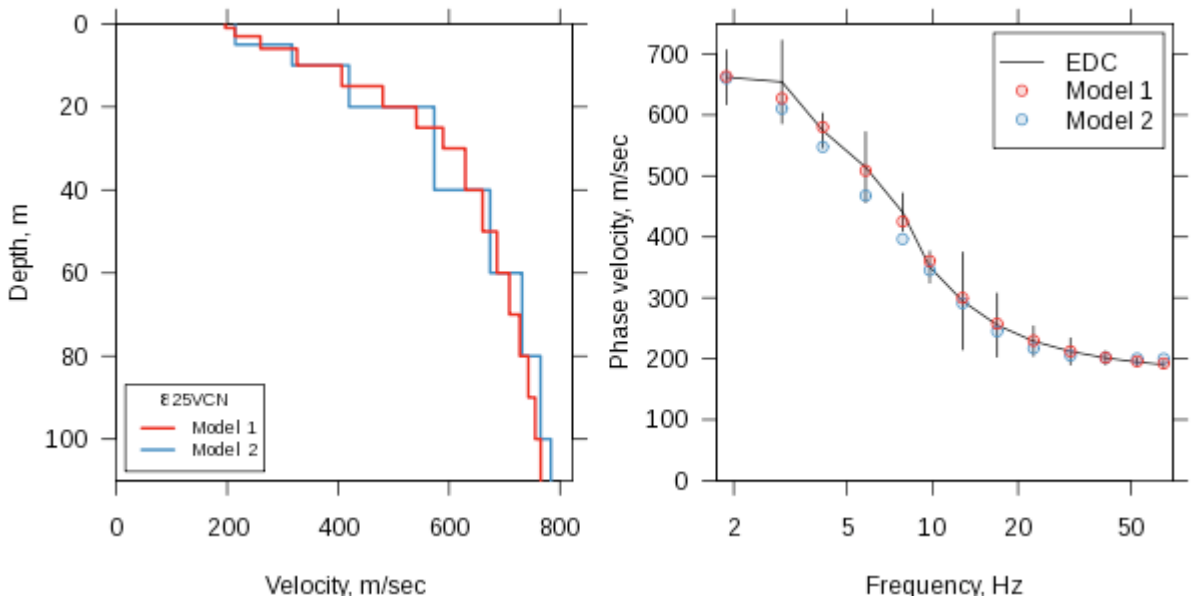


A1-35. SASW site 824VCY near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS station DFU Donna Lee, is within the white circle in E situated about 5 meters SW of the shakers. The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 256 meters. The green and white symbol in E is the published location of station DFU and is about 78 meters SE of the shakers.

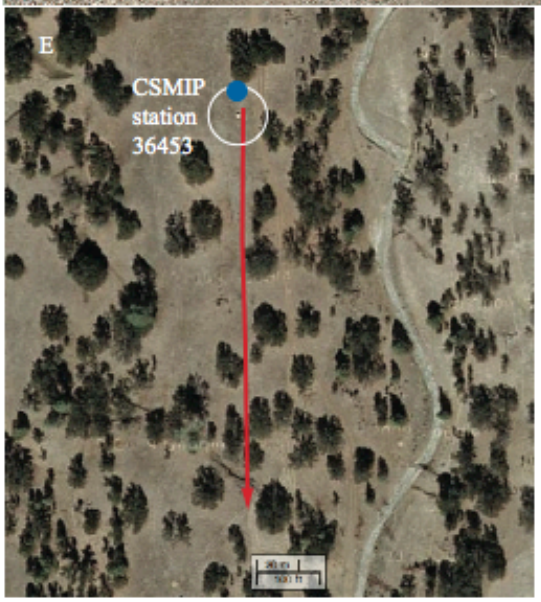


A1-36. Summary of site 824VCY. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

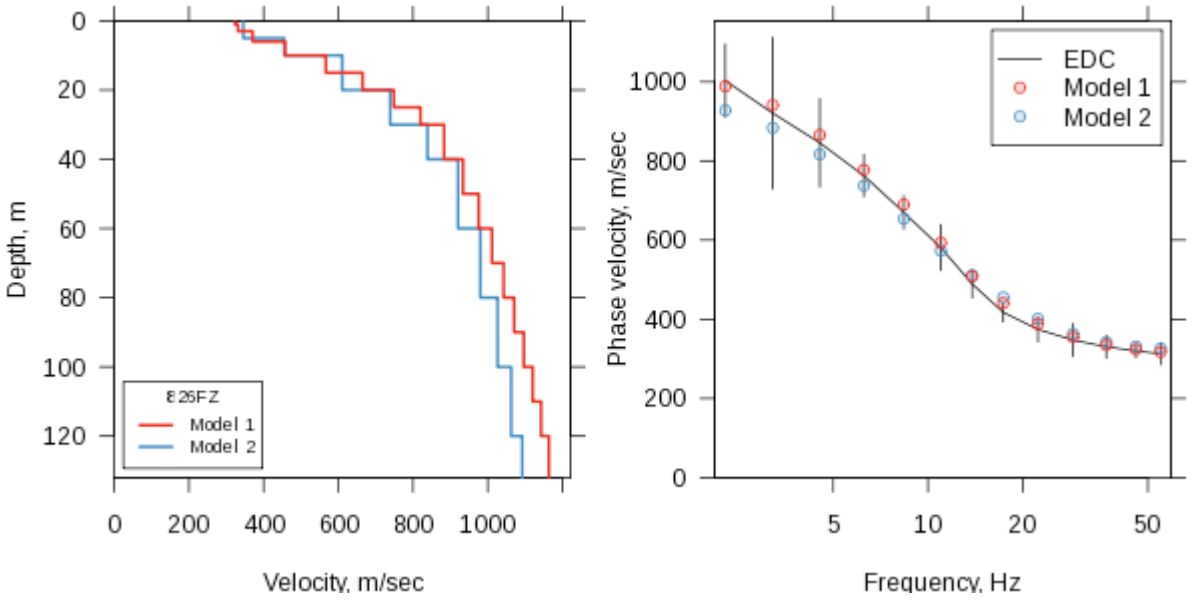
A1-37. SASW site 825VCN near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36455, Vineyard Canyon 1E, is within the white circle in B and E situated about 103 meters NW of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 160 meters.



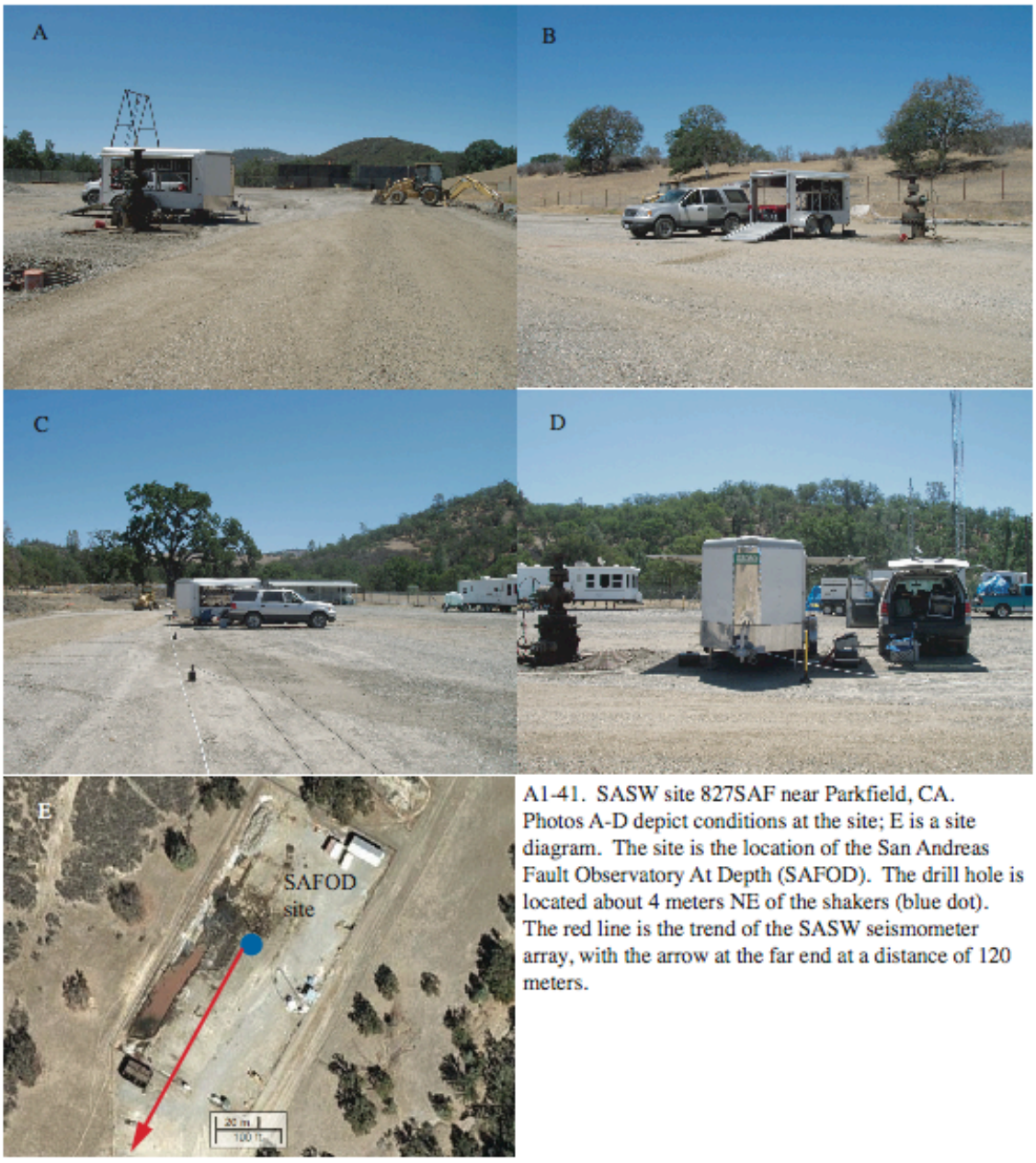
A1-38. Summary of site 825VCN. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



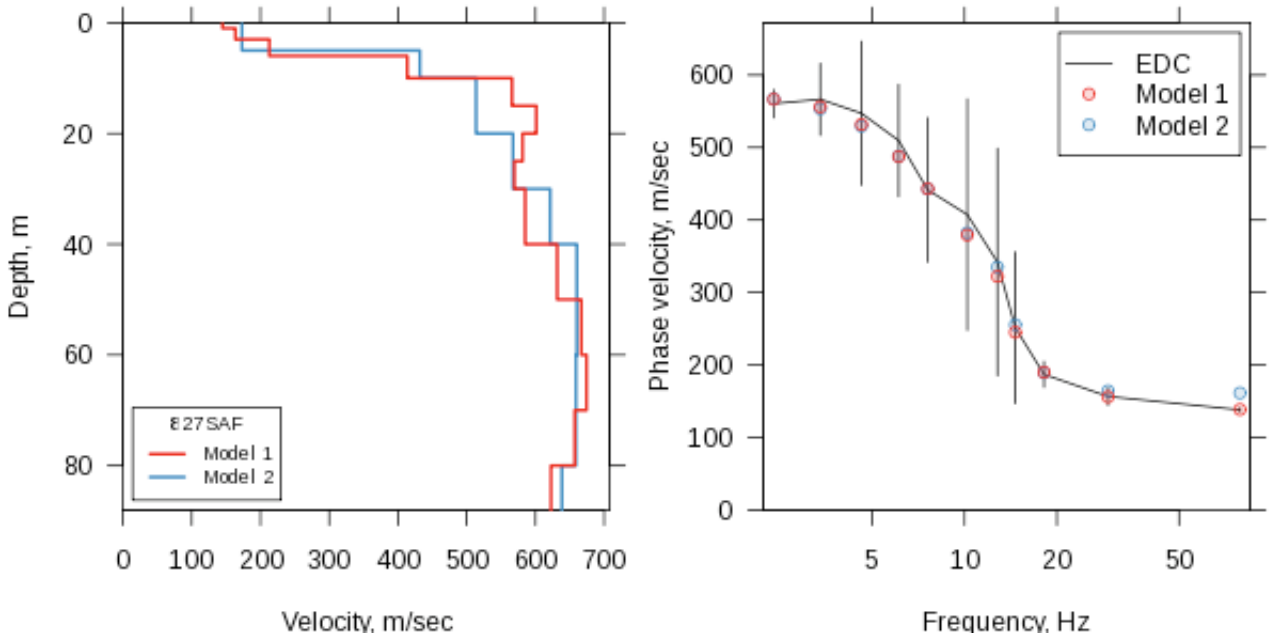
A1-39. SASW site 826FZ near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seimometer location, station CSMIP station 36453, Fault Zone 11, is within the white circle in E located 10 meters south of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 200 meters.



A1-40. Summary of site 826FZ. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

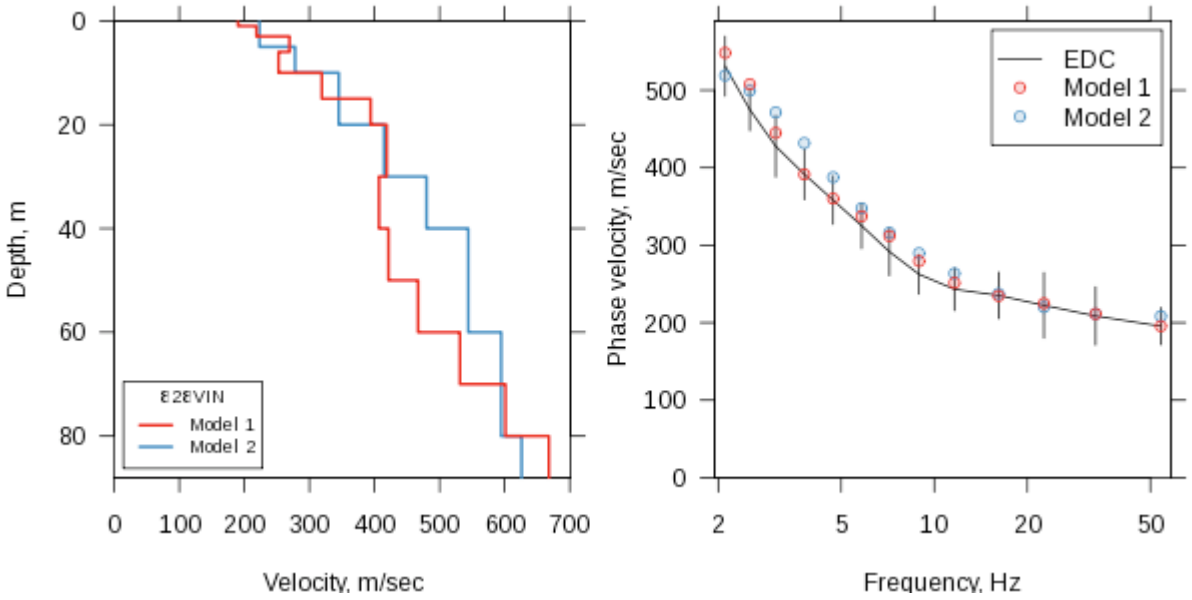


A1-41. SASW site 827SAF near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The site is the location of the San Andreas Fault Observatory At Depth (SAFOD). The drill hole is located about 4 meters NE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 120 meters.



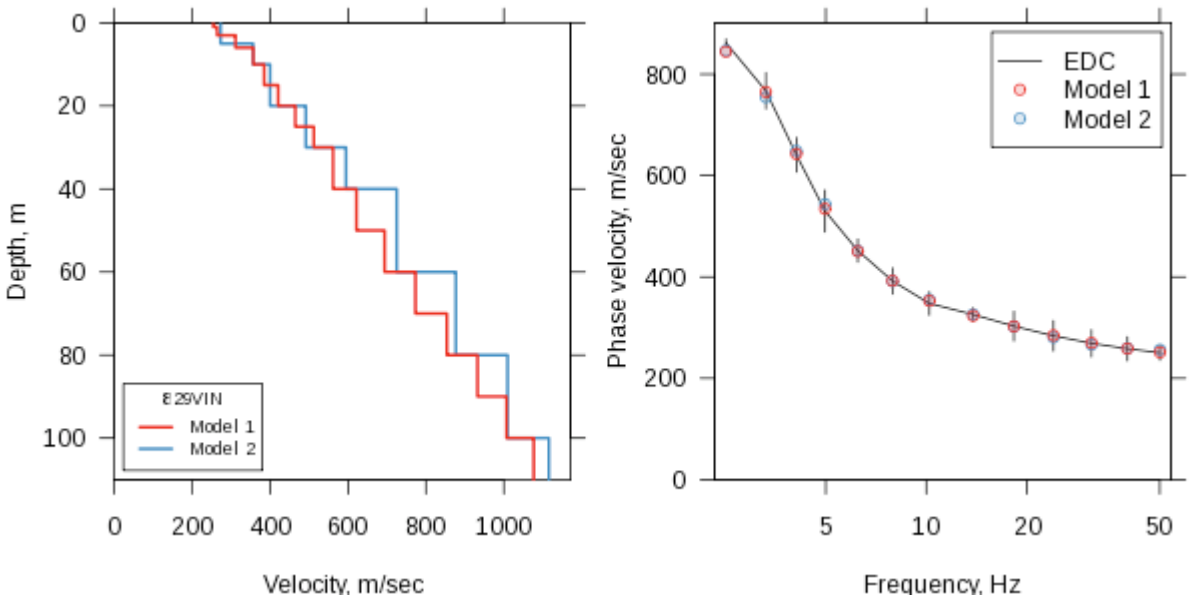
A1-42. Summary of site 827SAF. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

A1-43. SASW site 828VIN near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36440, Vineyard Canyon 5W, was not found in the field, but is located within the white circle in E situated about 430 meters NW of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 135 meters. The green and white symbol in E is the published location of station 36440, 301 meters NW of the shakers.

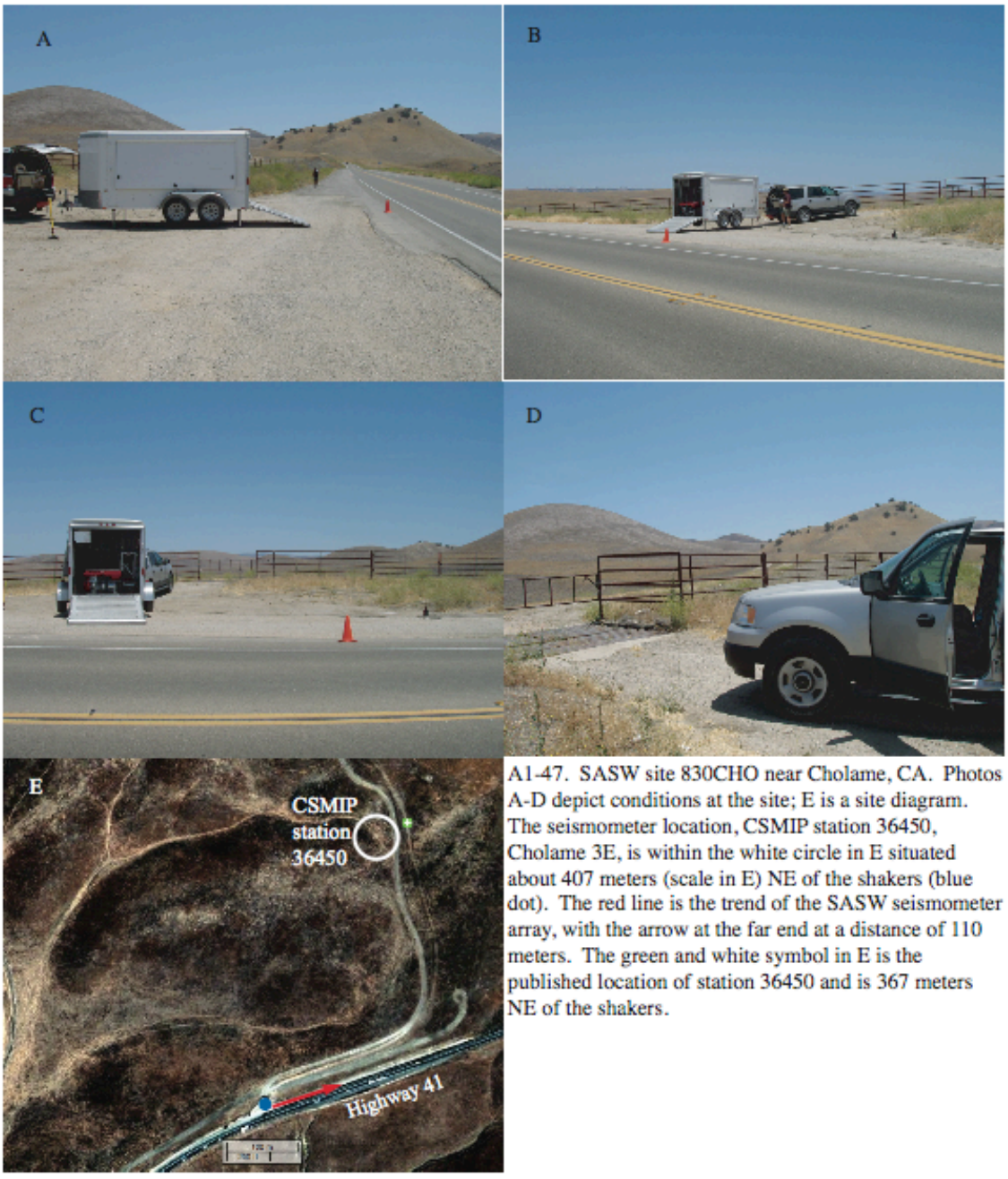


A1-44. Summary of site 828VIN. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

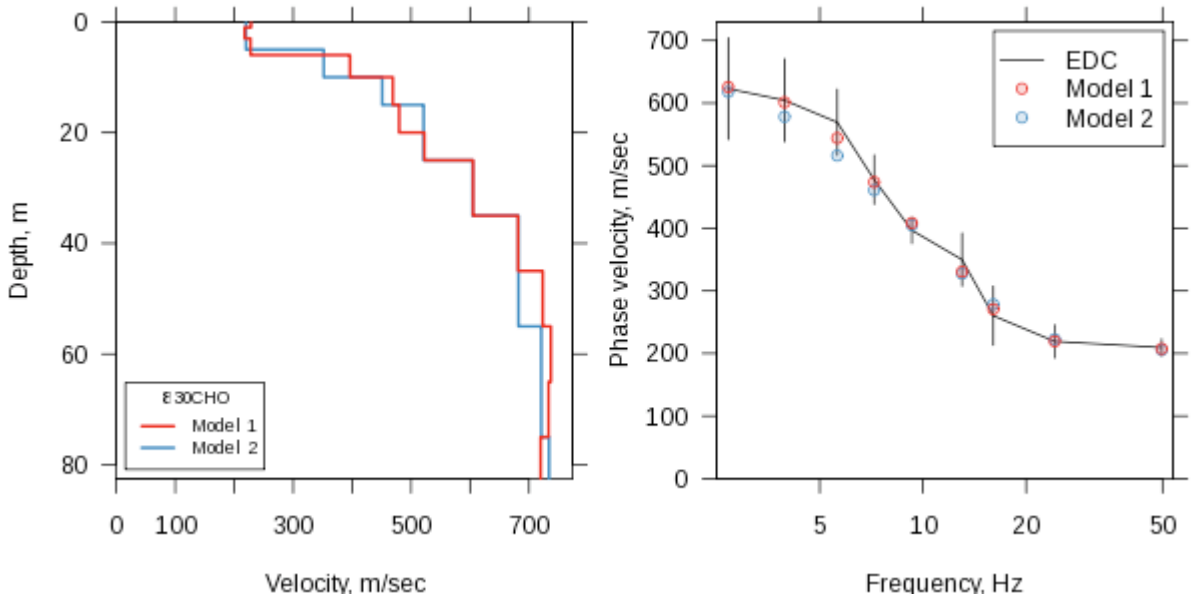
A1-45. SASW site 829VIN near Parkfield, CA. Photos A-C depict conditions at the site; D is a site diagram. The seismometer location, CSMIP station 36446, Vineyard Canyon 4W, was not identified in the field. The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 160 meters. The green and white symbol in E is the published location of station 36446 and is 191 meters north of the shakers (blue dot).



A1-46. Summary of site 829VIN. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

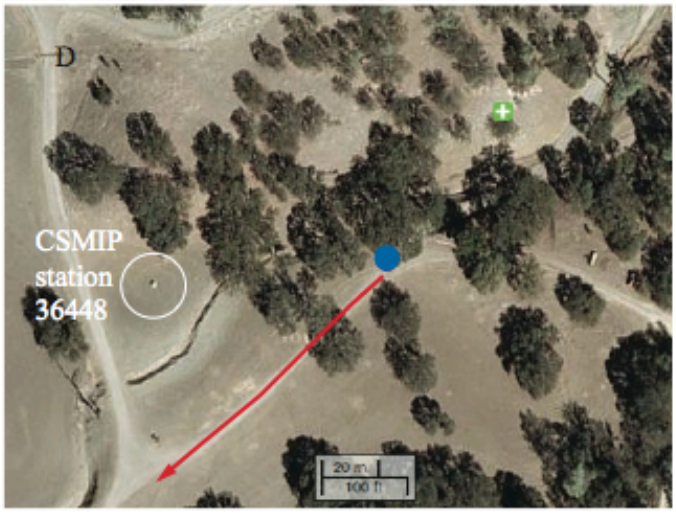


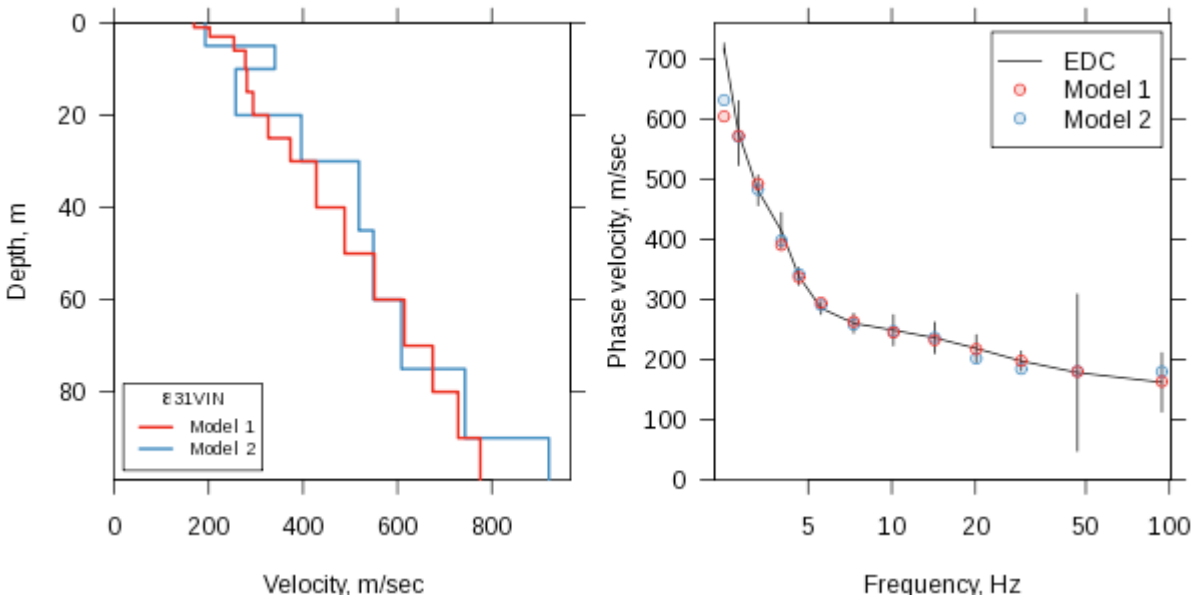
A1-47. SASW site 830CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36450, Cholame 3E, is within the white circle in E situated about 407 meters (scale in E) NE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 110 meters. The green and white symbol in E is the published location of station 36450 and is 367 meters NE of the shakers.



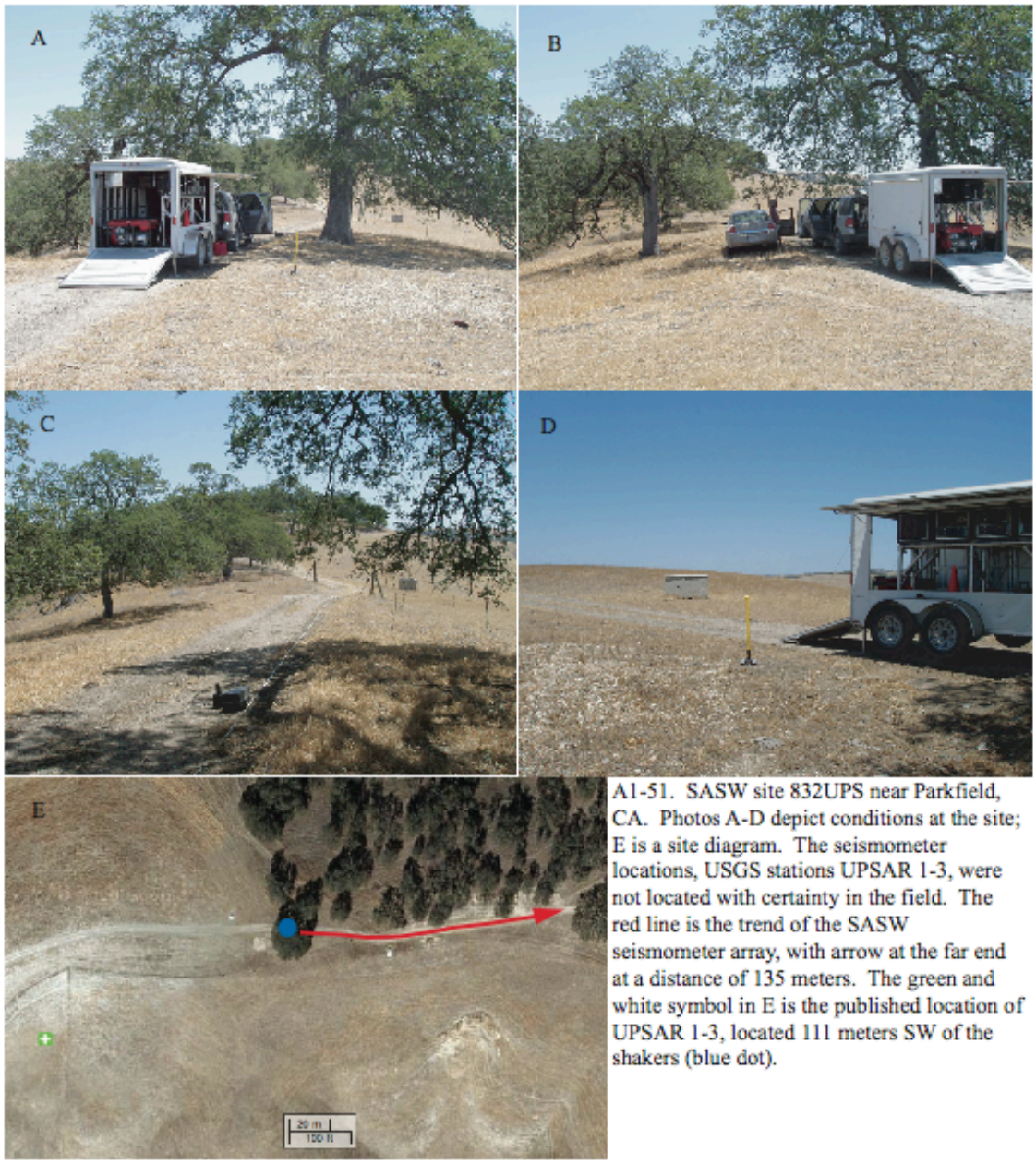
A1-48. Summary of site 830CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

A1-49. SASW site 831VIN near Parkfield, CA. Photos A-C depict conditions at the site; D is a site diagram. The seismometer location, CSMIP station 36448, Vineyard Canyon 1W, is within the white circle in B and D situated about 82 meters west of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 110 meters. The green and white symbol in E is the published location of station 36448 about 56 meters NE of the shakers.

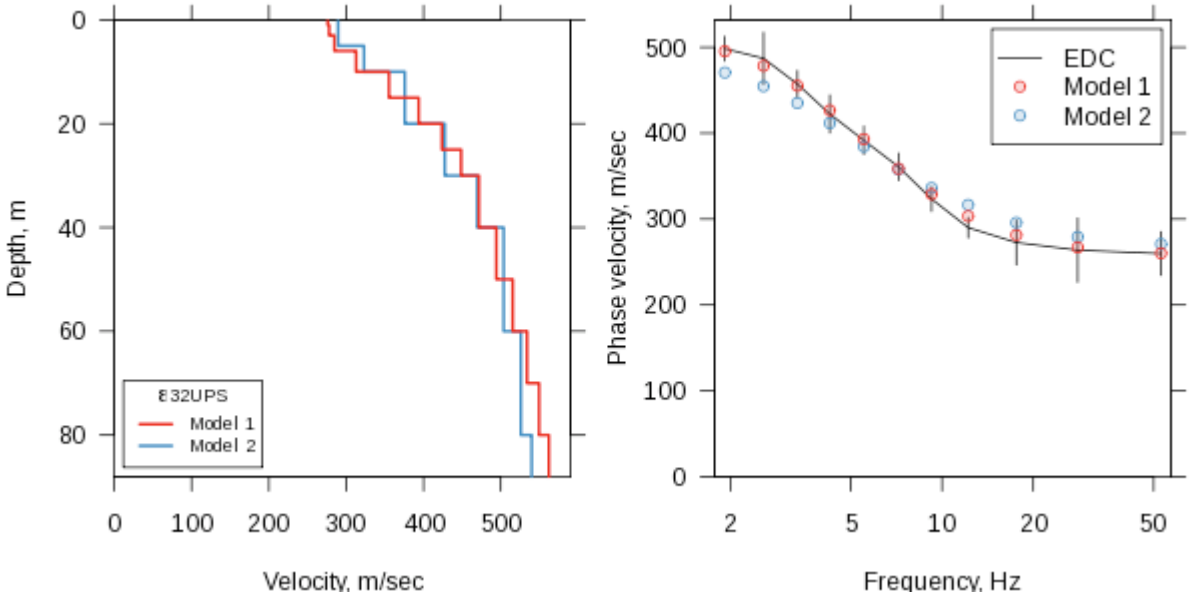




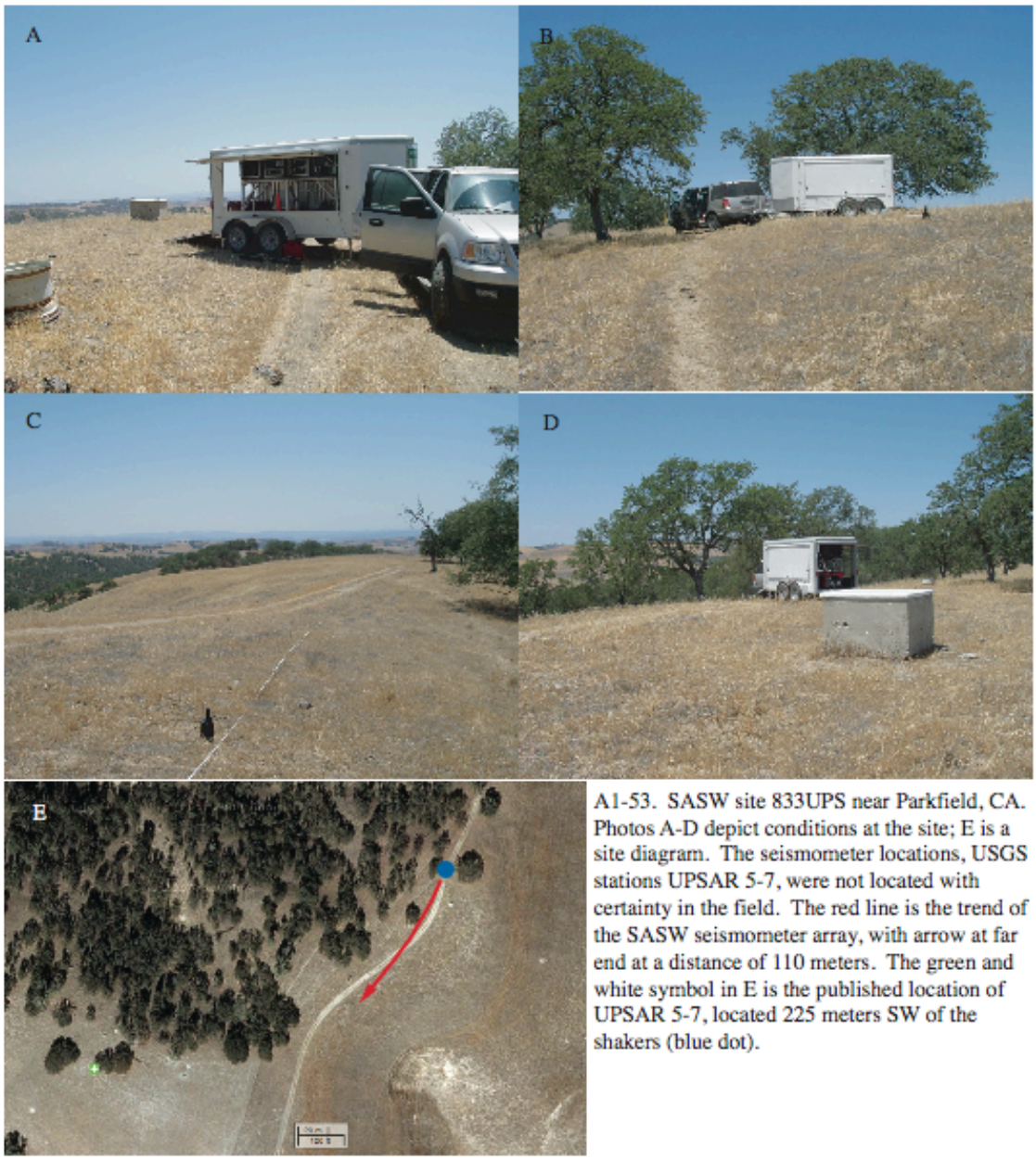
A1-50. Summary of site 831VIN. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



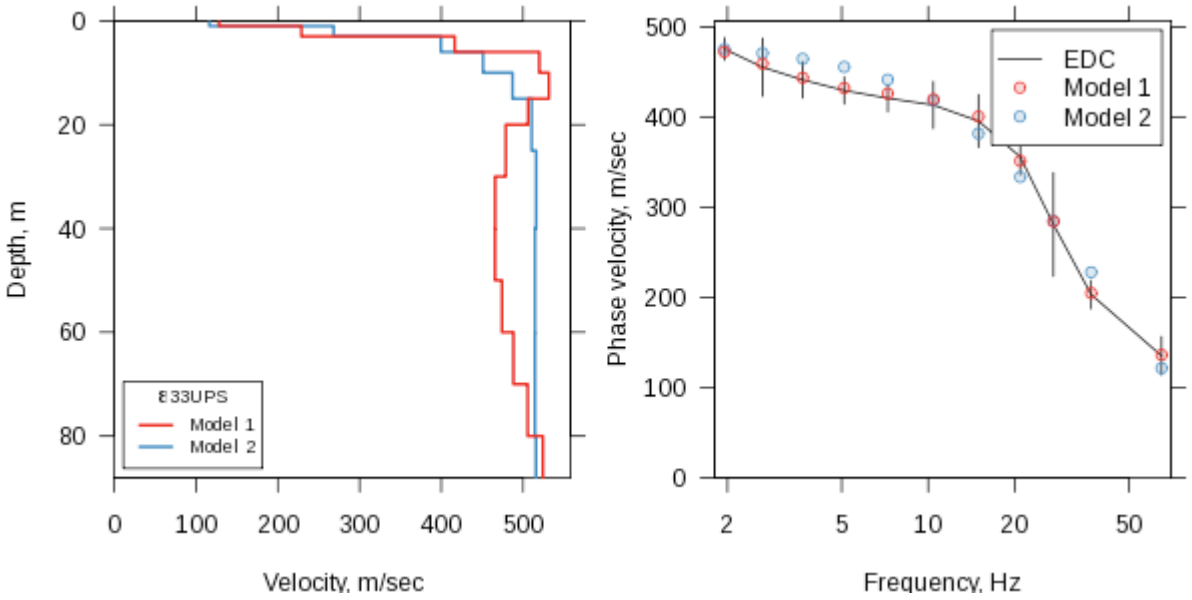
A1-51. SASW site 832UPS near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer locations, USGS stations UPSAR 1-3, were not located with certainty in the field. The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 135 meters. The green and white symbol in E is the published location of UPSAR 1-3, located 111 meters SW of the shakers (blue dot).



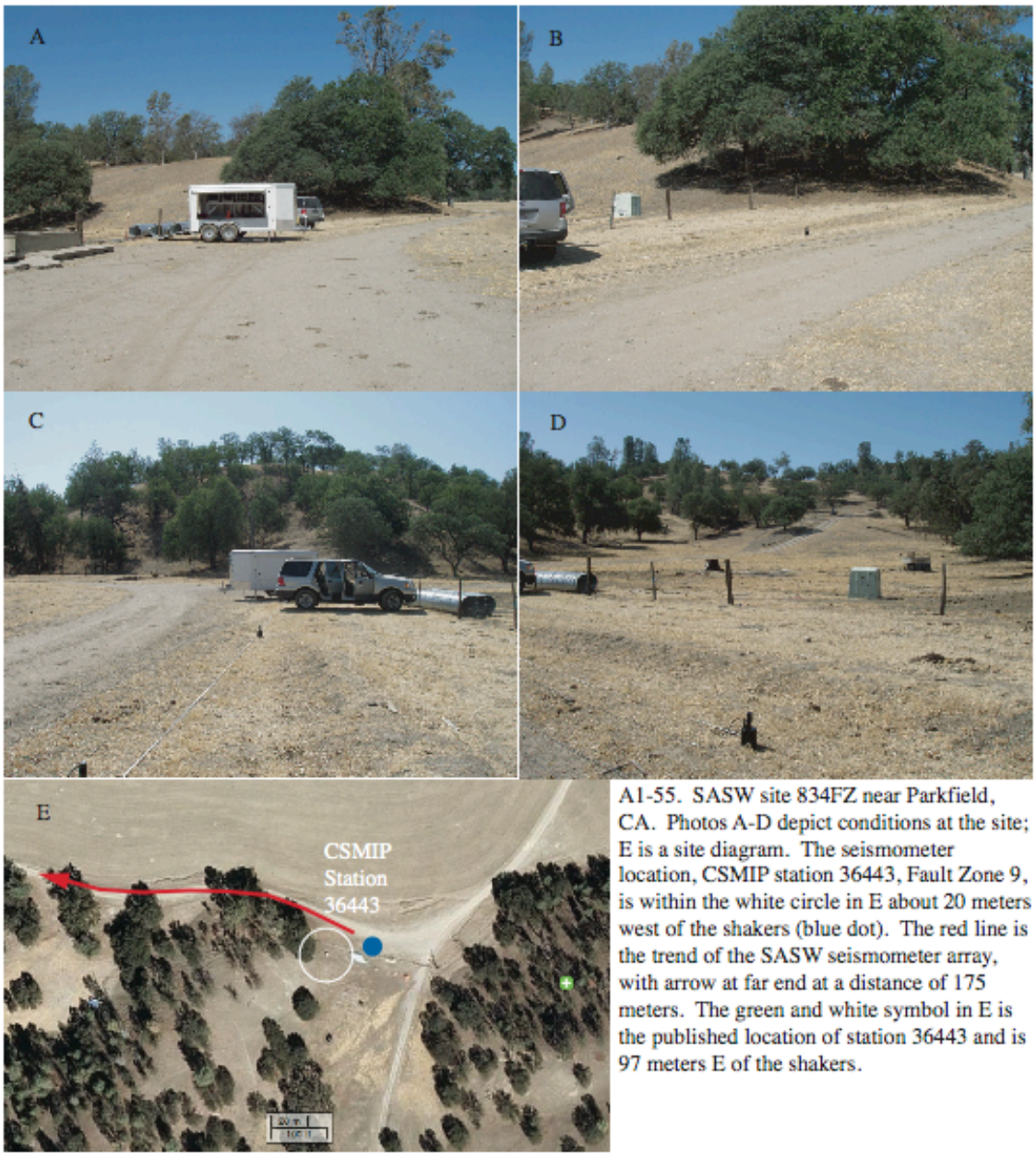
A1-52. Summary of site 832UPS. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



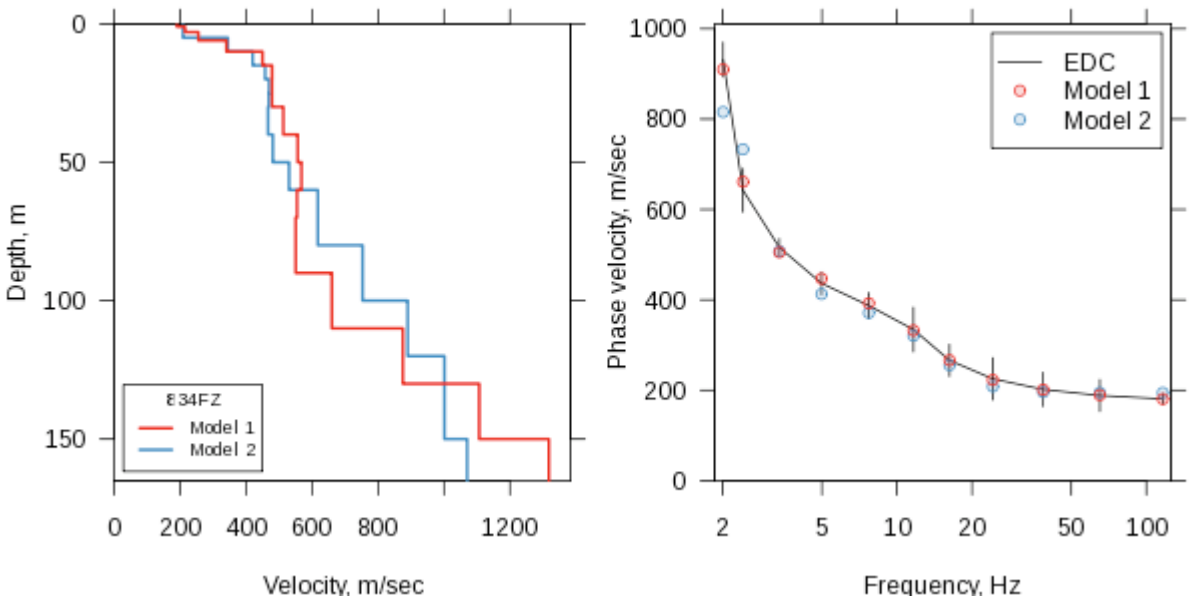
A1-53. SASW site 833UPS near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer locations, USGS stations UPSAR 5-7, were not located with certainty in the field. The red line is the trend of the SASW seismometer array, with arrow at far end at a distance of 110 meters. The green and white symbol in E is the published location of UPSAR 5-7, located 225 meters SW of the shakers (blue dot).



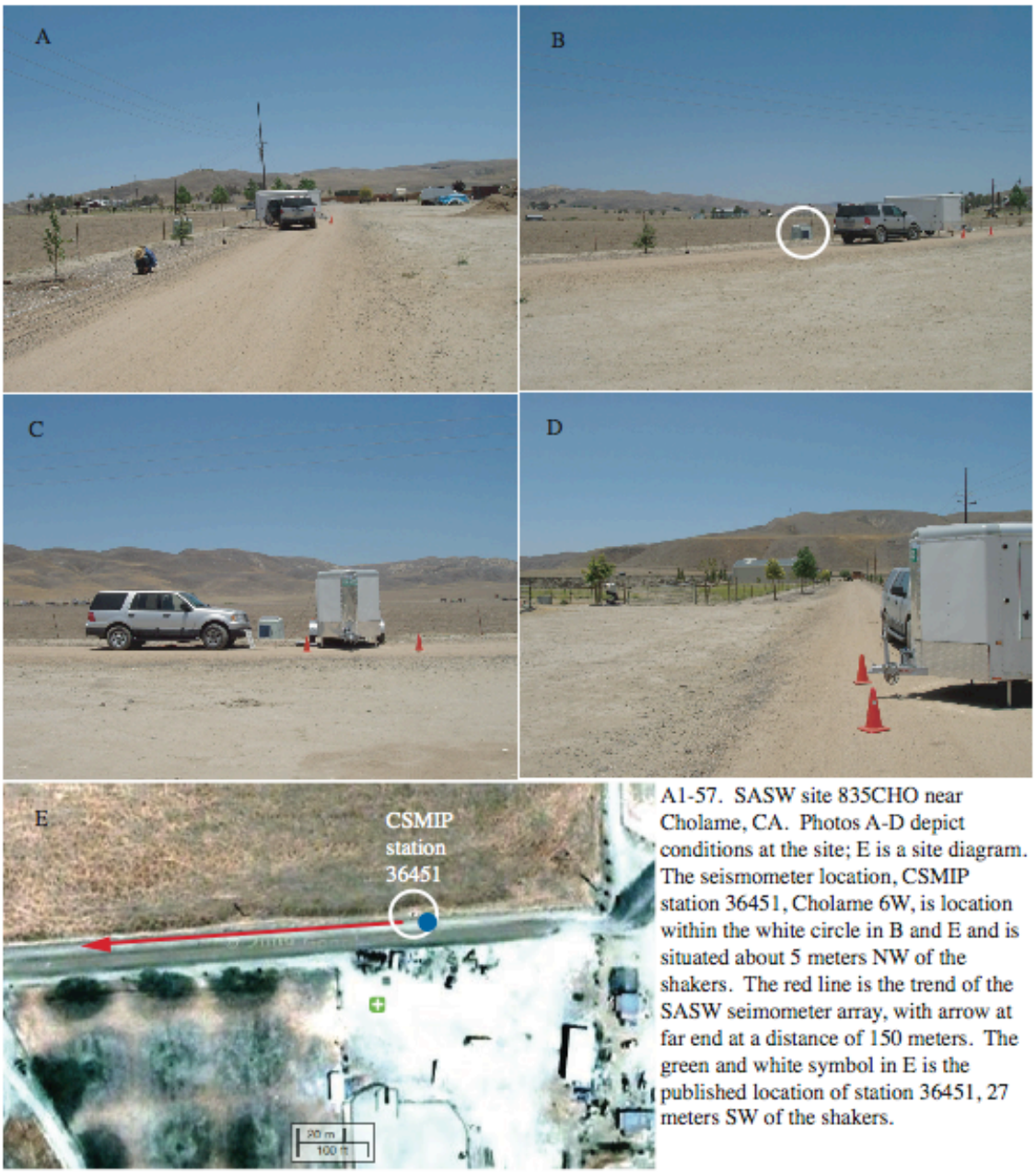
A1-54. Summary of site 833UPS. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



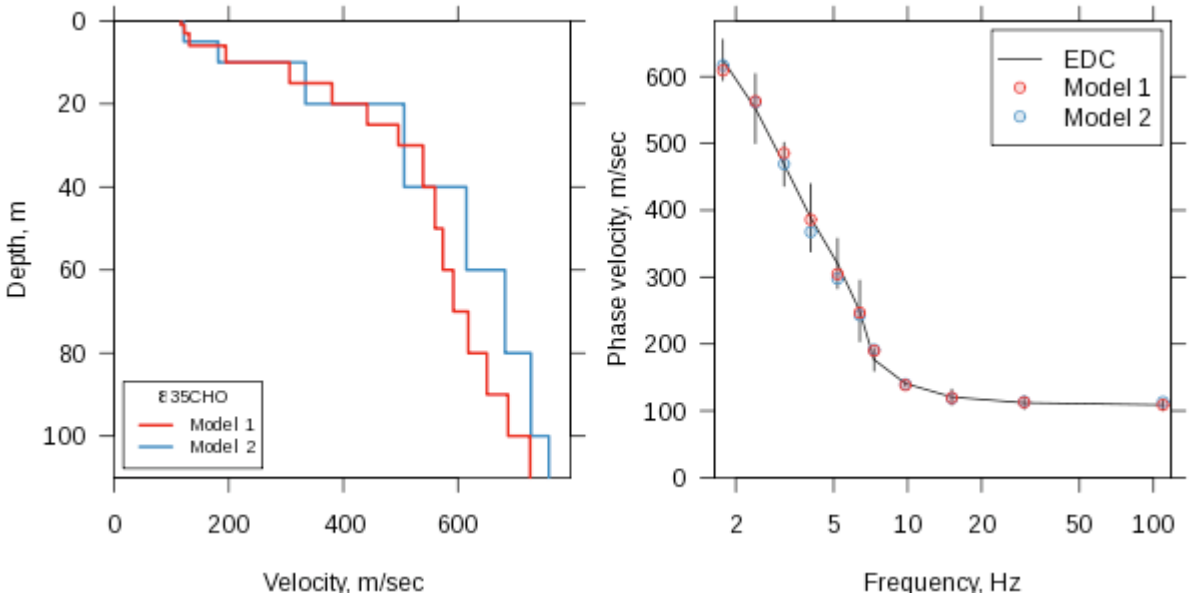
A1-55. SASW site 834FZ near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36443, Fault Zone 9, is within the white circle in E about 20 meters west of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at far end at a distance of 175 meters. The green and white symbol in E is the published location of station 36443 and is 97 meters E of the shakers.



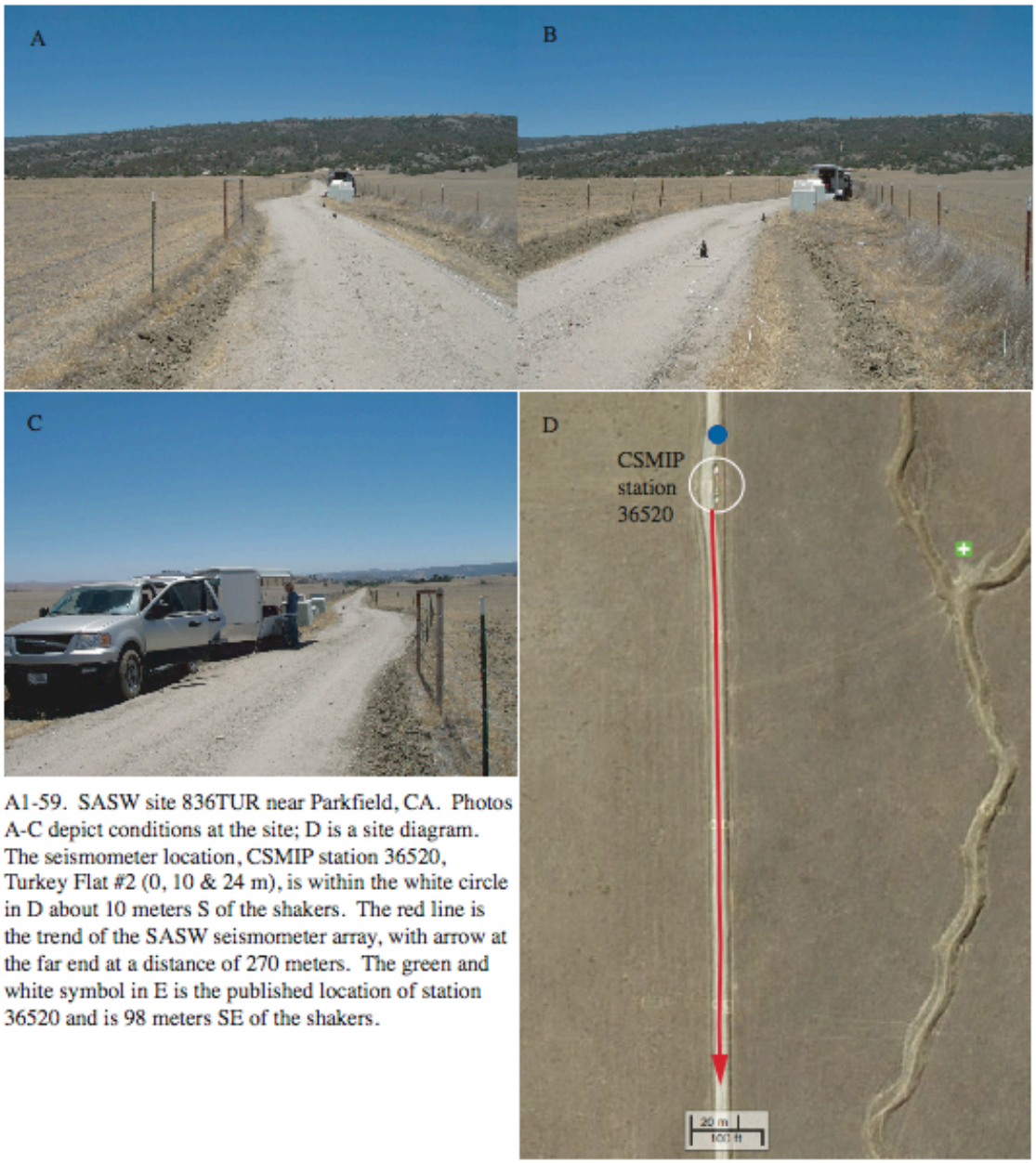
A1-56. Summary of site 834FZ. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



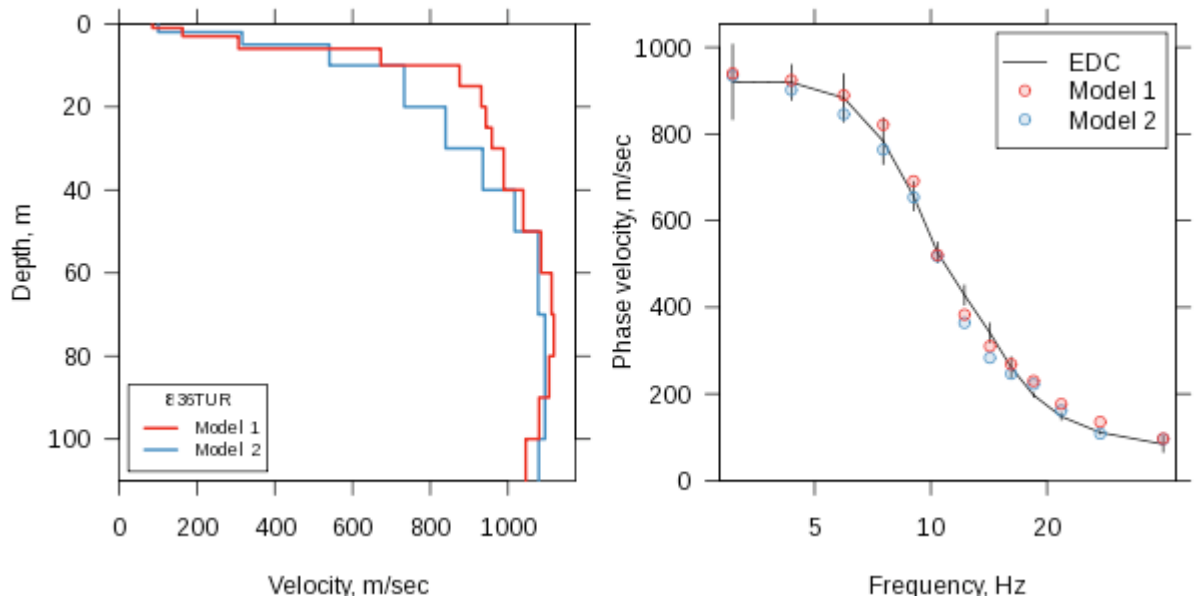
A1-57. SASW site 835CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36451, Cholame 6W, is location within the white circle in B and E and is situated about 5 meters NW of the shakers. The red line is the trend of the SASW seimometer array, with arrow at far end at a distance of 150 meters. The green and white symbol in E is the published location of station 36451, 27 meters SW of the shakers.



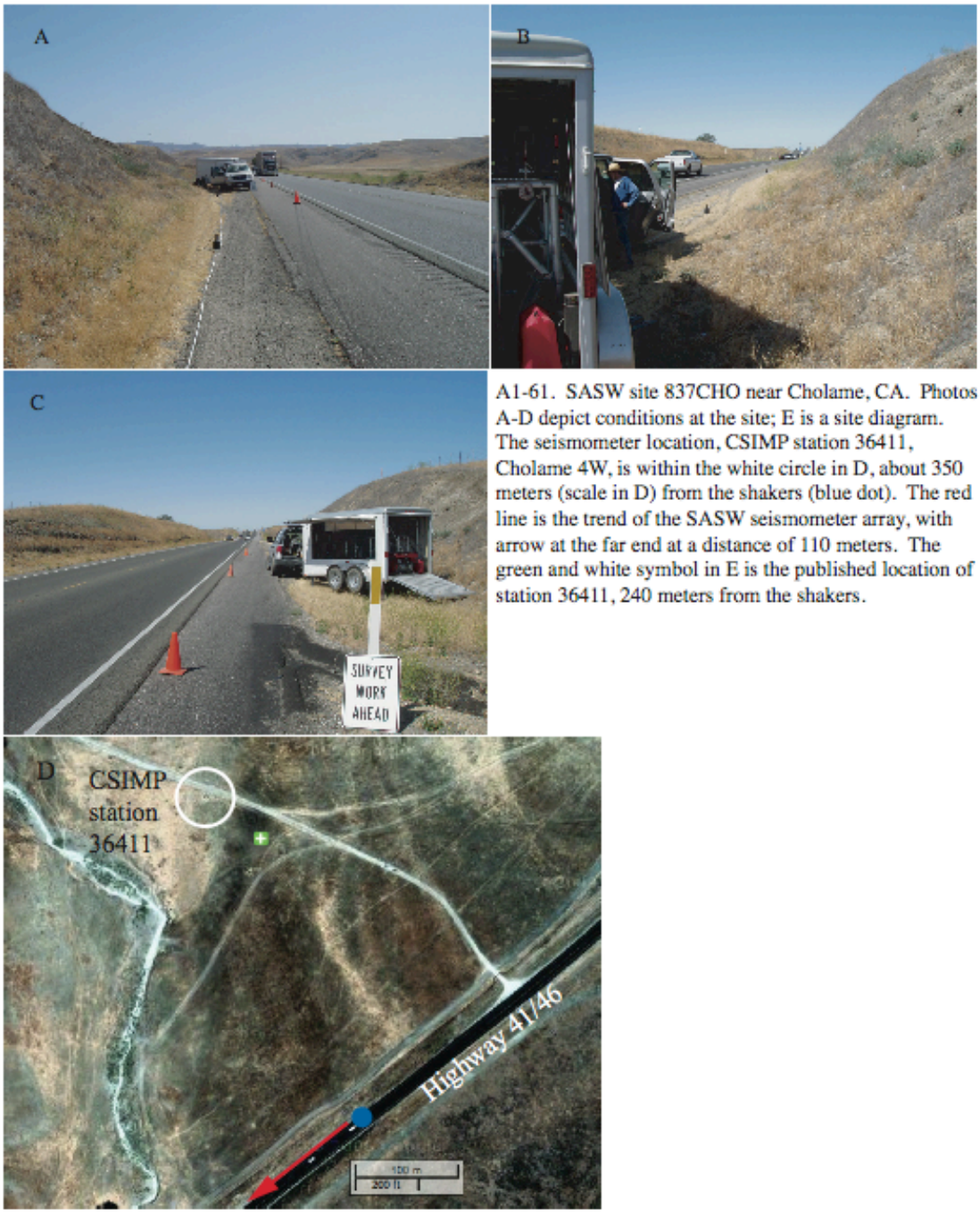
A1-58. Summary of site 835CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



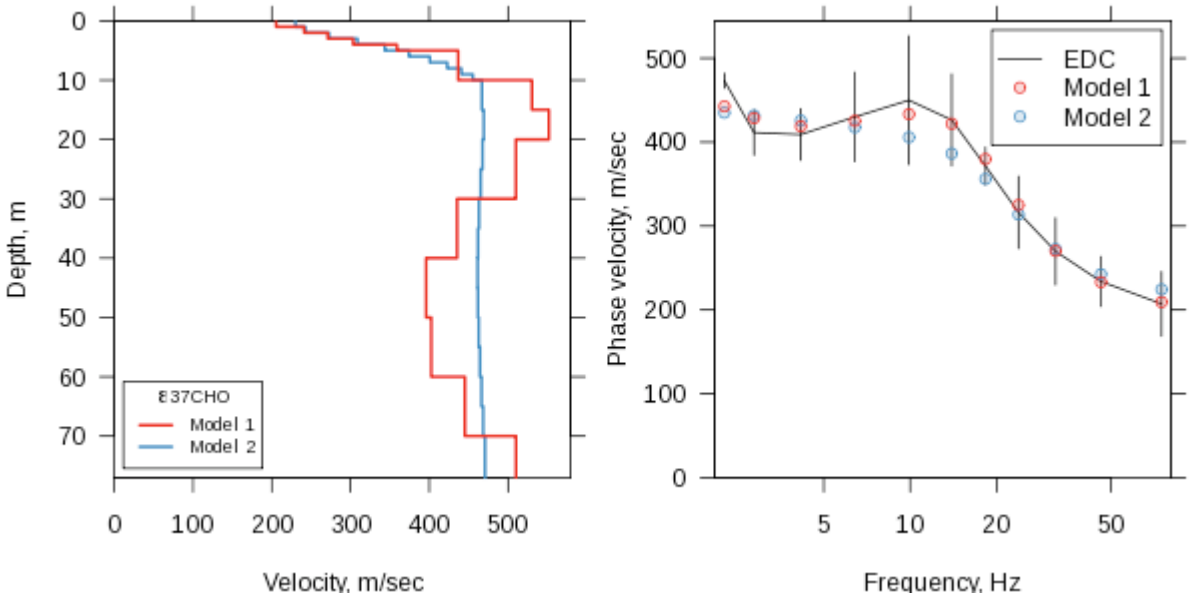
A1-59. SASW site 836TUR near Parkfield, CA. Photos A-C depict conditions at the site; D is a site diagram. The seismometer location, CSMIP station 36520, Turkey Flat #2 (0, 10 & 24 m), is within the white circle in D about 10 meters S of the shakers. The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 270 meters. The green and white symbol in E is the published location of station 36520 and is 98 meters SE of the shakers.



A1-60. Summary of site 836TUR. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

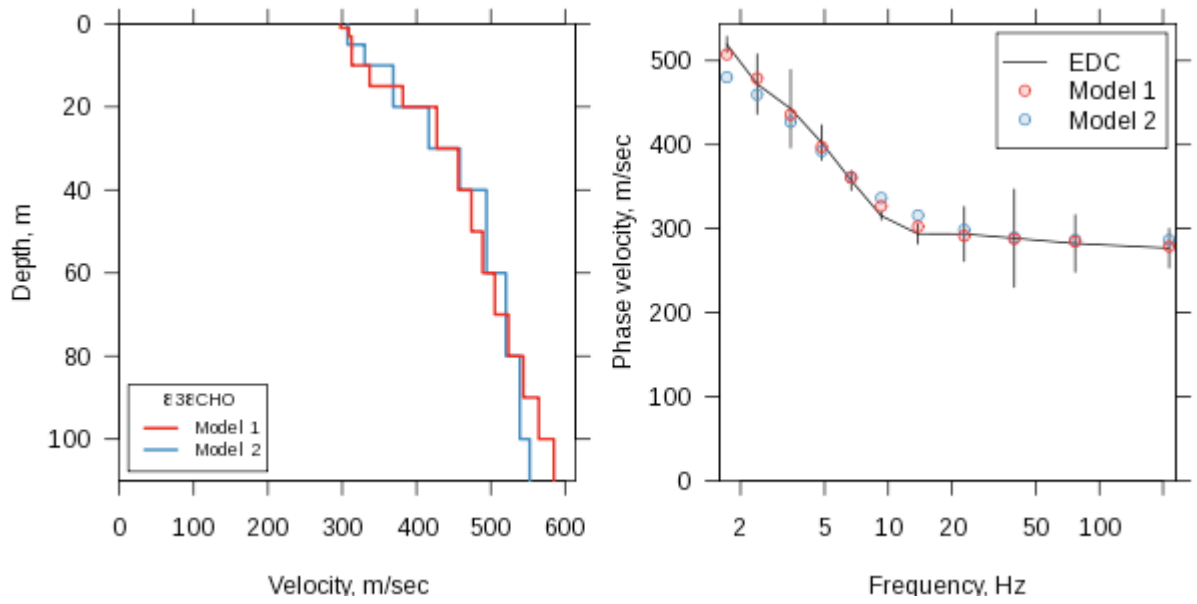


A1-61. SASW site 837CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSIMP station 36411, Cholame 4W, is within the white circle in D, about 350 meters (scale in D) from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 110 meters. The green and white symbol in E is the published location of station 36411, 240 meters from the shakers.

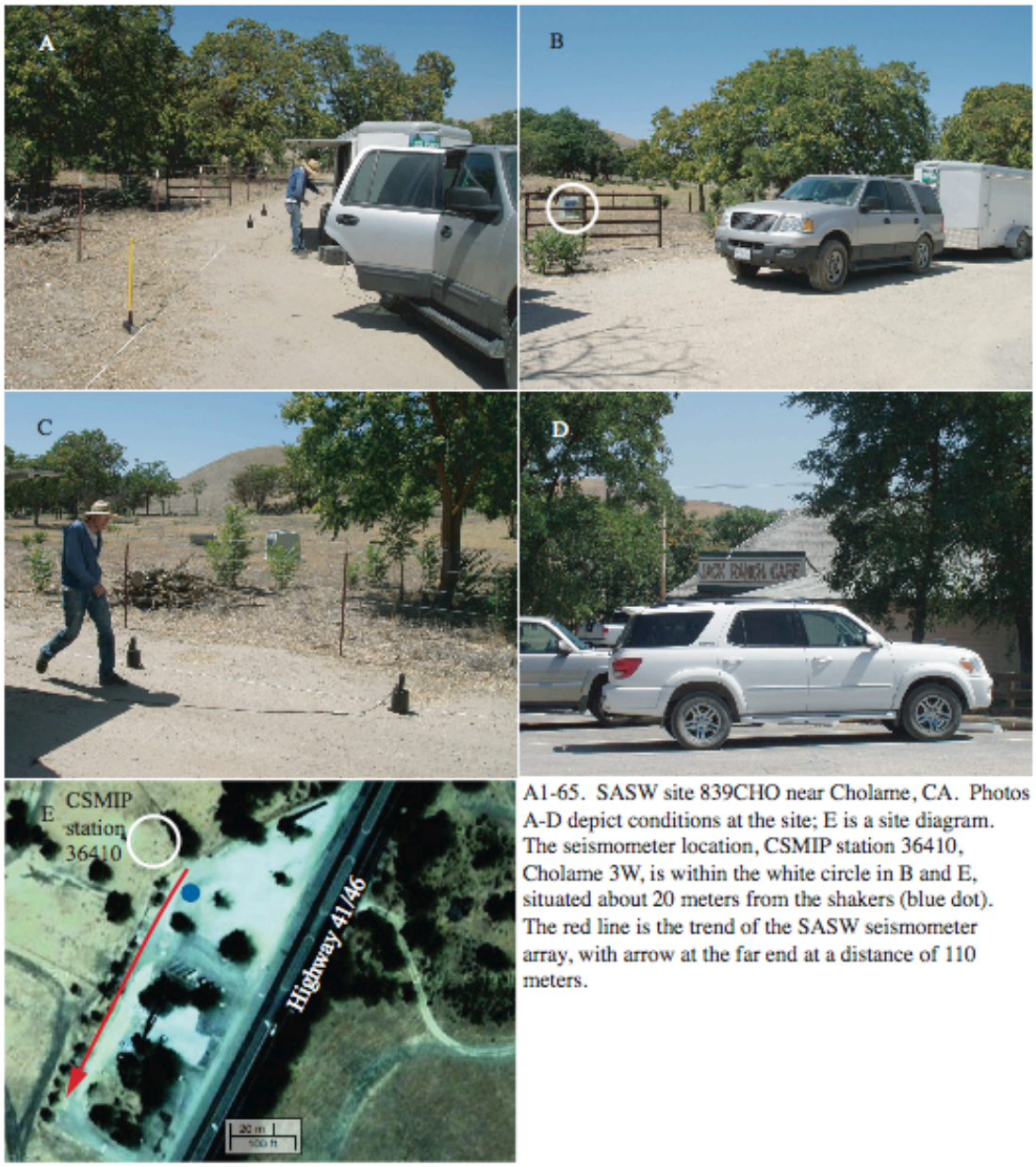


A1-62. Summary of site 837CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

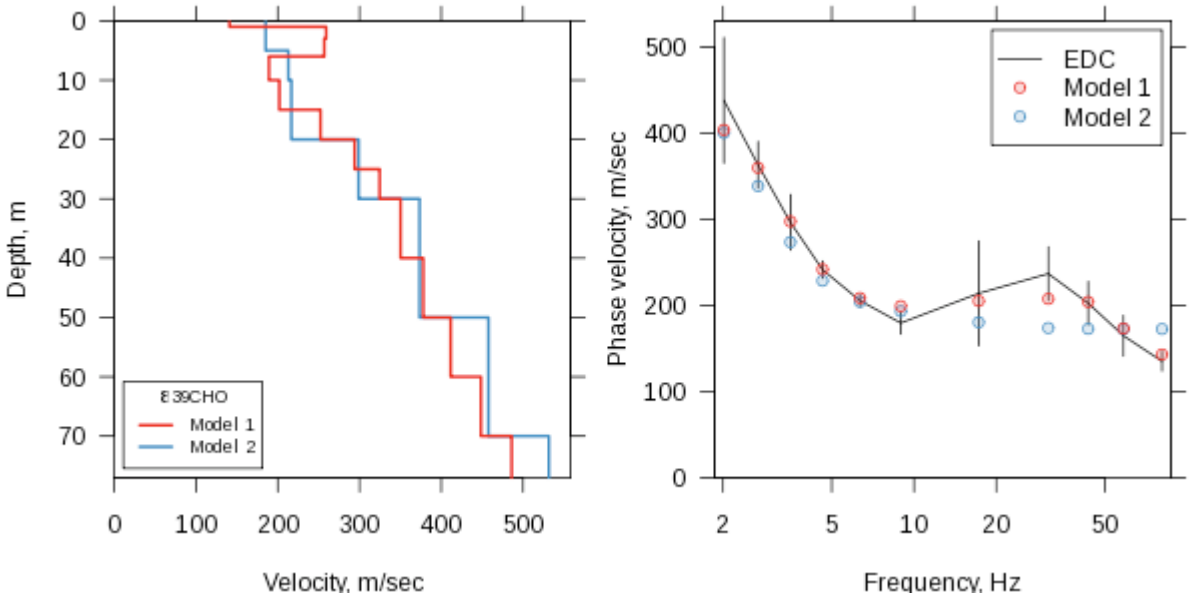
A1-63. SASW site 838CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36229, Cholame 12W, was not identified in the field. The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 130 meters. The green and white symbol in E is the published location of station 36229, situated 303 meters SW of the shakers (blue dot).



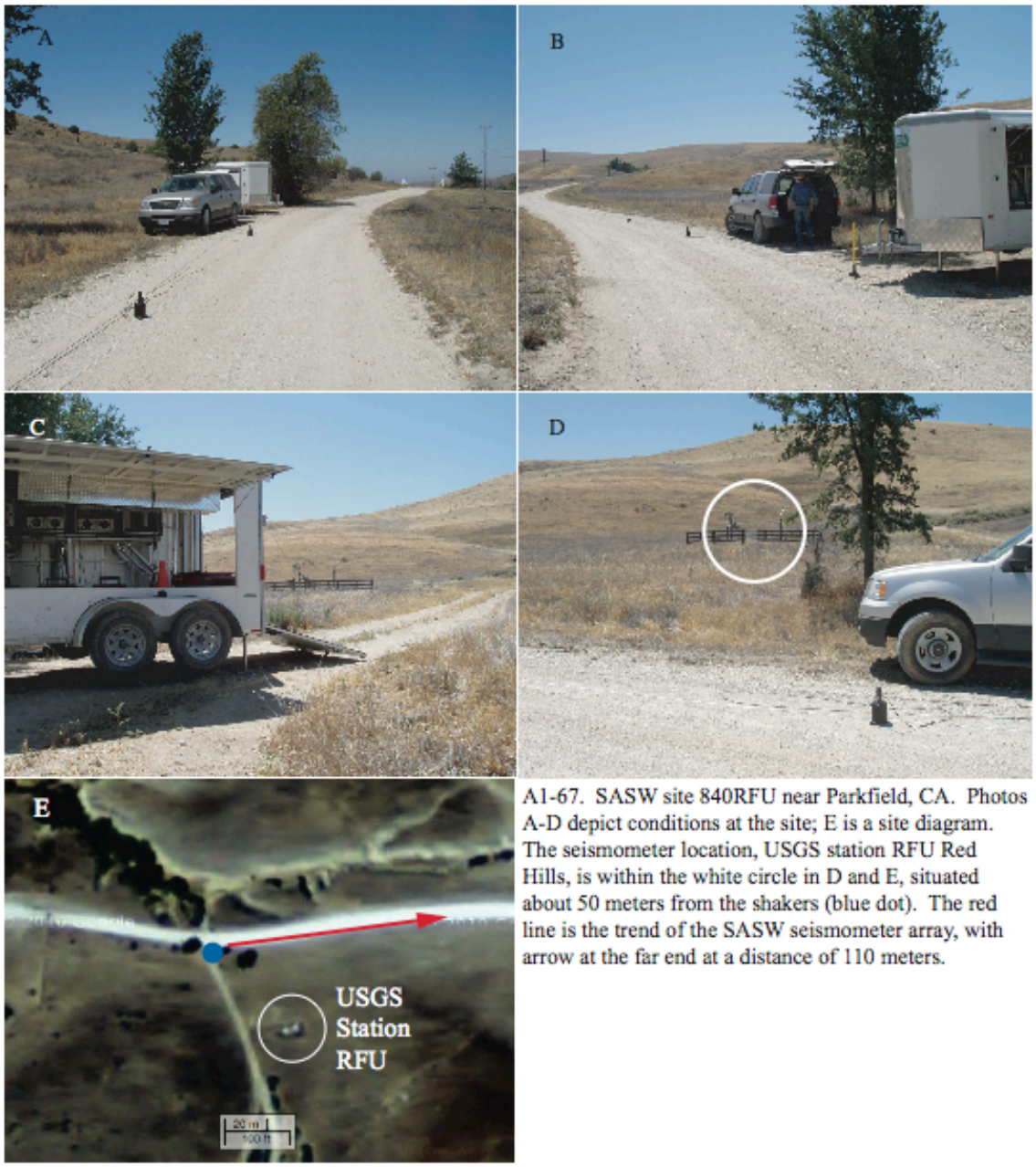
A1-64. Summary of site 838CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



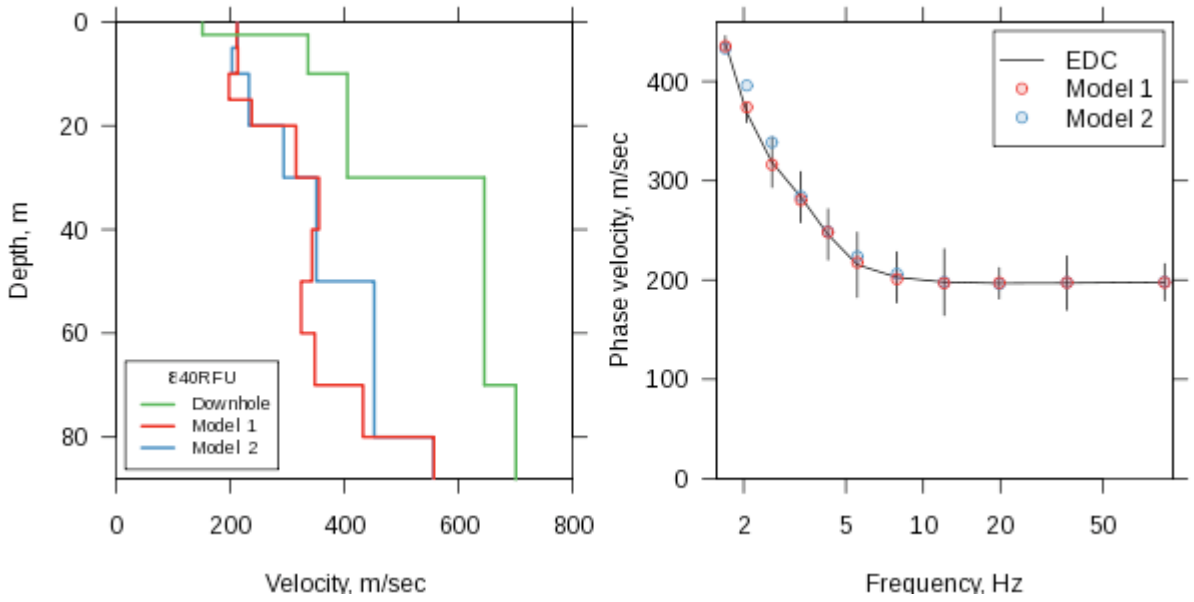
A1-65. SASW site 839CHO near Cholame, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36410, Cholame 3W, is within the white circle in B and E, situated about 20 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 110 meters.



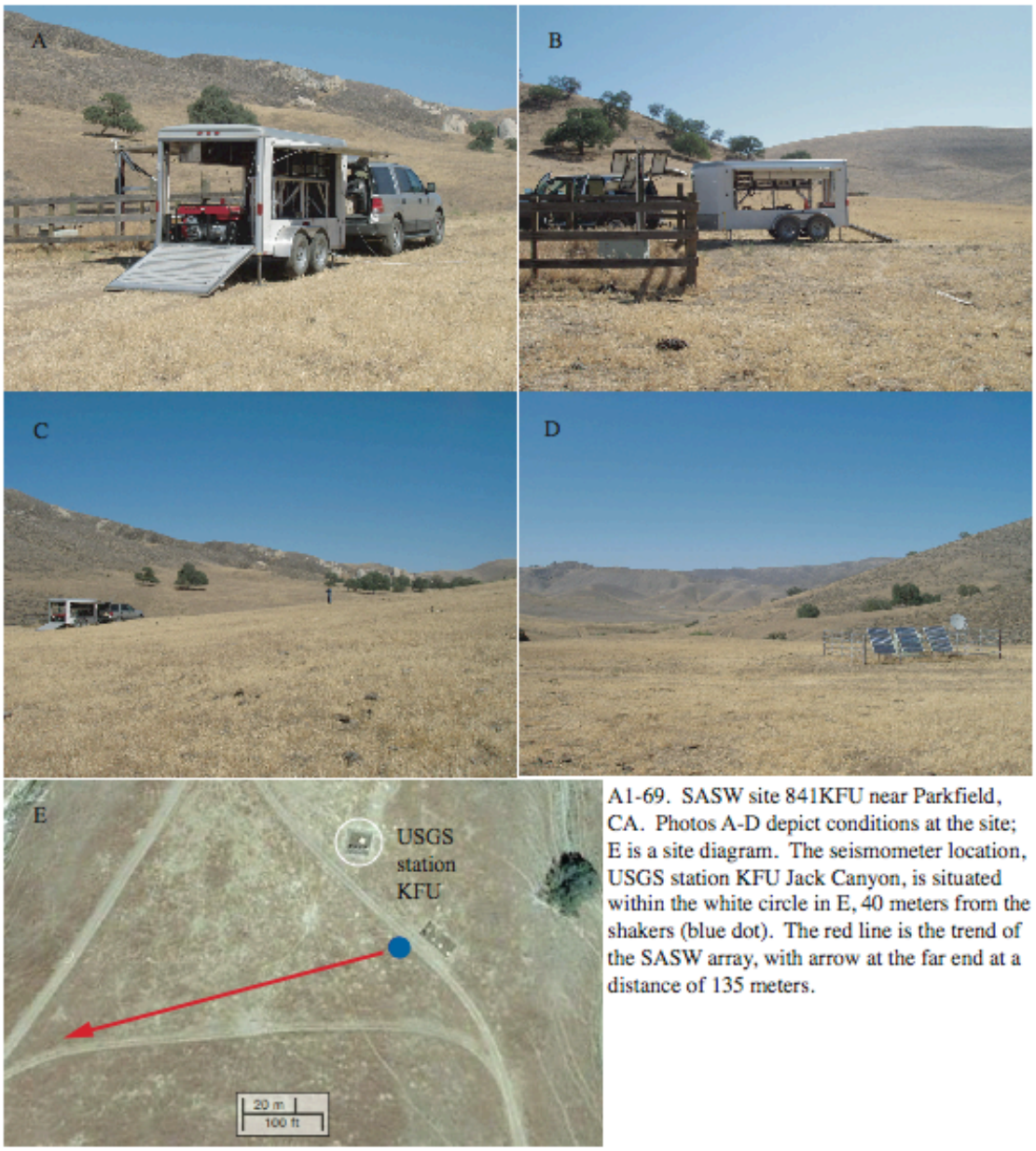
A1-66. Summary of site 839CHO. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



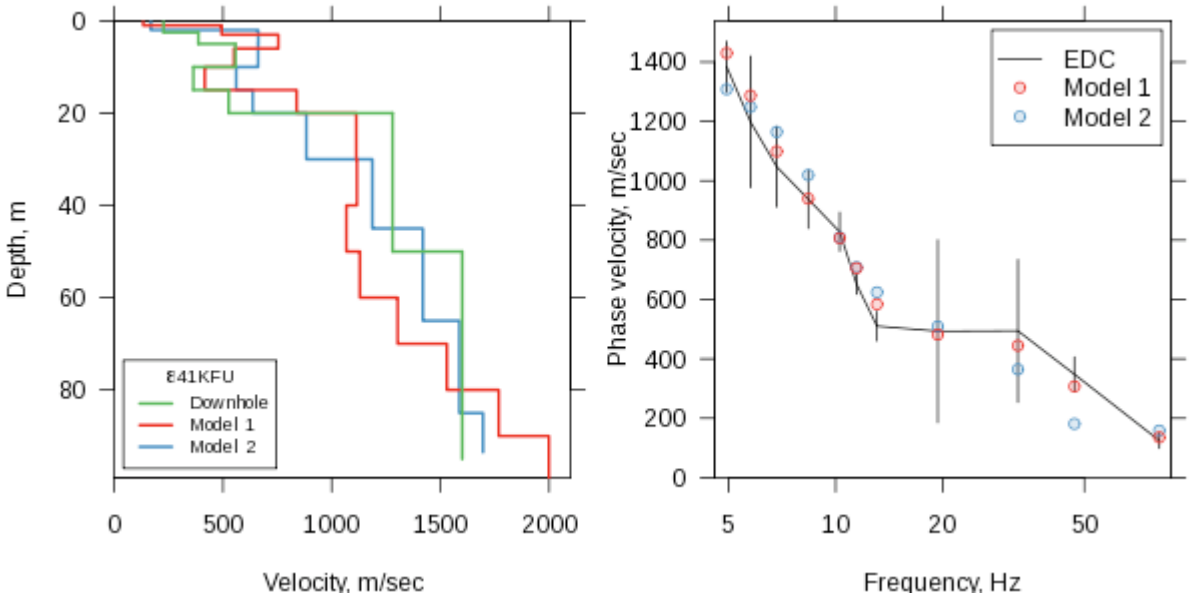
A1-67. SASW site 840RFU near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS station RFU Red Hills, is within the white circle in D and E, situated about 50 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 110 meters.



A1-68. Summary of site 840RFU. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

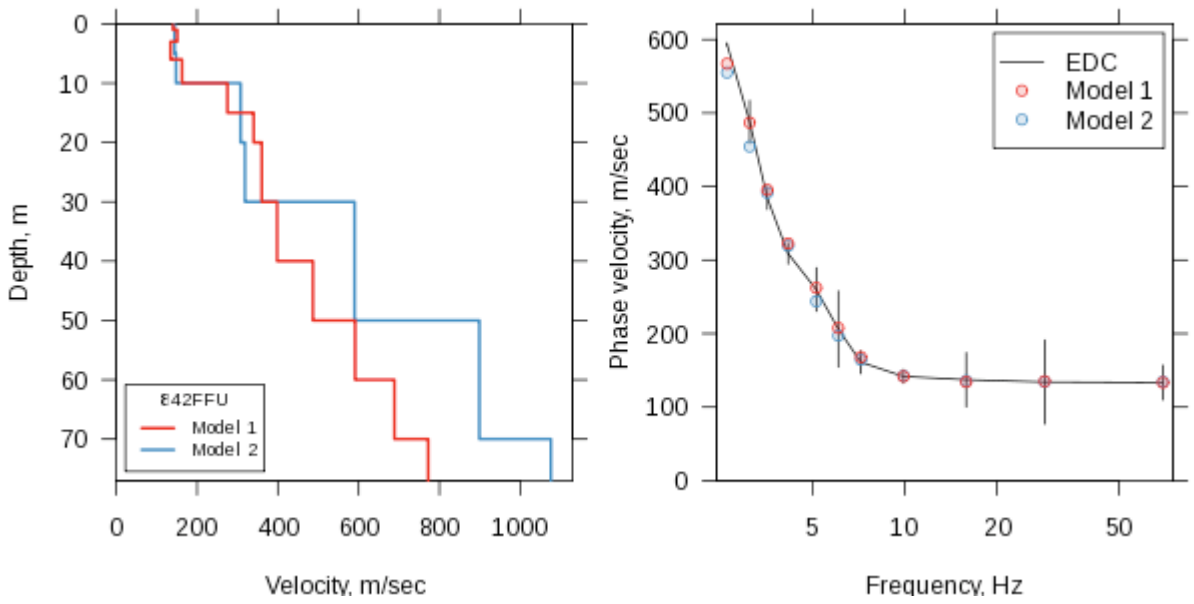


A1-69. SASW site 841KFU near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS station KFU Jack Canyon, is situated within the white circle in E, 40 meters from the shakers (blue dot). The red line is the trend of the SASW array, with arrow at the far end at a distance of 135 meters.

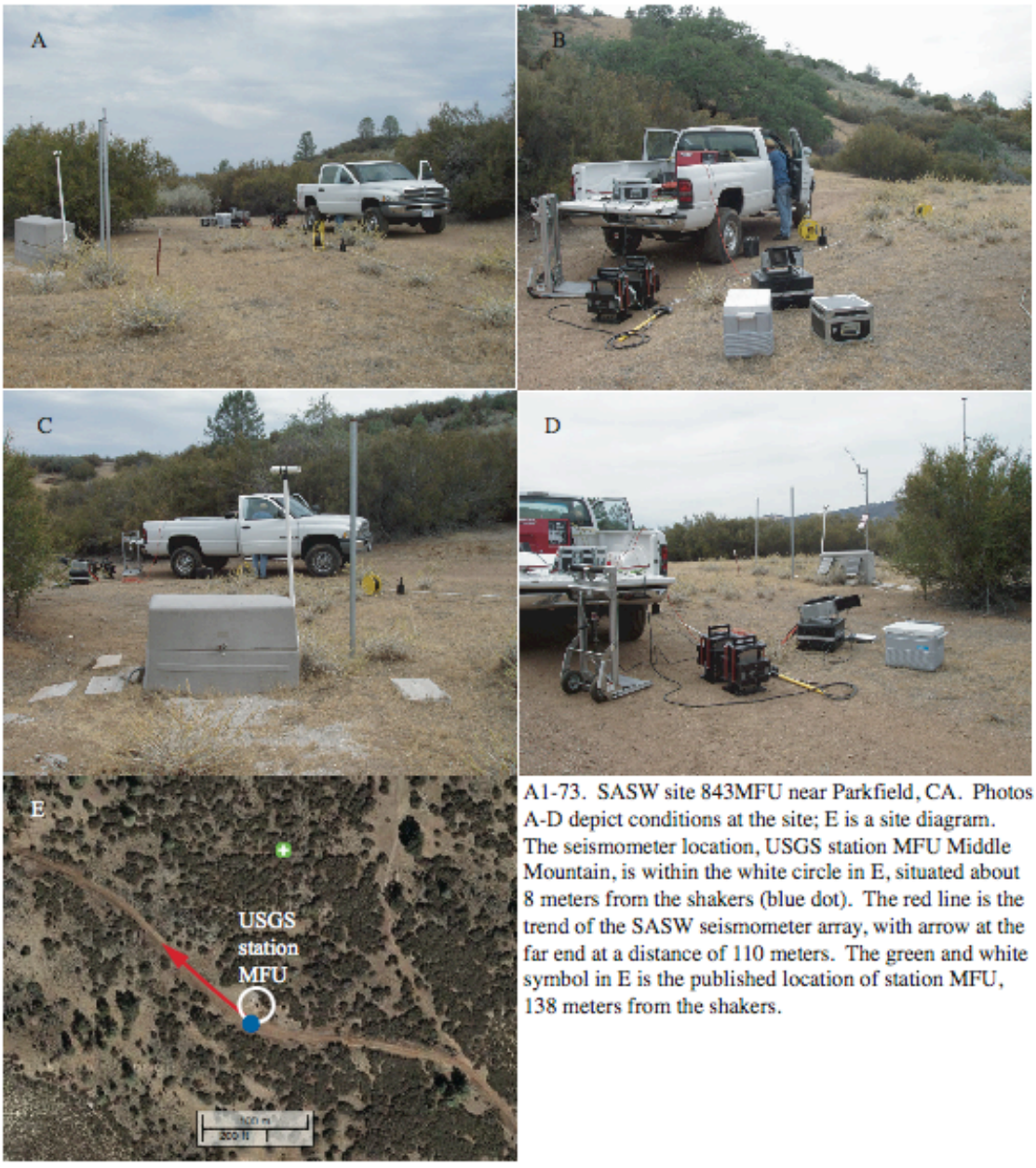


A1-70. Summary of site 841KFU. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

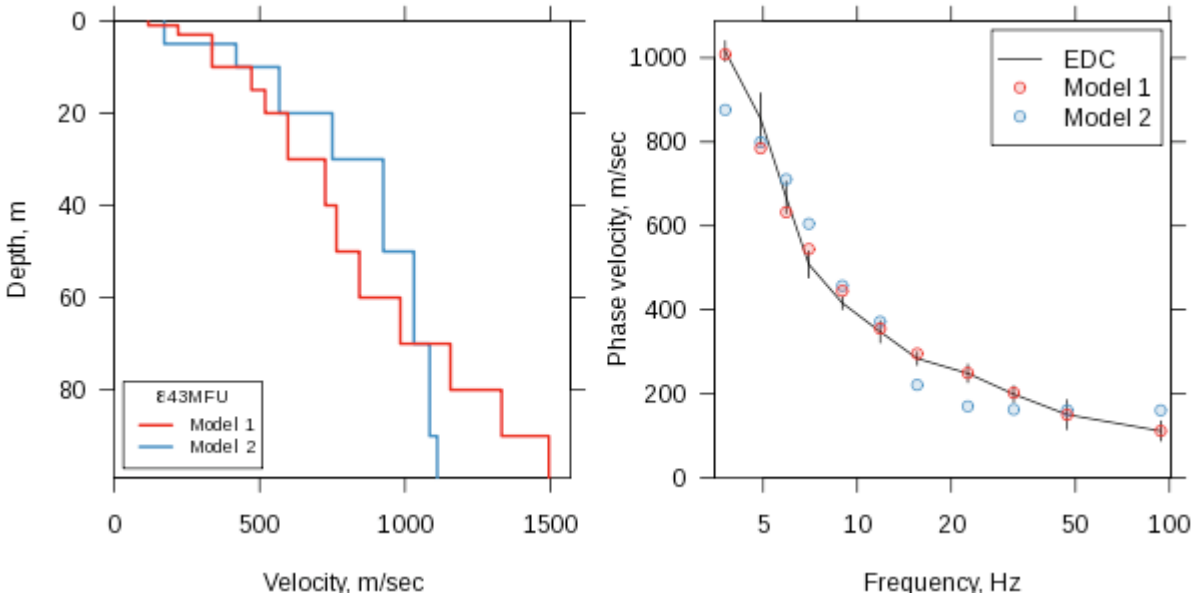
A1-71. SASW site 842FFU near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS station FFU Froelich, is within the white circle in E situated about 6 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 110 meters. The green and white symbol in E is the published location of station FFU, 163 meters from the shakers.



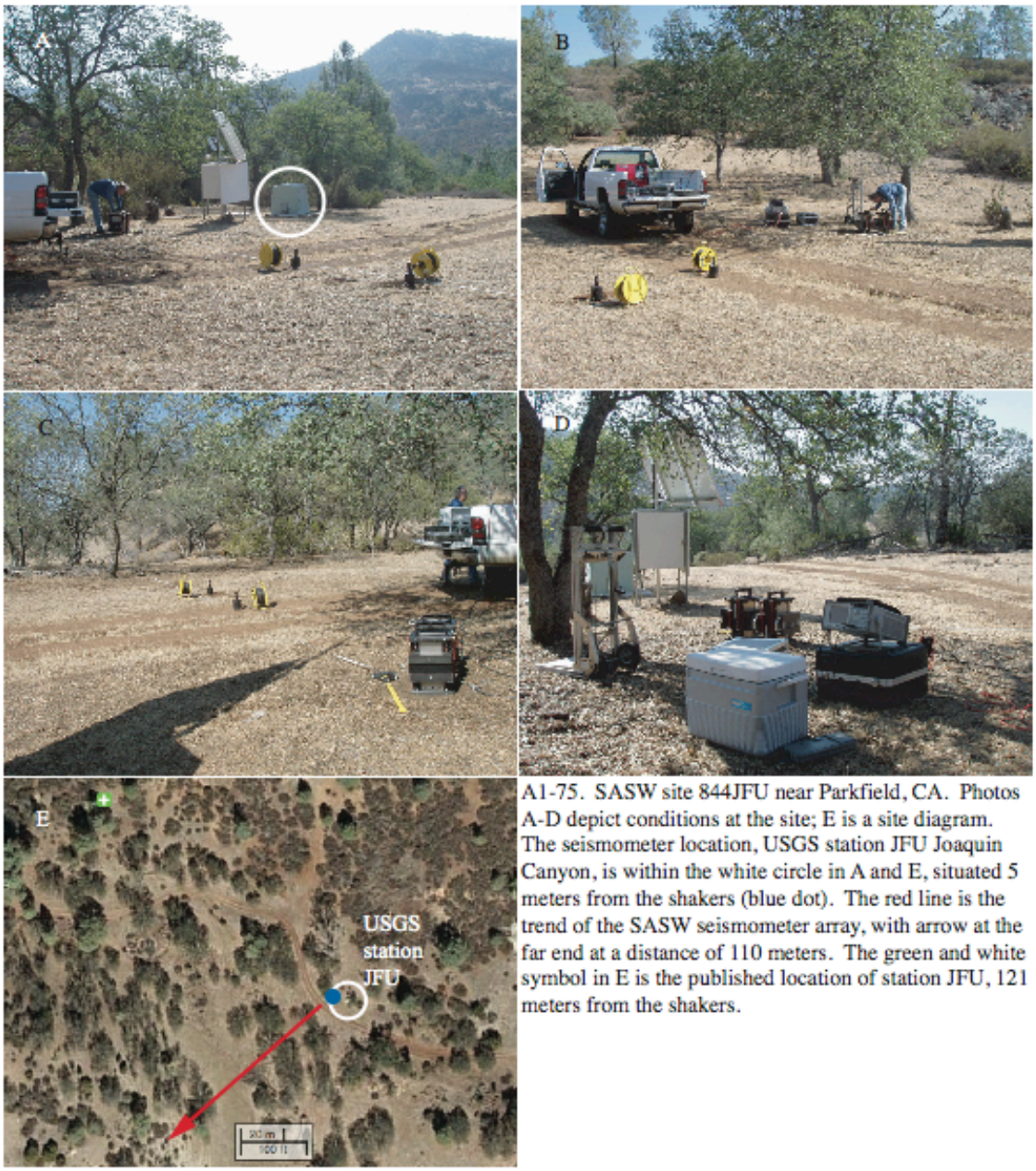
A1-72. Summary of site 842FFU. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



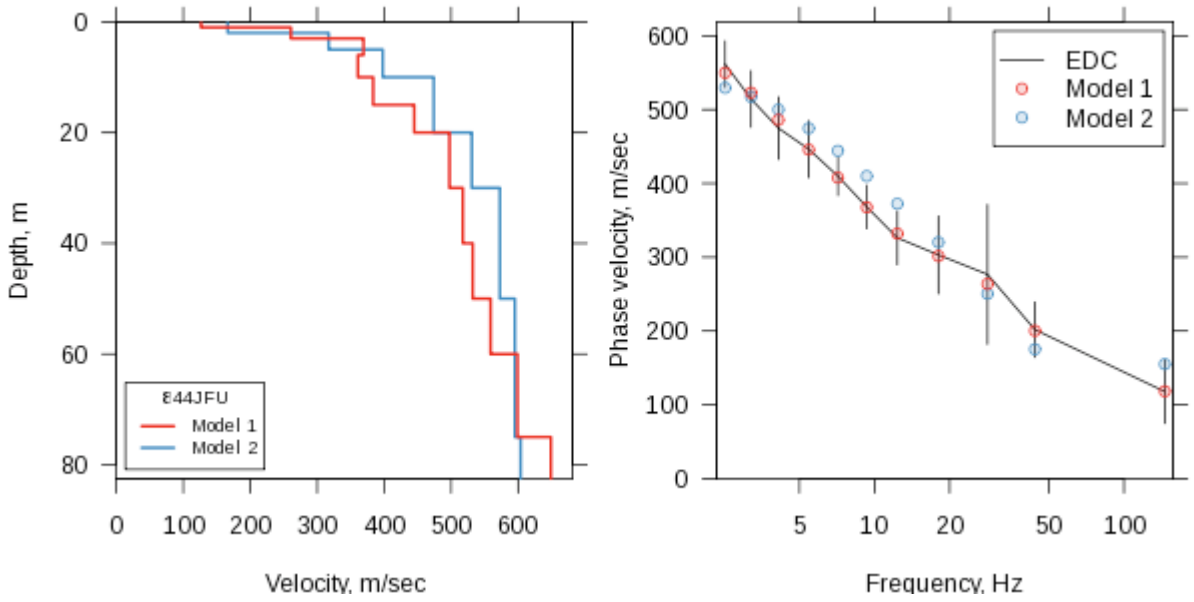
A1-73. SASW site 843MFU near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS station MFU Middle Mountain, is within the white circle in E, situated about 8 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 110 meters. The green and white symbol in E is the published location of station MFU, 138 meters from the shakers.



A1-74. Summary of site 843MFU. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

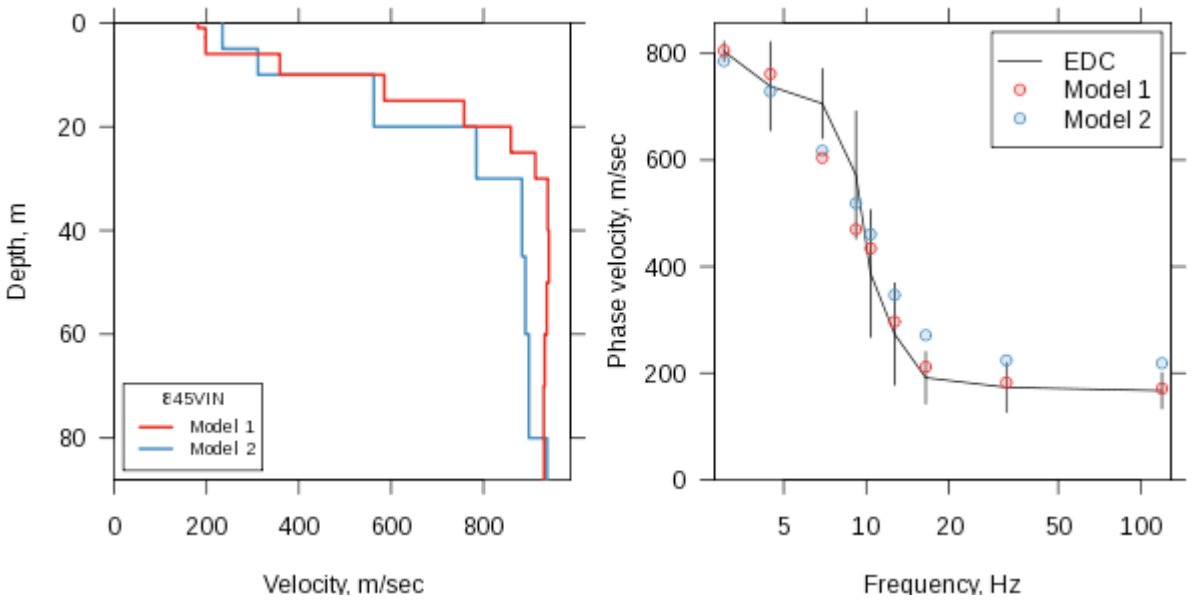


A1-75. SASW site 844JFU near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS station JFU Joaquin Canyon, is within the white circle in A and E, situated 5 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 110 meters. The green and white symbol in E is the published location of station JFU, 121 meters from the shakers.

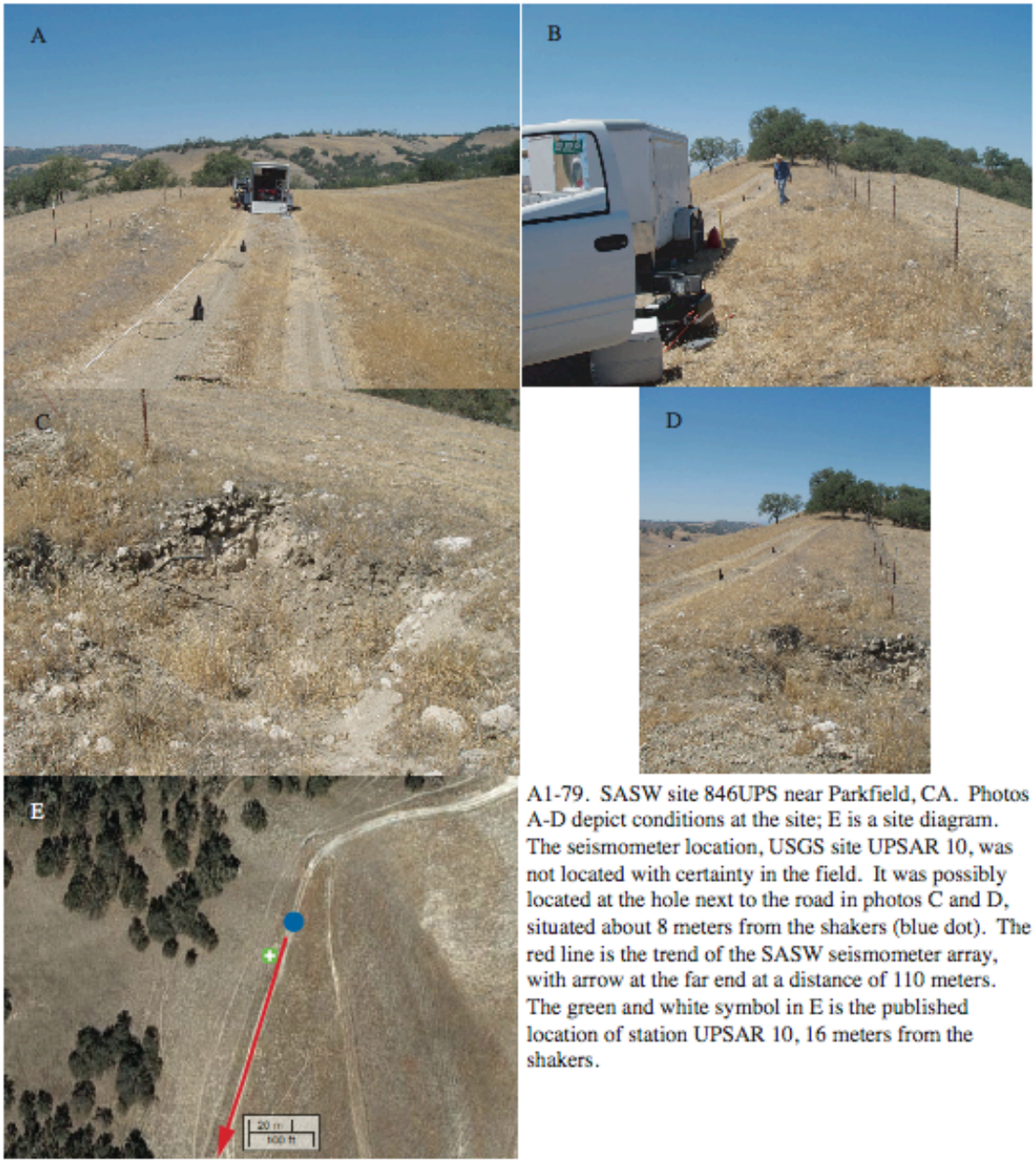


A1-76. Summary of site 844JFU. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

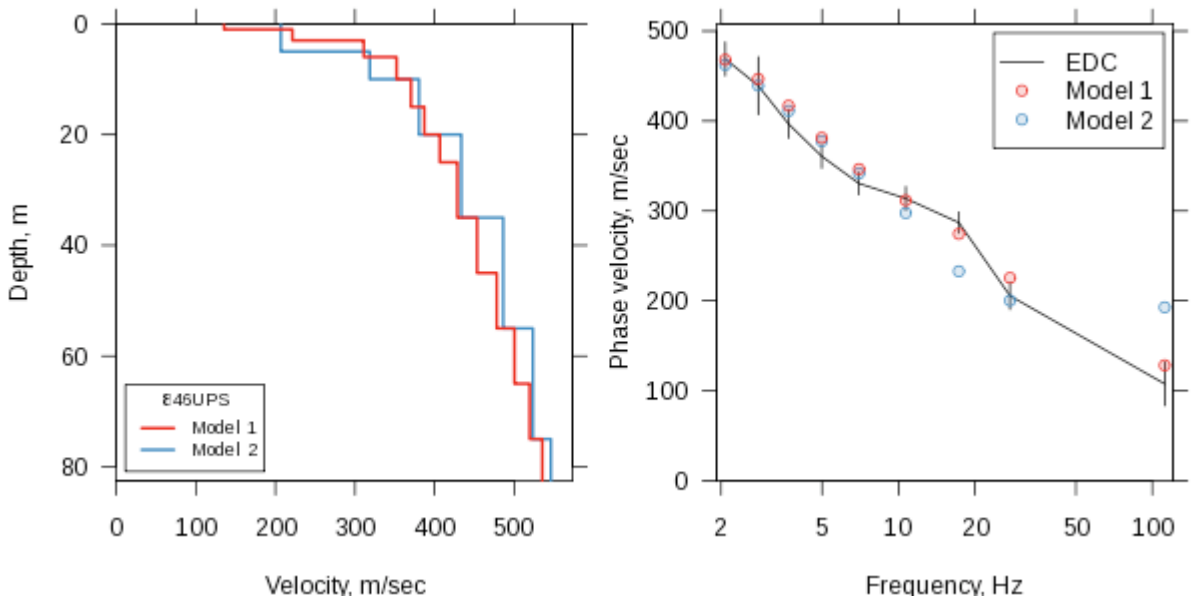
A1-77. SASW site 845VIN near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36447, Vineyard Canyon 2W, is within the white circle in E, situated about 5 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 110 meters. The green and white symbol in E is the published location of station 36447, 88 meters E of the shakers.



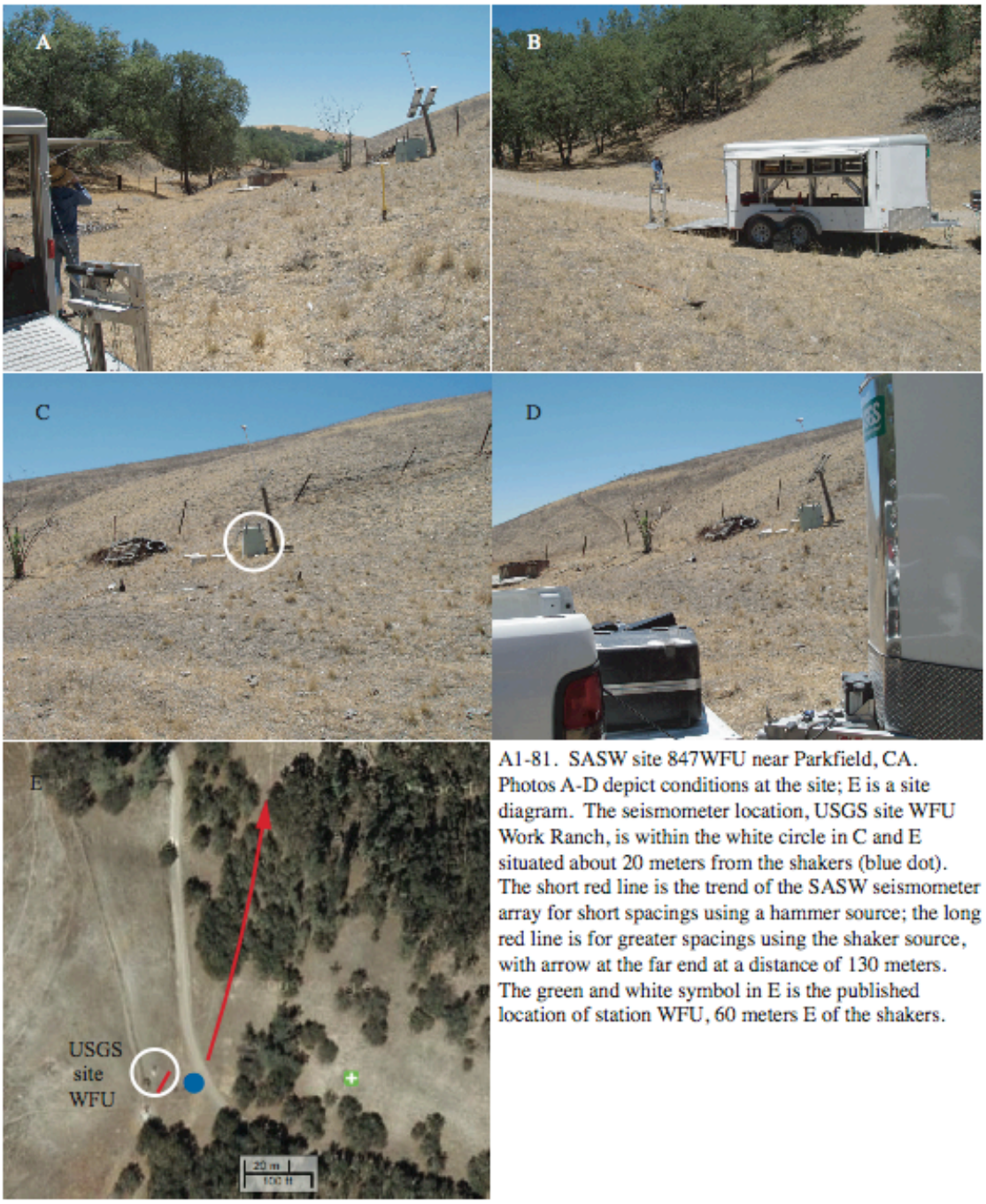
A1-78. Summary of site 845VIN. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



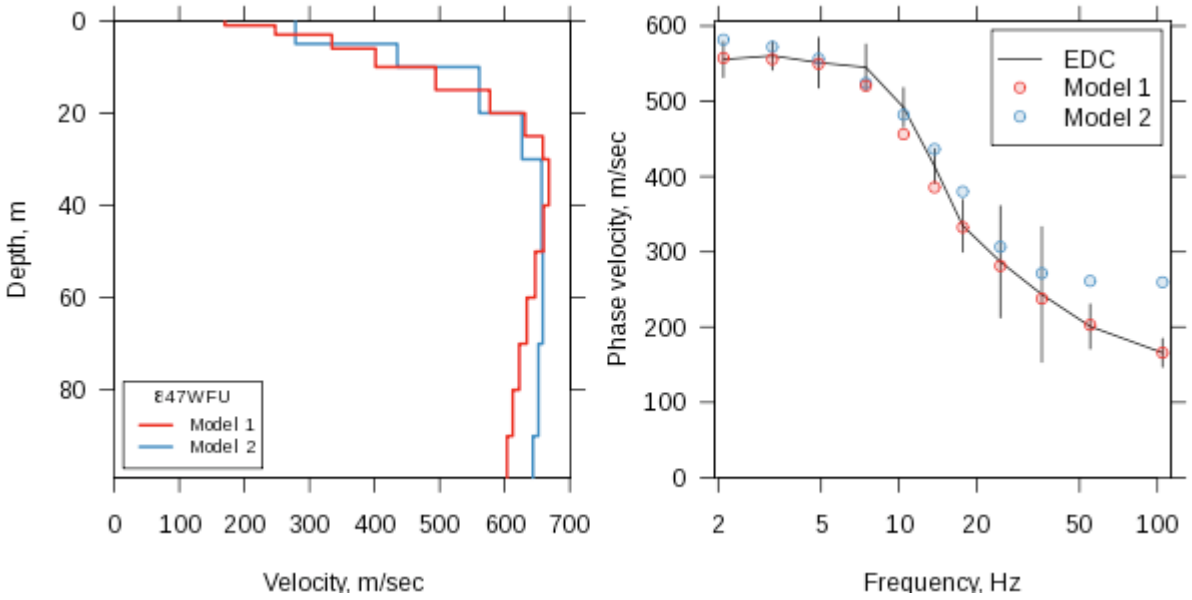
A1-79. SASW site 846UPS near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS site UPSAR 10, was not located with certainty in the field. It was possibly located at the hole next to the road in photos C and D, situated about 8 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 110 meters. The green and white symbol in E is the published location of station UPSAR 10, 16 meters from the shakers.



A1-80. Summary of site 846UPS. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

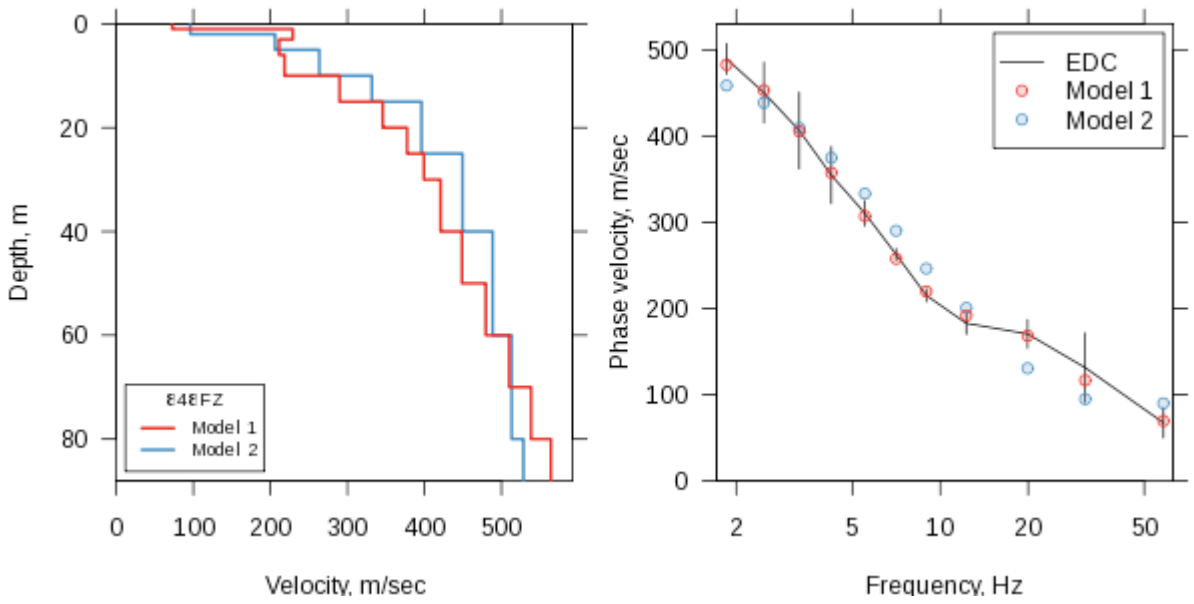


A1-81. SASW site 847WFU near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS site WFU Work Ranch, is within the white circle in C and E situated about 20 meters from the shakers (blue dot). The short red line is the trend of the SASW seismometer array for short spacings using a hammer source; the long red line is for greater spacings using the shaker source, with arrow at the far end at a distance of 130 meters. The green and white symbol in E is the published location of station WFU, 60 meters E of the shakers.



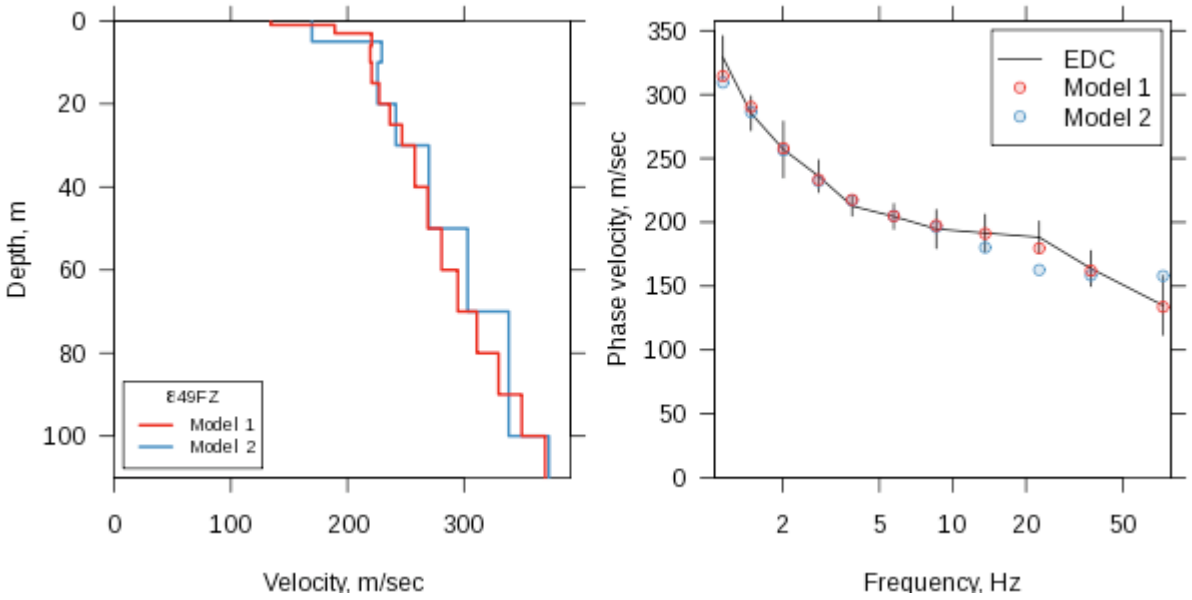
A1-82. Summary of site 847WFU. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

A1-83. SASW site 848FZ near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36454, Fault Zone 6, is within the white circle in D and E, situated about 20 meters from the shakers. The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 130 meters. The green and white symbol in E is the published location of station 36454, 137 meters from the shakers.

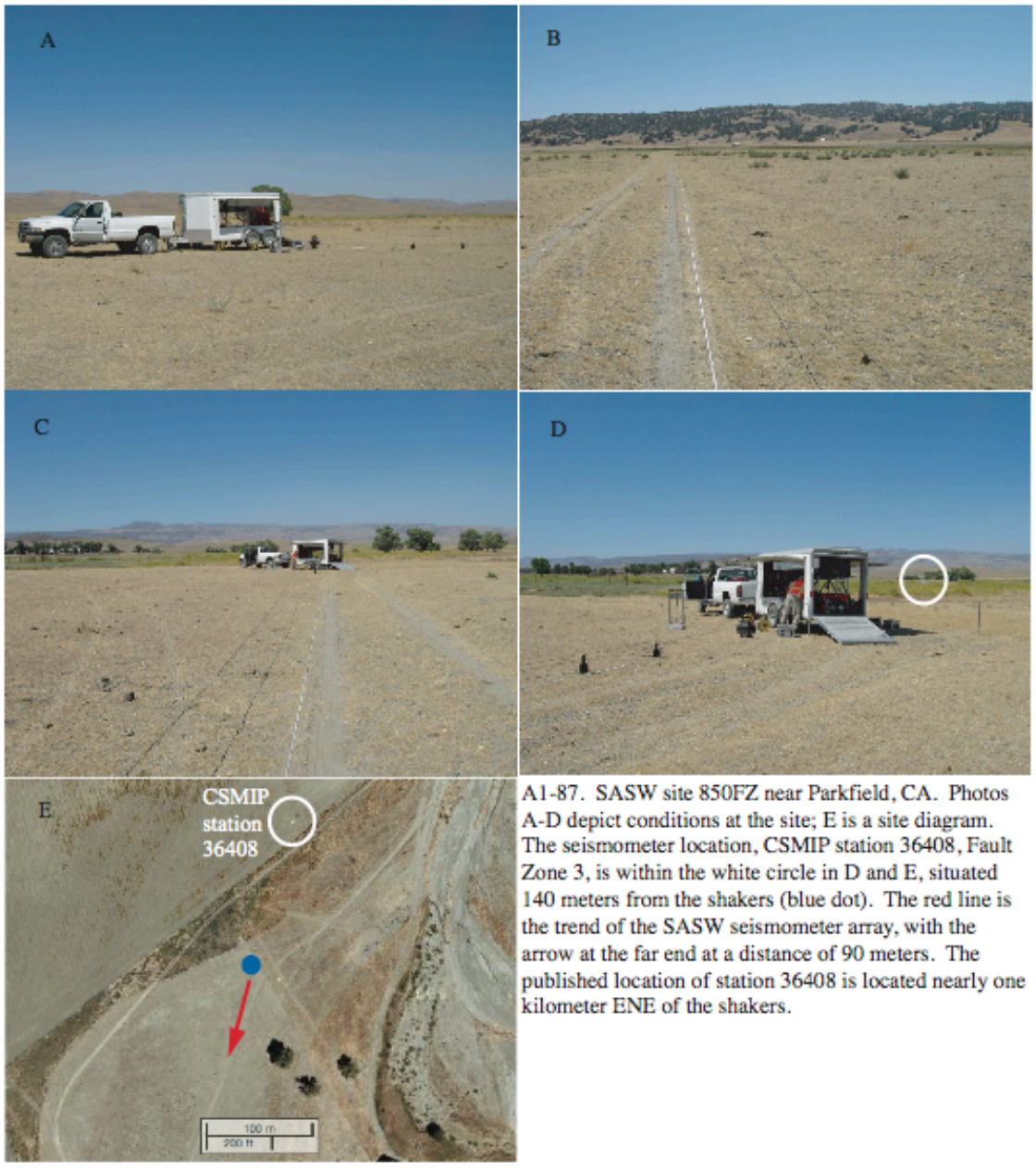


A1-41. Summary of site 848FZ. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

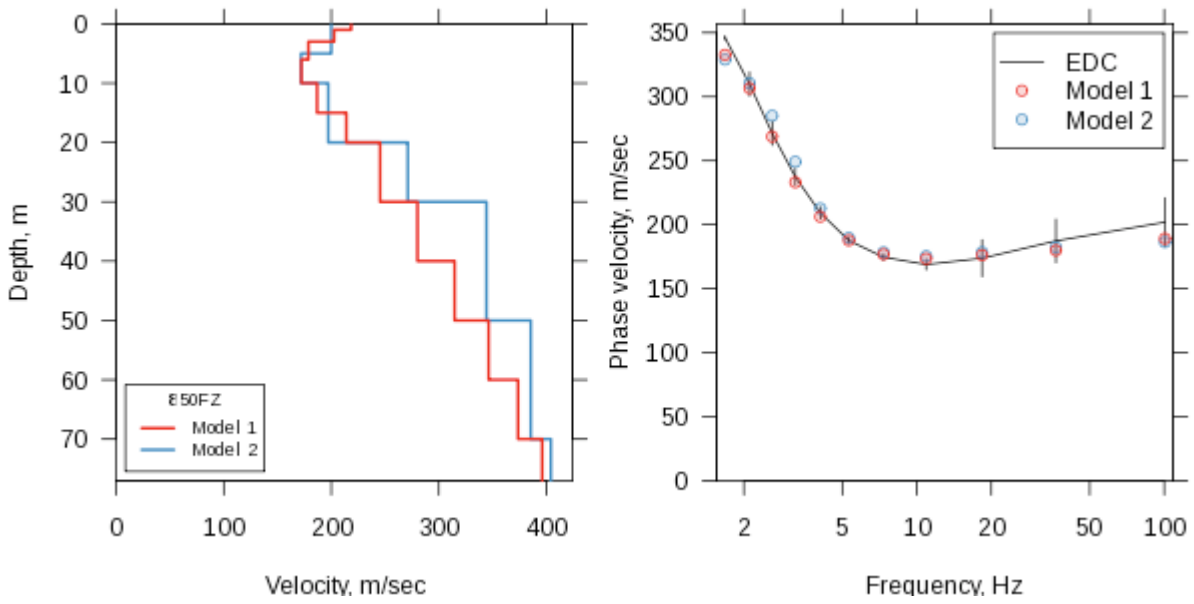
A1-85. SASW site 849FZ near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36414, Fault Zone 4, is within the white circle in D and E, situated about 64 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 90 meters. The green and white symbol in E is the published location of station 36414, 68 meters from the shakers.



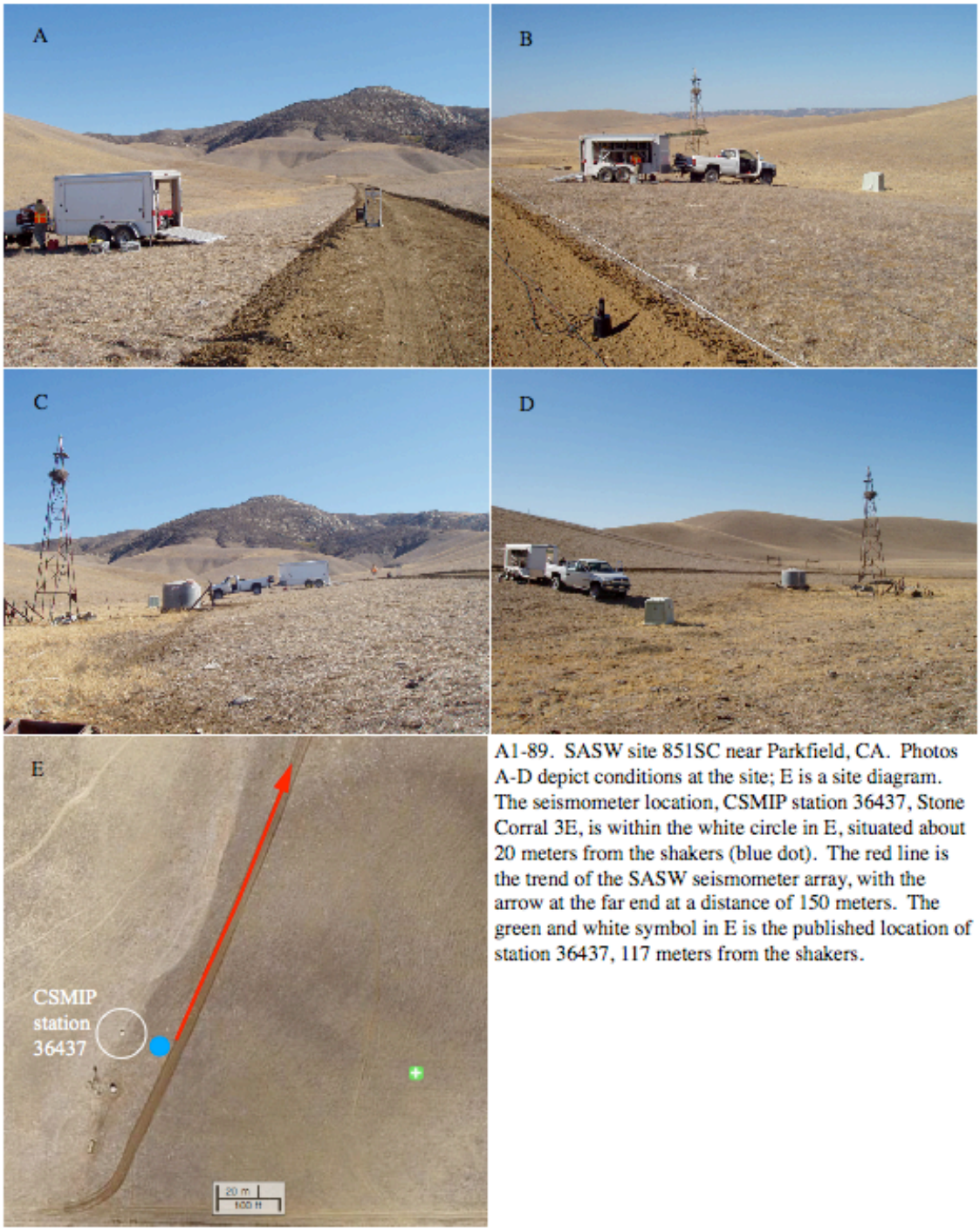
A1-86. Summary of site 849FZ. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



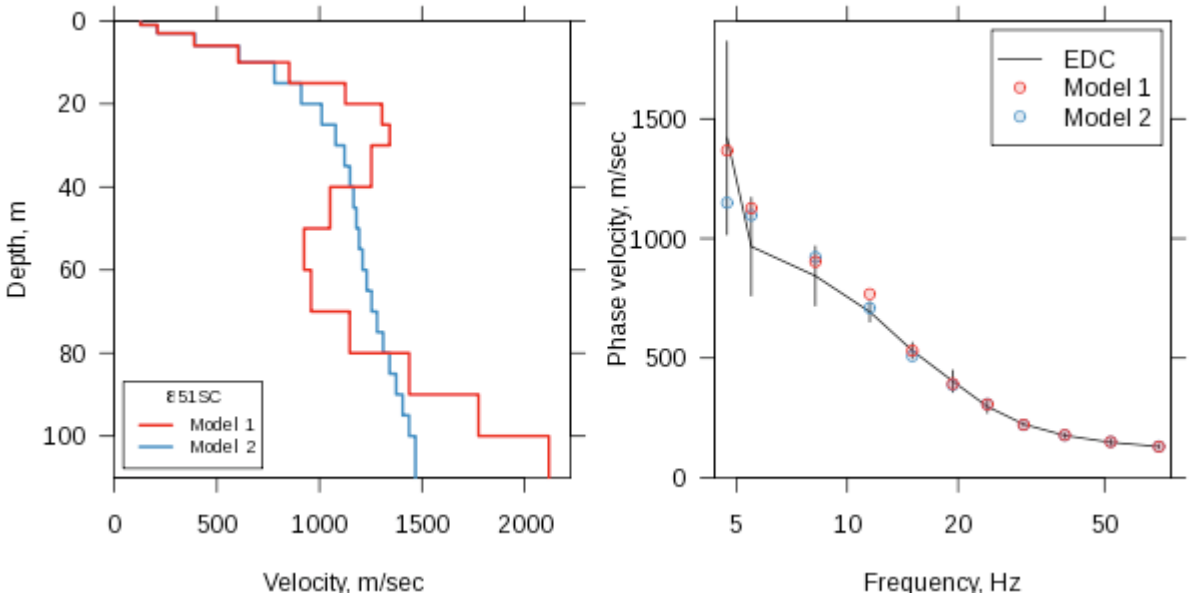
A1-87. SASW site 850FZ near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36408, Fault Zone 3, is within the white circle in D and E, situated 140 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 90 meters. The published location of station 36408 is located nearly one kilometer ENE of the shakers.



A1-88. Summary of site 850FZ. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

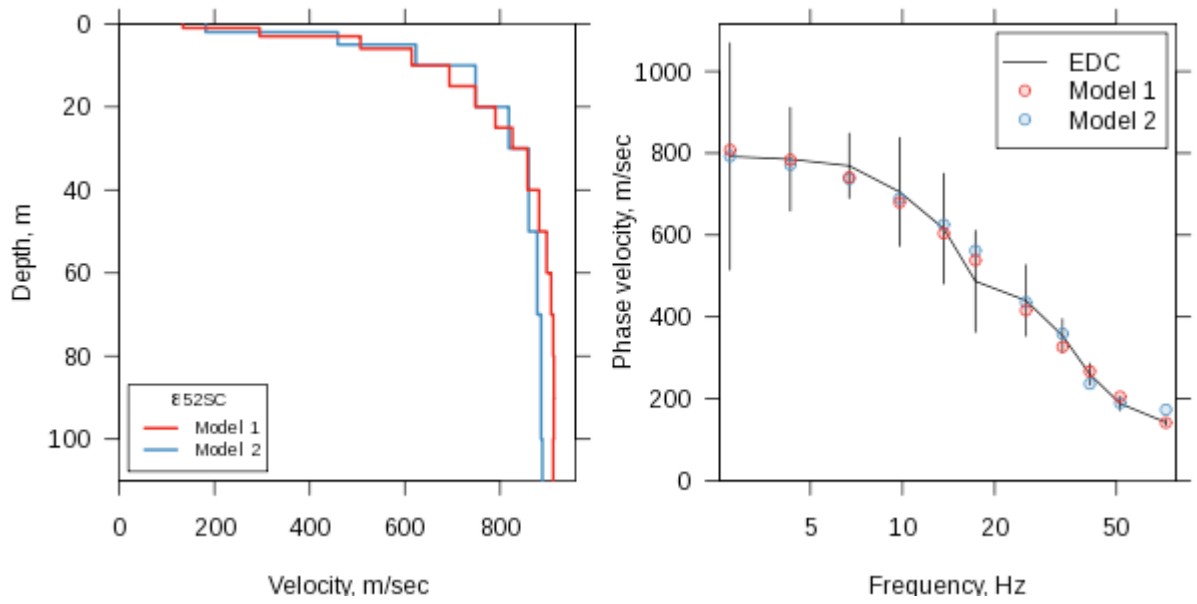


A1-89. SASW site 851SC near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36437, Stone Corral 3E, is within the white circle in E, situated about 20 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 150 meters. The green and white symbol in E is the published location of station 36437, 117 meters from the shakers.

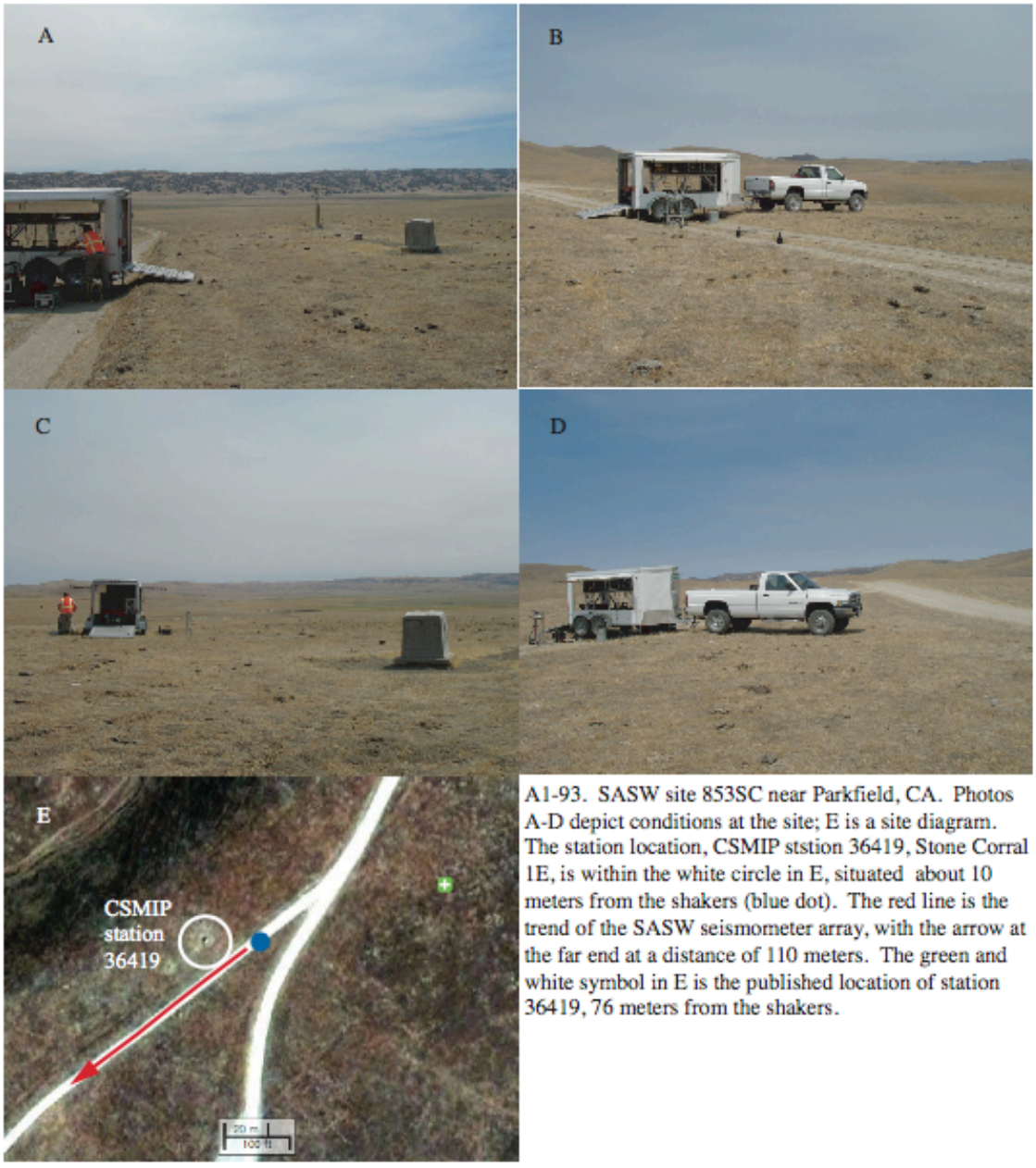


A1-90. Summary of site 851SC. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

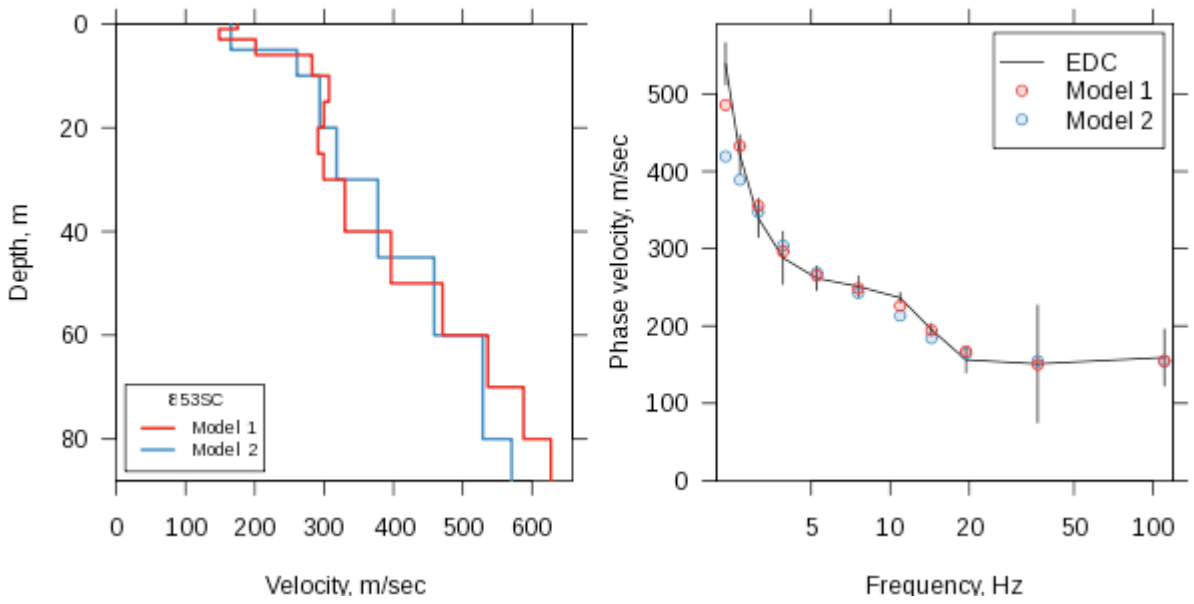
A1-91. SASW site 852SC near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36422, Stone Corral 2E, is within the white circle in B and E, situated about 15 meters from the shakers (blue dot). The red line is the trend of the SASW seimometer array, with the arrow at the far end at a distance of 130 meters. The green and white symbol in E is the published location of station 36422, 112 meters SE of the shakers.



A1-92. Summary of site 852SC. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

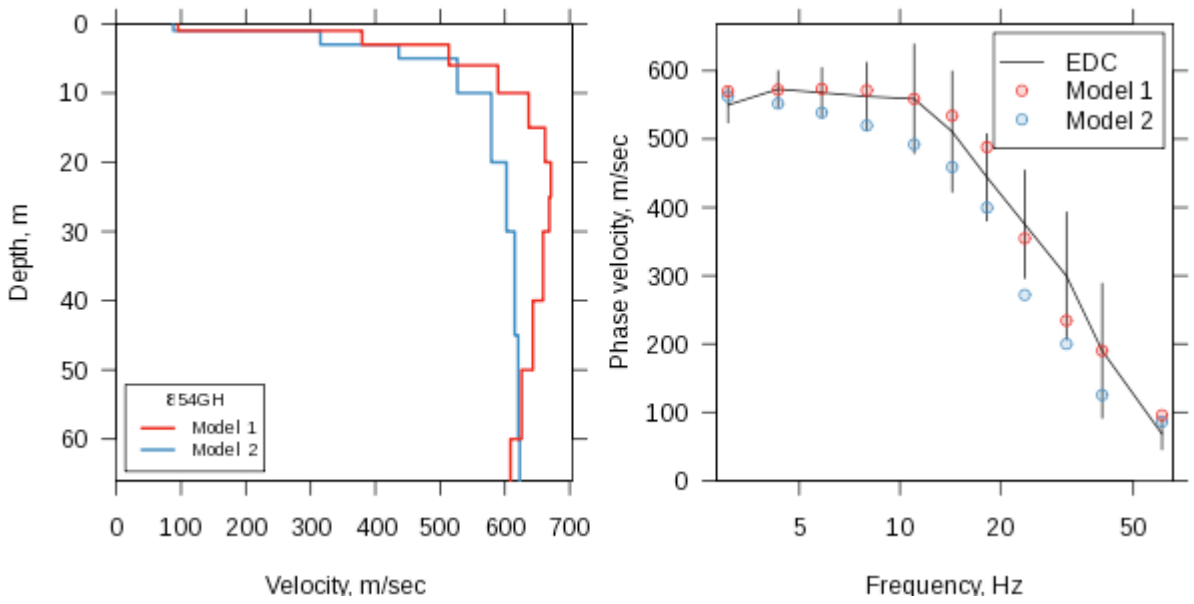


A1-93. SASW site 853SC near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The station location, CSMIP ststion 36419, Stone Corral 1E, is within the white circle in E, situated about 10 meters from the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 110 meters. The green and white symbol in E is the published location of station 36419, 76 meters from the shakers.

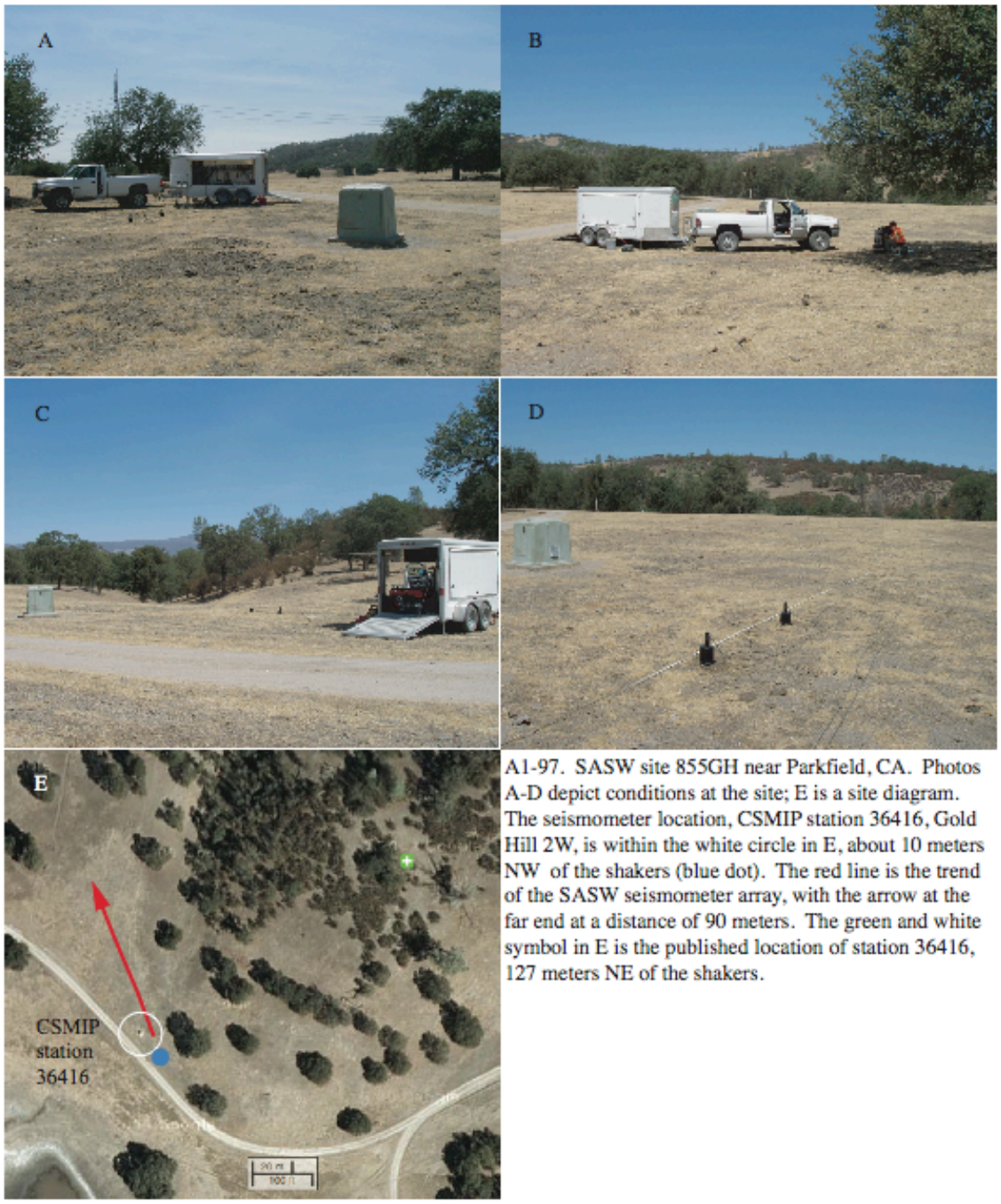


A1-94. Summary of site 853SC. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

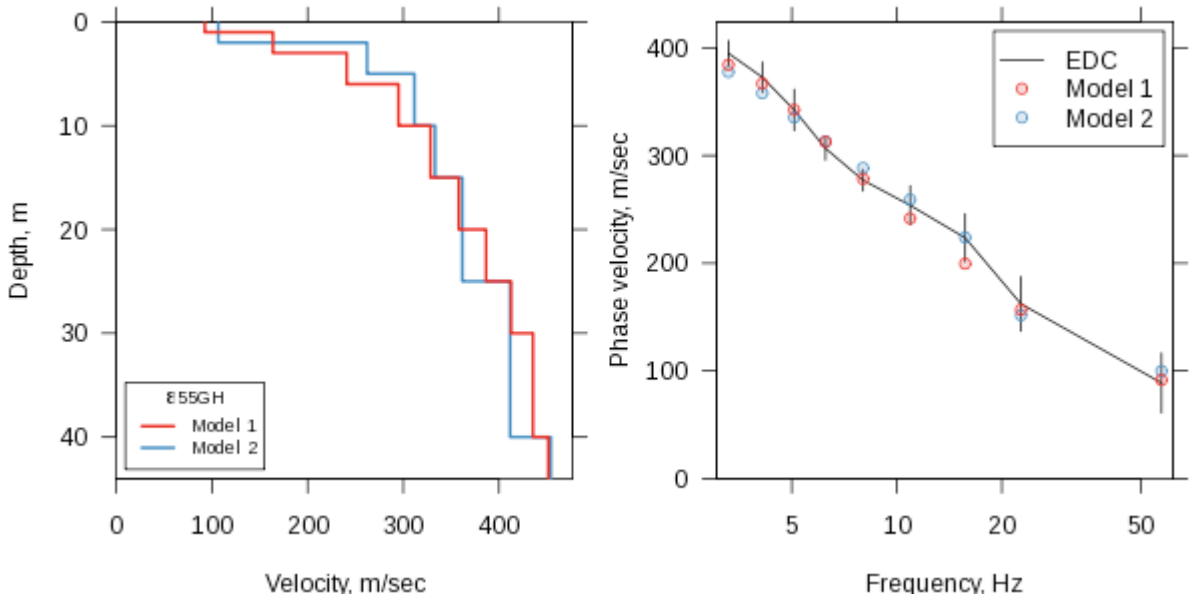
A1-95. SASW site 854GH near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36420, Gold Hill 3W, is within the white circle in E, situated about 6 meters SE of the Shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 100 meters. The green and white symbol in E is the published location of station 36420, 91 meters from the shakers.



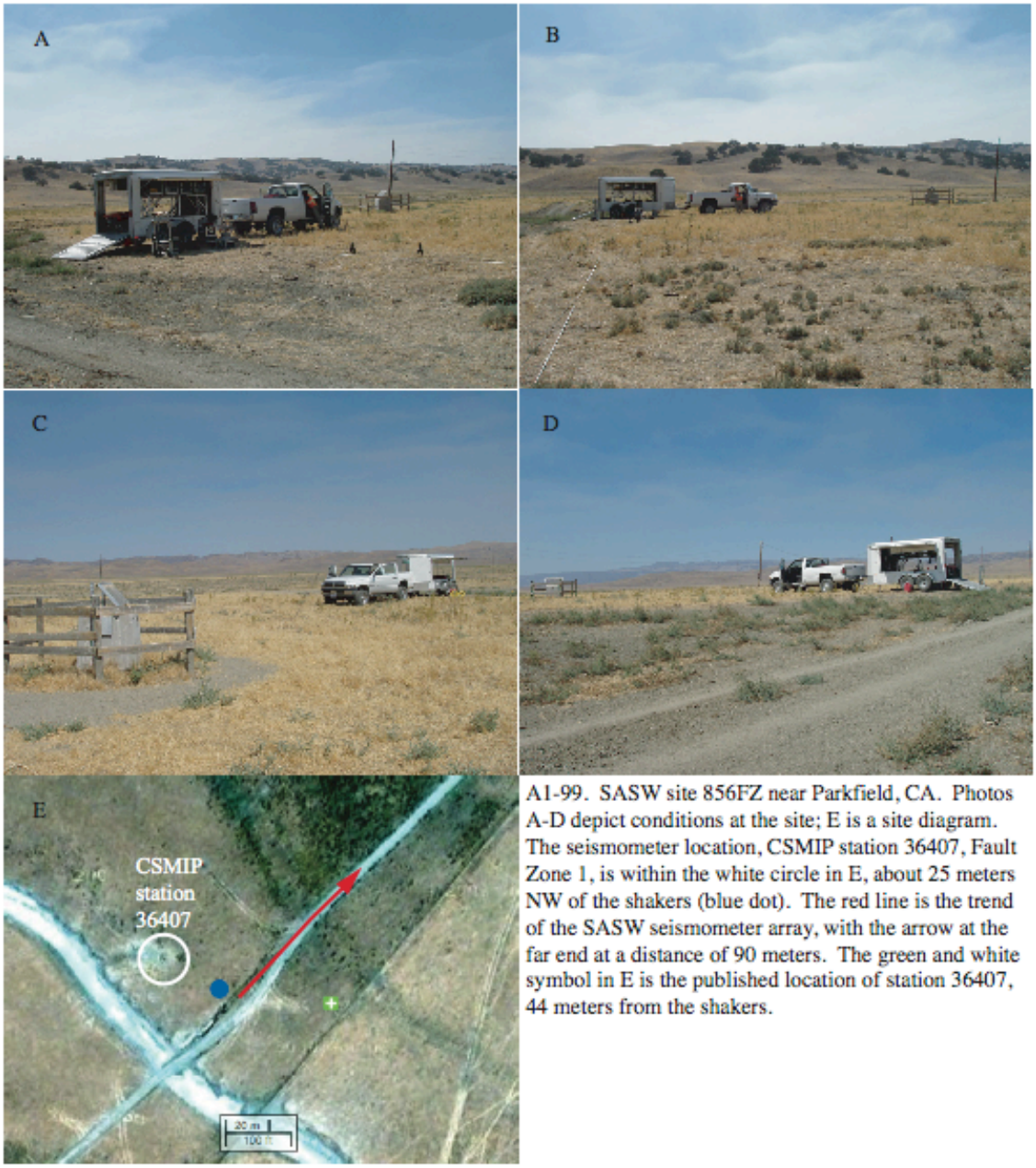
A1-96. Summary of site 854GH. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



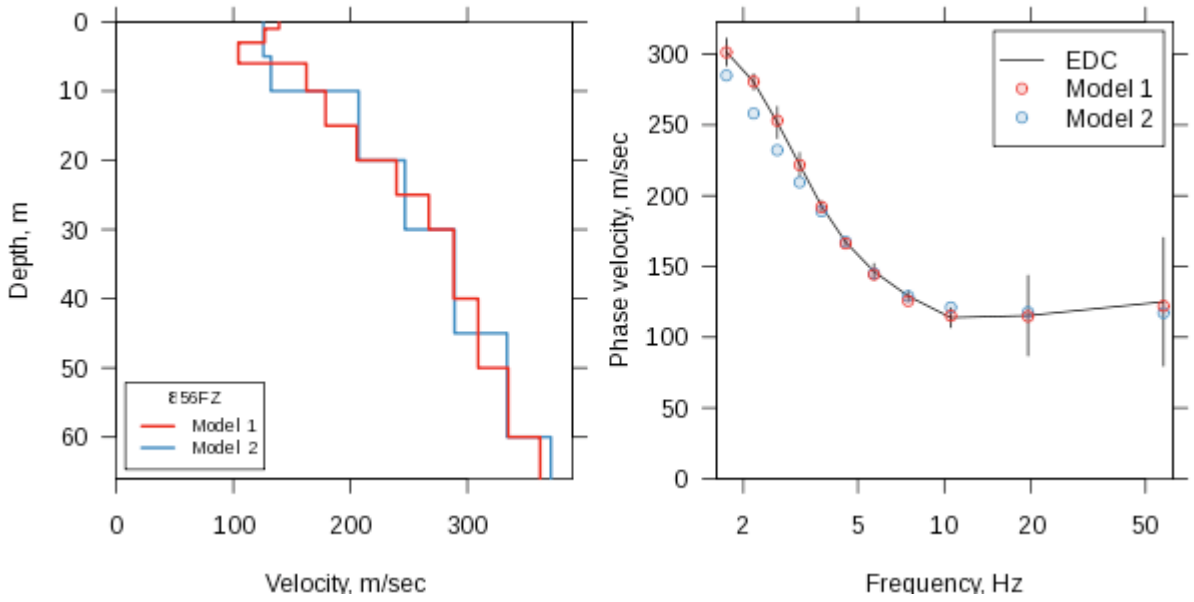
A1-97. SASW site 855GH near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36416, Gold Hill 2W, is within the white circle in E, about 10 meters NW of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 90 meters. The green and white symbol in E is the published location of station 36416, 127 meters NE of the shakers.



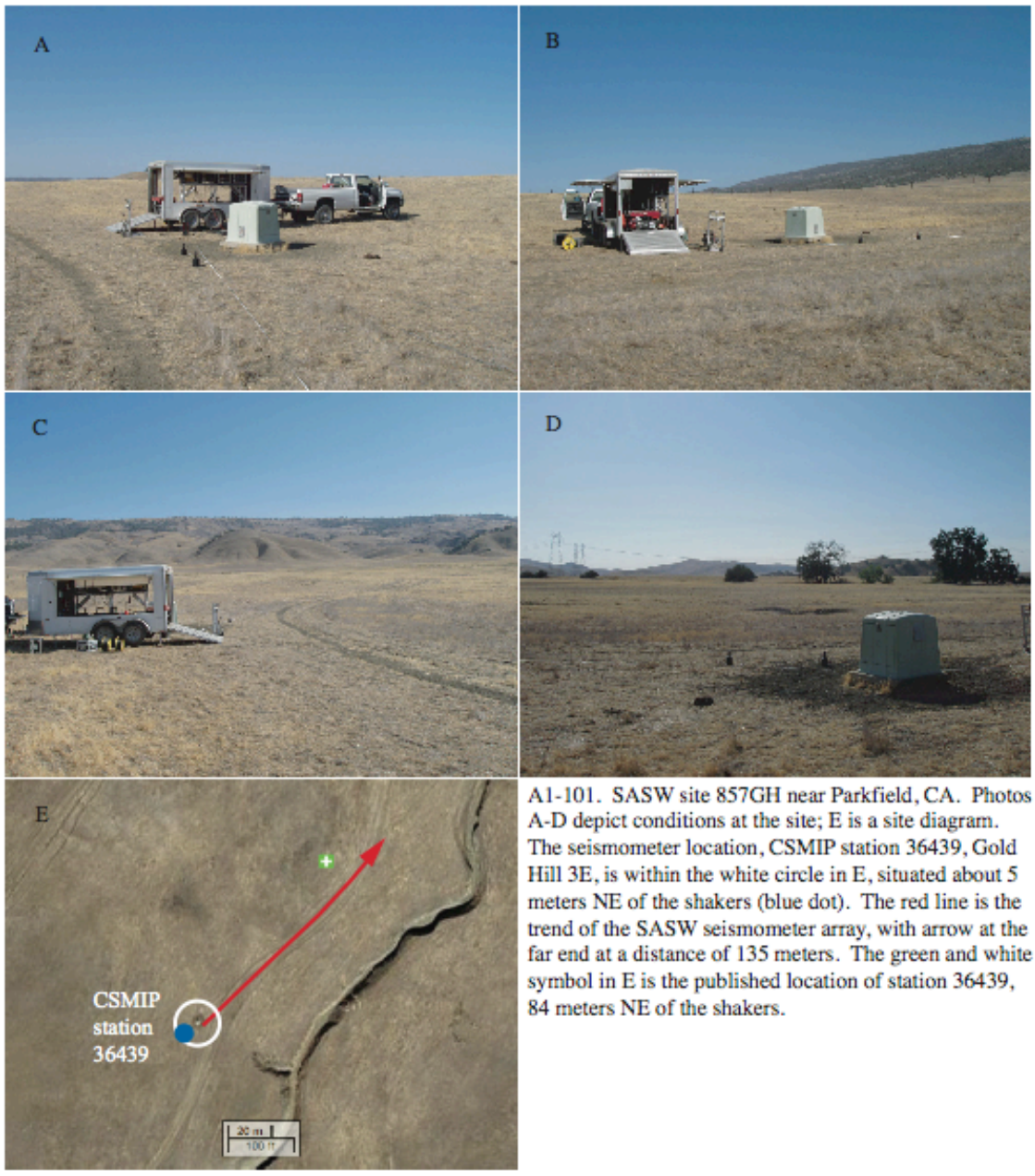
A1-98. Summary of site 855GH. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



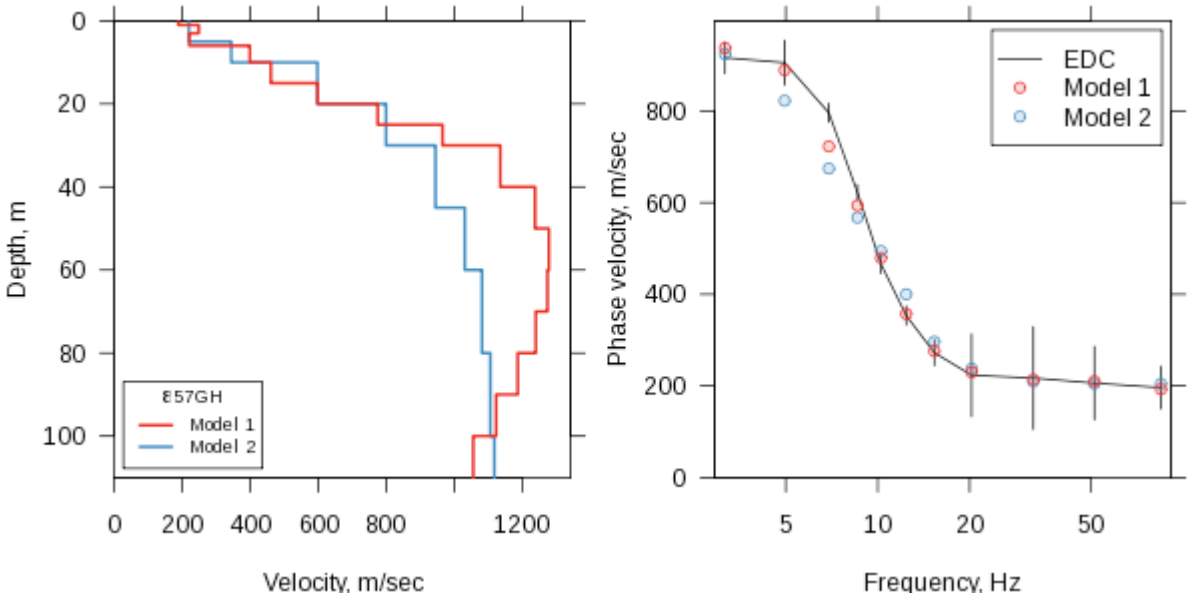
A1-99. SASW site 856FZ near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36407, Fault Zone 1, is within the white circle in E, about 25 meters NW of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 90 meters. The green and white symbol in E is the published location of station 36407, 44 meters from the shakers.



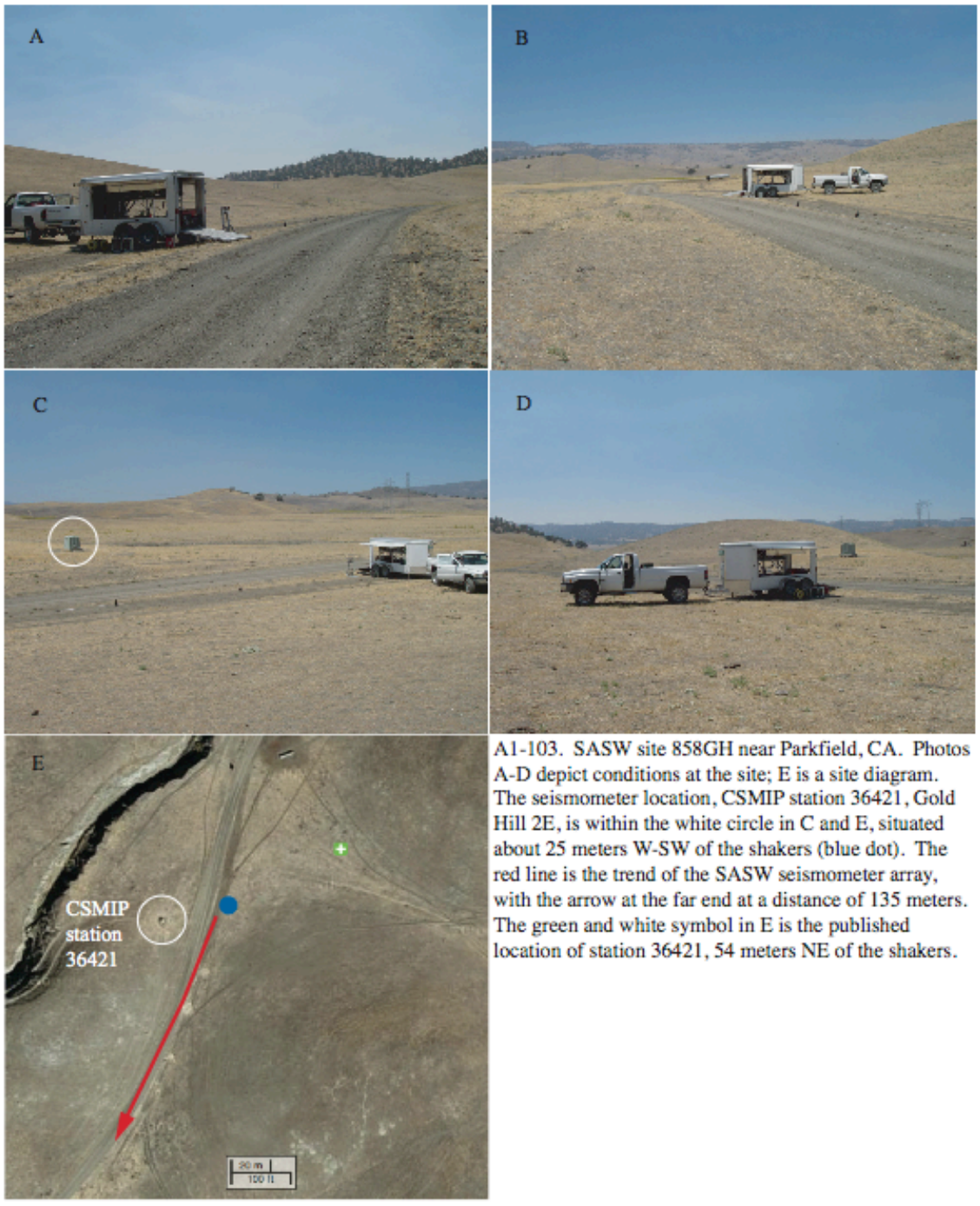
A1-100. Summary of site 856FZ. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.



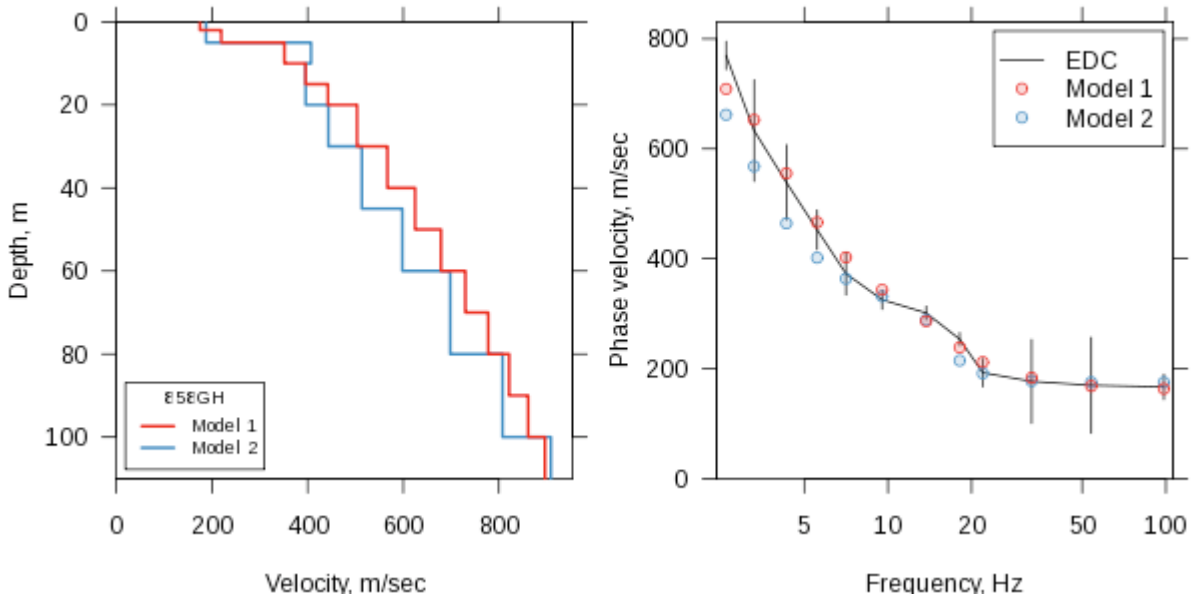
A1-101. SASW site 857GH near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36439, Gold Hill 3E, is within the white circle in E, situated about 5 meters NE of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with arrow at the far end at a distance of 135 meters. The green and white symbol in E is the published location of station 36439, 84 meters NE of the shakers.



A1-102. Summary of site 857GH. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

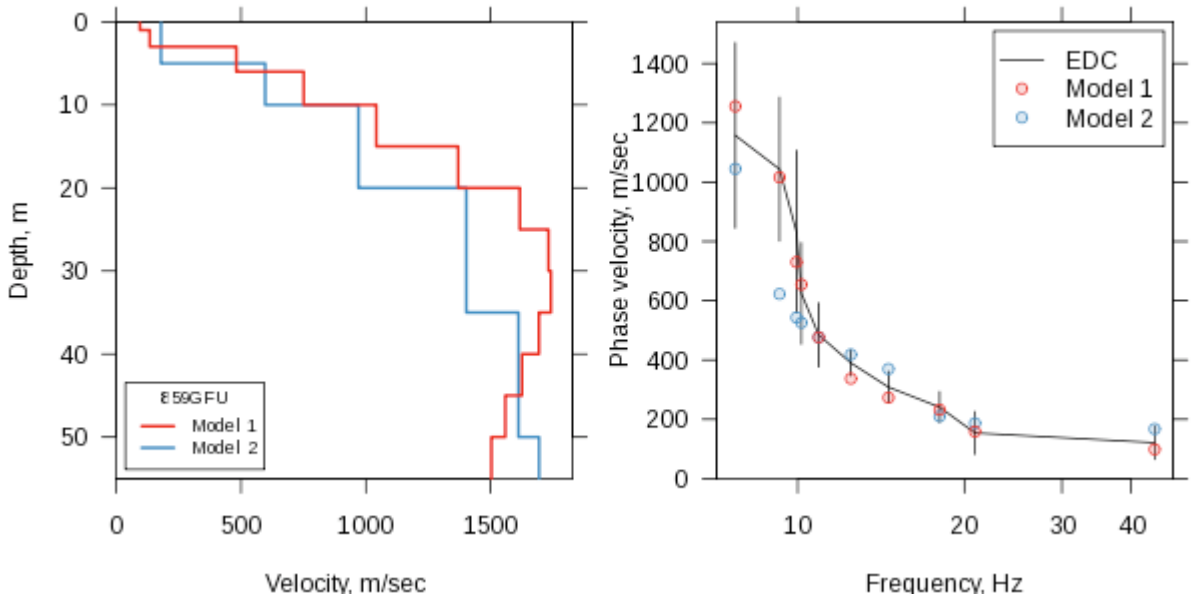


A1-103. SASW site 858GH near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, CSMIP station 36421, Gold Hill 2E, is within the white circle in C and E, situated about 25 meters W-SW of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 135 meters. The green and white symbol in E is the published location of station 36421, 54 meters NE of the shakers.



A1-104. Summary of site 858GH. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.

A1-105. SASW site 859GFU near Parkfield, CA. Photos A-D depict conditions at the site; E is a site diagram. The seismometer location, USGS station GFU Gold Hill, is within the white circle in E situated about 5 meters NW of the shakers (blue dot). The red line is the trend of the SASW seismometer array, with the arrow at the far end at a distance of 95 meters. The green and white symbol in E is the published location of station GFU, situated 143 meters NE of the shakers.



A1-106. Summary of site 859GFU. Left panel: V_s profiles; Right panel: empirical and model dispersion curves.