NEW RIVER/ MESQUITE SEISMIC REFLECTION SURVEY
IMPERIAL VALLEY, CALIFORNIA

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Project Number: 5177

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ACRONYMS AND ABBREVIATIONS

2-D	Two Dimensional
3-D	Three Dimensional
AVO	Amplitude Versus Offset
BGS	Below Ground Surface
CMP	Common Mid-Point
CD	Compact Disk
dB	Decibel
EHSL	East Highline Seismic Lineament
E-Logs	Electrical (Lithological) Logs
ft	Feet
GPS	Global Positioning System
Hz	Hertz
Km	Kilometer
lbs	Pounds
m	Meter
msec	Millisecond
NAD27	North American Datum 1927
NAD83	North American Datum 1983
RFP	Request for Proposal
RMS	Root of the Mean Square
SOW	Statement of Work
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
ZAPATA	Zapata Incorporated, Blackhawk Division

1 INTRODUCTION

Zapata Incorporated, Blackhawk Division (ZAPATA) performed seismic reflection surveys in Imperial Valley, CA between the dates of August 2, 2010 and September 2, 2010. ZAPATA performed this survey for Ram Power, Inc as an aid for future development of geothermal resources in the New River and Mesquite lease areas. 54.41 kms (33.81 miles) of seismic reflection data were collected. The plan for this work was detailed in ZAPATA's proposal #10RAM025 dated April 19, 2010. Figure 1-1 shows the general location of the New River/Mesquite seismic survey. A seismic base map is provided as Figure A-1 in Appendix A. This report and all figures, raw and processed data, and survey results are included on the attached DVD.

1.1 OBJECTIVE

The objective of this seismic survey was to map subsurface faults and fractures up to a maximum depth of 15,000 ft. Additionally, these data are to be used for seismic inversion analysis and amplitude versus offset (AVO) studies. These additional studies required that the true amplitudes of the reflections were preserved during data collection and processing.

1.2 GEOLOGIC SETTING

The New River/Mesquite projects lie within the south central portion of the Salton Trough, a topographic and structural depression within the Colorado Desert physiographic province. The Salton Trough is a transition zone between the ocean-floor spreading regime of the East Pacific Rise of the Gulf of California and the transform tectonic environment of the San Andreas Fault system. The Imperial Valley, lying mostly below sea level, is filled with sediments ranging from 3.7 km (12,000 ft) thick at the north end near the Salton Sea to greater than 4.8 km (16,000 ft) thick near the Mexico – United States border. In the New River/Mesquite area, these sediments are comprised of alternating sandstones, siltstones and mudstones to a depth in excess of 3.5 kilometers (~12,000 ft). At depths below 3.5 kilometers, the sediments begin to transition into greenschist facies low-grade metamorphic rocks (Severson, 1987). The basement rocks within the Salton Trough are composed of Late Cenozoic crystalline igneous and metamorphic rocks. Additionally, a sub-basement of mafic rock is present at depths ranging from 10 km to 16 km (33,000 to 52,000 ft) in depth (Fuis and Kohler 1982). Two major northwest-trending faults cut through the Imperial Valley, the San Andreas and the Imperial Faults.

The seismic data acquired for the New River/Mesquite lease areas overlie the area where the Imperial Fault transitions into the Brawley Seismic Zone. The Imperial Fault is primarily right lateral strike slip, with a smaller vertical component of displacement, as evidenced by fault scarps at the surface within the survey area (Severson, 1987).

2 SEISMIC DATA ACQUISITION

2.1 EQUIPMENT

2.1.1 Seismic Source

Three iVi EnviroVibes were used to generate the acoustic energy for this survey, and are shown in Figure 2-1. Each EnviroVibe is capable of imparting acoustic signal with a theoretical peak force of 15,000 lbs. EnviroVibes have a smaller impact on the environment and infrastructure than traditional, larger vibrators, and their smaller size allowed for passage though the narrow gaps and tight turns present at the field site, in addition to crossing small bridges with reduced load limits.

The three EnviroVibe trucks were synchronized and controlled by a Seismic Source Inc. Force 2 Encoder/Decoder. Table 2-1 shows the source parameters used for data acquisition on the New River/Mesquite project. The source interval was every 200 ft, centered on the half stations. The sources were rolled on to and rolled off of the spread.

FIGURE 2-1 ENVIROVIBE TRUCKS

TABLE 2-1 SEISMIC SOURCE DETAILS

Sweep Frequency	Linear 8-90 Hz
Sweep Length	10 seconds
Listen Time	5 seconds
Start/End Tapers	0.3/0.3 cosine tapers
Source Array	3 Vibes / 12 sweeps / no moveup

2.1.2 Seismic Receivers

The seismic receivers used were Geospace SM4, 10 Hz geophones. Six geophones were used per station. Stations were set up at 100-ft intervals. The six geophones were spread evenly over the 100 ft, centered on the surveyed station locations. This receiver array, in combination with the source array, provided maximum ground roll attenuation without introducing trace mixing.

Trace mixing would have distorted true amplitudes, which are needed for inversion and AVO studies.

2.1.3 Seismic Recording Instrumentation

The data were collected with a Seistronix EX-6 System, which was capable of recording up to 432 channels per shot. The Seistronix is a 24-bit distributed cable telemetry recording system. This allowed for layout across obstacles such as the ever-present irrigation canals. Data collection offsets were set to a maximum of 17,000 ft in order to meet the depth imaging objectives. The nominal maximum fold was 75.

Data were acquired using SEG polarity standards and no acquisition filters were applied during recording. The preamplifier gain used in data acquisition was 24 dB for all channels, and a sample rate of 2 msecs was used. Shot records were 15 seconds in length and uncorrelated. Data were output in SEG2 format.

2.2 SURVEY LOCATIONS

Ram Power, Inc. generated and provided the seismic data collection plan. The overall seismic program went through several iterations due to permit issues. The final seismic program was comprised of two north/south oriented lines, eight east/west oriented lines and one southwest/northeast line, for a total length of 54.41 km (33.81 miles). A base map, showing exact line locations and well control, is presented in Figure A-1 in Appendix A.

All receiver locations, and selected source locations, were surveyed by ZAPATA using a survey grade Trimble 5700/R7 RTK-DGPS system. A GPS base control point ("Stage_Base") was established at the staging area on the Spreckle's Sugar property. Stage_Base was carried in from NGS control point "N 611" using an OPUS obtained solution for this location. An additional satellite base control point was added, "River_Base", to fill in GPS survey in the New River channel. Table 2-2 below lists the survey coordinates for the GPS base station control points. The point coordinates are listed in NAD83, UTM Zone 11, meters and WGS84 Latitude/Longitude.

TABLE 2-2 GPS BASE STATION CONTROL POINTS

Point ID	Easting (m)	Northing (m)	Elevation (m)	Latitude (d.dd)	Longitude (d.dd)
Stage_Base	635,585.030	3,641,770.374	-33.937	32.90574890	-115.55018969
River_Base	631,989.704	3,645,671.502	-25.233	32.94136813	-115.58806557
N 611 (Opus)	635,443.247	3,642,515.461	-34.751	32.91248538	-115.55159593

3 SEISMIC DATA PROCESSING

Sterling Seismic Inc. completed seismic data processing under the direction of a ZAPATA Senior Geophysicist. Sterling Seismic uses the Landmark ProMax software operating on Linux workstations.

The processing flow used for the seismic data described herein is based on a standard common-mid-point (CMP) reflection processing sequence with several enhancements added due to the specific conditions at the site. Each line was processed individually while keeping all area-based parameters the same. Phase I processing steps are performed on shot records (surface ordered). For Phase II processing steps, the data are sorted into CMP gathers (sub-surface ordered). In Phase III, the processed CMP gathers from each location along the survey line are then stacked (horizontally summed) to form a single trace at each sub-surface location. The final steps in Phase III were performed on the set of CMP stacked traces for each line, which resulted in the final output sections. Table 3-1 summarizes the processing flow:

TABLE 3-1 DATA PROCESSING FLOW

Phase I
SEG-2 to Internal Format
Vibroseis Correlation
Geometry/Survey Input
True Amplitude Gain Recovery
Trace by Trace Editing
Refraction/Datum/Elevation Statics Applied
Surface Consistent Amplitude Equalization, Minimum Phase Correction
Surface Consistent Deconvolution 160msec Operator
Spectral Balancing 8-92 Hz
Sort to CDP Gathers
Phase II
(1) NMO/Mute Analysis (1)Surface Consistent Automatic Statics
(2) NMO/Mute Analysis (2)Surface Consistent Automatic Statics
Linear Noise Attenuation
TV-Amplitude Equalization
(3)NMO/Mute Application (3)Surface Consistent Automatic Statics
CDP Trim Statics
Phase III
CDP Stack
Final Datum Statics
Spectral Whitening 8-88 Hz
FX Decon
Migration

3.1 PHASE I

3.1.1 Seg2 to Internal Format
The field data were received in the Society of Geophysicists industry standard SEG-2 Format. The data were converted to an internal ProMax format, and loaded to a hard disk.

3.1.2 Vibroseis Correlation
Uncorrelated records were collected in the field. These records were 15 seconds in length: 10-second sweep, 5-second listen. The records were then correlated with a synthetic sweep generated from the known sweep produced by the vibrators. Correlation reduces the 10-second sweep to a known zero-phase wavelet of short duration. The correlation process effectively reduces the record length from 15 seconds to 5 seconds.

3.1.3 Geometry/Survey Input
A surveyor recorded the easting (x), northing (y), and elevation (z) for each receiver location. The geometric relationships between source and active receivers were recorded for each shot by the Observer. The relational information and the coordinates were input into a spreadsheet file. Each recorded trace was assigned its relevant positioning and elevation information. The relationships between traces were also recorded.

3.1.4 True Amplitude Recovery
The amplitude of the signal decreases with time and distance as the energy radiates away from the vibrators. True Amplitude Recovery, a time variant scalar, was applied to compensate for this loss of amplitude.

3.1.5 Trace by Trace Editing
Each shot record is displayed in order to view noisy traces. Noise can be caused by a variety of sources including, among others, fluctuating electric fields such as power lines, and vehicular traffic when near roads. Upon display, traces that appeared to have a detrimental effect on the final product were zeroed out and flagged as 'dead.' These dead traces were excluded from further processing.

3.1.6 Datum/Elevation Statics Applied
Datum Statics were applied to each trace based on the associated source and receiver elevation information. These statics are time shifts to correct for variations in travel times caused by elevation. A constant correction velocity was used to convert the elevation differences (feet) to the time shifts (seconds). For this survey, the correction velocity was 8,000 ft/sec. The datum elevation was sea level.

3.1.7 Refraction Statics
The Green Mountain Geophysics Fathom System was used to analyze, model, and calculate the refraction statics for each line. This process is as follows:

- Each shot record was displayed, and the first break arrival times were picked on each trace.

- These pick times were then separated into refractor components along the line.
- Pick times from each refractor were analyzed and decomposed into velocity and delay times.
- These components were then combined with the surface elevation information to construct an earth model.
- From the earth model, along with the datum and correction velocity information, a combined refraction/datum static was computed for each source and receiver position along the line.
- These "long period" statics were then applied to each trace based on the source and receiver location of that trace.

3.1.8 Surface Consistent Amplitude Equalization, Minimum Phase Correction

It is probable that some source points along the line encountered varying surface conditions, such as a paved road, that caused the energy from that source point to differ from the energy of the other source points. To correct for this situation, the average amplitude value for each shot was analyzed. A scalar was then applied to each shot in order to bring the amplitudes to a constant value.

A minimum phase correction was used to convert the zero phase wavelet resulting from the correlation process, described above, to a minimum-phase wavelet.

3.1.9 Surface Consistent Deconvolution

High frequencies are required to see the details in thin beds whereas lower frequencies determine overall structural content. Therefore, it is important that all frequencies are maintained within the data.

Deconvolution was used to enhance the frequency bandwidth of the data and remove any individual signatures from sources and receivers. Due to the natural attenuation by the ground of the input seismic signal with depth and distance, higher frequencies lose amplitude faster than lower frequencies. The deconvolution algorithm attempted to make the frequency spectrum of the data as broad as possible with all frequencies having nearly the same amplitude. This is similar to boosting the treble on a stereo. Visually, deconvolution made reflecting events "sharper" on the shot records.

The Deconvolution Operator used on this data was derived by using a 'spiking' algorithm. An inverse wavelet was calculated by analyzing the responses from each Source and Receiver position, thereby removing the individual source and receiver signatures and making the solution surface consistent. A 160-millisecond Spiking Deconvolution Operator was deemed to produce the best results.

3.1.10 Spectral Balancing

After deconvolution, the frequency spectrum of the data was still slightly uneven in appearance. Lower frequencies still had slightly higher amplitudes. Spectral Balancing was used to equalize frequencies within small bandwidth windows to correct for the remaining unevenness.

Additionally, Spectral Balancing band limited the data set. The result was a flattening of the frequency spectrum of the data. For this data, spectral whitening was applied over the bandwidth of 8 to 92 Hz.

3.2 PHASE II

3.2.1 CMP Sorting

Beginning in Phase II, the data were in the original shot order, as recorded in the field. Shot order is consistent with the surface positions of each source and receiver. Each trace, using the definitions from the geometry information, had a sub-surface position. The sub-surface position of a trace is generally at the mid-point between source and receiver surface positions. Common-mid-point (CMP) gathering is performed so that all traces with the same sub-surface position are grouped together. All subsequent Phase II data processing steps were performed in the sub-surface domain, requiring data to be CMP gathered.

3.2.2 NMO/Automatic Surface Consistent Statics

Normal move-out (NMO) processing was used to correct reflected events for offset (distance traveled). Reflected seismic events produce a hyperbolic curve on shot records and CMP gathers (time versus distance) due to the reflected wave traveling different distances between the shot points and receivers. The curvature of this hyperbola is a function of the dip of the geologic strata and the subsurface velocity.

To perform the NMO correction the following steps were performed:

- A curve was fitted to the hyperbolic event seen on the CMP gather.
  - This fitting process was accomplished by visually matching a curve on the screen with the reflected event or by analyzing panels of data stacked at different velocities.
  - This curve described the velocity that, when applied, flattened out the hyperbola.
  - This was done at intervals of 50 CMP locations along each line.
- After selecting the best fit at each CMP, the time/velocity pairs were saved.
- Velocities can vary along the line. Velocities were linearly interpolated between locations where picked.
- Each line has its own set of velocity functions that will vary with the geologic conditions encountered along each line.
- Velocity analysis was performed iteratively in conjunction with residual statics corrections.
- The cycle of velocity analysis and residual statics application was continued until no further improvement was seen in the stacked section.

Automatic Surface Consistent Residual Statics were used to correct for inconsistencies in thickness and/or velocity of the near surface weathered layer. The changes in the near surface could have an impact on the travel time of the seismic signal. Calculations were derived by cross-correlating events in one source record to the same events in neighboring source records.

A time shift was calculated for each surface source point. The same procedure was performed on receiver gathers with static shifts being calculated for each surface receiver position. Smoothing filters were applied to the static shifts to compensate for linear trends, such as regional dip. Each trace was then time shifted with a value derived from its own source and receiver information. This process was iteratively performed with the velocity analysis until no further improvement was seen on the stacked data.

3.2.3 Mute Analysis

Muting, which zeros amplitudes within a specific area, was used to remove coherent noise features, such as ground roll or air waves, and to eliminate shallow, first break events that are stretched and distorted by the NMO correction. If muting is not performed, refraction events could have resulted in erroneous reflectors within the final stacked sections. However, using a mute too severe could remove important reflection events, degrading the final product. The first break mutes were determined by analyzing several NMO and static corrected CMP gathers along the line. Mutes were evaluated by viewing panels of stacked data in which the mute application varies the percentage of NMO stretch allowed. The mutes were analyzed on these lines every 50 CMPs.

3.2.4 Linear Noise Attenuation

Linear Noise Attenuation (LNA) algorithms were used to further reduce coherent noise trains, such as ground roll. Frequency – wavenumber (F-k) filtering is a commonly used LNA algorithm. However, for this data, the LNA used operated in the frequency – distance (F-X) domain. This LNA used weighted sums across traces to attenuate (selectively) any events that were linear in nature within a range of velocities defined by the seismic data processor. The amplitudes of the linear signals were rescaled down to the level of background noise, rather than being muted or removed.

3.2.5 CMP Stack

All traces with a common mid-point were stacked (mathematically summed). The amplitude values of each trace within a CMP gather were summed, outputting a single stacked trace. This single stacked trace represented a single sub-surface CMP location. This summing process resulted in a significant signal-to-noise improvement in the data. The stacked CMP traces for each point were combined to represent a cross-section of the earth beneath the surface locations of each seismic line.

3.3 PHASE III

All Phase III processes were done on post-stacked data.

3.3.1 Post Stack Statics and Whitening

A final pass of datum statics and spectral whitening, as described above, was applied post stack. The stack produced at this point is included in electronic format in Appendix B.

3.3.2 F-X Deconvolution

F-X deconvolution was applied post-stack to attenuate random noise and improve coherency. This algorithm divided the two-dimensional filtering problem into many one-dimensional filtering problems in space, one for each frequency. The term deconvolution is something of a misnomer for this particular application, since deconvolution refers to the removal of predictable information. In this case, the data of interest are the predictable parts of the input, and the non-linear information is regarded as the "noise". Seismic sections with post-stack FX-decon applied constitute a separate deliverable, and are included in electronic format in Appendix B. The decision to use the sections with FX-decon applied is a judgment made by the seismic data interpreter.

3.3.3 Migration

Migration was used to reverse the natural process of diffraction and to collapse hyperbolas to their originating points. Additionally, migration repositioned reflectors to their proper spatial positions, usually up-dip to an extent defined by the velocity. It also attenuated random noise that does not focus to an origin point. For this data, the migration was performed using 90, 95 and 100 percent of the interval velocities derived from the stacking velocities. The migration performed using 95% was chosen as the final product. Migrated sections constitute a separate deliverable, and are included in electronic format in Appendix B. In addition, seismic sections with both FX-decon and migration applied are included.

4 SEISMIC DATA INTERPRETATION

A map showing the projection of seven major faults to the surface is presented in Figure A-2. These major faults are color-coded for correlation with the interpreted seismic sections presented in Figures A-3 through A-13 in Appendix A. All of these seismic lines tie nicely at their intersections and are scaled identically, allowing for folding and correlation of these paper plots to each other. The fault interpretations are presented on the migrated sections, without post-stack spectral whitening and FX-deconvolution applied. The ZAPATA interpretations presented here are aimed at outlining the gross structural features in the prospect area, and as such, should be regarded as preliminary.

4.1 GENERAL

Overall, processing results appear to be good. Coherent reflection events can be seen on some sections down to 2.5 seconds. Faults manifest themselves as narrow white demarcations in the upper part of the sections. A detailed examination of the fault traces reveals that reflection events terminate along these lines, along with some apparent offset bedding and small folding. Reflection events fade with depth to varying degrees on each line, at least in part due to geologic changes such as chloritization, or a transition into a low-grade metamorphic environment with depth.

In this survey area, the known trace of the Imperial Fault Zone runs more or less between the Mesquite and New River leasehold areas. The character of subsurface reflections varies markedly across the Imperial Fault Zone. In general, the seismic lines within the Mesquite leasehold area exhibit more coherent reflection events (at least on the east side) and are less heavily faulted than the New River leasehold to the west. Within and west of the Imperial Fault Zone, the rocks are shattered by numerous crisscrossing faults, and correlating reflection events for any appreciable distance becomes problematic. On the Mesquite side, an obvious marker bed occurs generally between 400 and 500 milliseconds, and this bed is useful in correlating some of the faults in that area. This same marker bed appears to occur within the New River leasehold, but is severely disrupted by faulting. For the interpretation of this dataset, it is ZAPATA's view that the abrupt change in observed reflectivity (for example on Line EW5, EW5.5 and EW6) is the key to identifying the main trace of the Imperial Fault. Once recognized as such, the structural details surrounding this main trace can be deciphered.

4.2 TIME TO DEPTH CONVERSION

Two sonic logs from within the New River/Mesquite prospect were digitized into .LAS format for use in the creation of synthetic seismograms for time-to-depth conversion. The most useful synthetic seismogram was developed from the Holly Sugar 44P well. The sonic log from this well extends from 1,400 to 6,290 feet measured depth. Unfortunately, due to its location, this well does not project neatly into a nearby seismic line. The only other sonic log available was collected in the Lacey 1-A well, but this log only runs from 10,800 to 12,100 feet (measured depth), and turned out to be of insufficient length to aid in time-to-depth conversion. No density logs were available for this area.

The wavelet on the synthetic seismogram derived from the Holly Sugar 44P well sonic log was generated such that it matched the wavelet of the wiggle traces on line EW4.5, which is the closest line on the west side of the Imperial Fault. The synthetic seismogram is shown as Figure A-14, and the wiggle trace of EW4.5 is shown as Figure A-15, both in Appendix A. Due to the highly faulted nature of the subsurface in the vicinity of Holly Sugar 44P well located west of the main trace of the Imperial Fault, a good match between the synthetic and the seismic lines could not be found in close proximity to the well. However, a good tie was found at SP 202 along EW4.5 where a relatively intact package of sediments was located; it is a little further away than desirable but sufficient for a reasonable approximation. Six good tie points are marked on the synthetic seismogram and matched to the wiggle trace of the seismic line (marked with red dots on the section). Only a small amount of manipulation (shift up or down the section) is necessary to get a clear tie, and this is likely due to the effect of density changes not compensated for in the creation of the synthetic seismogram. In fact, there is a clear one-to-one correlation for many reflection events between the synthetic and the seismic line when viewed in detail. The potential errors in time-to-depth conversion result from the distance between the well location and its tie point on the seismic line (and any changes in reflector depth due to the faults in between those two points).

The depths corresponding to these six tie points are marked on Figure A-15, as well as 2000-ft depth increments. These 2000-ft depth increments are also placed on Figures A-3 through A-13. Interval velocities between marked events were calculated during the generation of the synthetic seismogram. These are shown at the bottom of Figure A-14 and in Table 4-1. The times of the events as seen in the seismic data are also included in Table 4-1.

TABLE 4-1 TIME TO DEPTH CONVERSION

Event	Depth (ft)	Time On Sonic (sec)	2 Way Time on EW4.5 (sec)	Interval Height (ft)	Interval Time (sec)	Interval Velocity (ft / sec)
Start of Log	1400	0.000	0.510			
				270	0.086	6266
6	1670	0.086	0.610			
				490	0.148	6621
5	2160	0.234	0.745			
				1060	0.284	7460
4	3220	0.518	1.350			
				800	0.189	8458
3	4020	0.708	1.230			
				1200	0.256	9375
2	5220	0.964	1.510			
				950	0.193	9848
1	6170	1.156	1.725			
				120	0.024	10221
End of Log	6290	1.180	1.740			

4.3 FAULTS

The complexity of faulting in the New River/Mesquite area is impressive. Major fault alignments are generally northwest to southeast; however, the interpretation presented here also includes a series of faults extending off to the northeast. Fault planes dip steeply to the east or south in the eastern part of the survey area, and steeply to the west in the western part of the survey area closer to the New River. All of the major fault planes exhibit some degree of associated antithetic faulting with resulting rotated blocks. In addition, particularly along the main trend of the Imperial Fault, a fault zone comprised of numerous braided fault planes is evident. The interpretation presented here does not attempt to map all of the faulting within the survey area. Instead, this interpretation attempts to establish a framework of major fault trends, hopefully aiding in a broad understanding of the area.

The main trace of the Imperial Fault is presented as Fault F1 on the surface map and the interpreted sections. This fault trace is spectacularly clear on lines EW5, EW6, and EW5.5, where a thick package of coherent reflection events on the east side of these sections comes to an abrupt halt against a disrupted zone extending off to the west. On all three sections, this fault plane dips steeply to the east. The previously mentioned marker bed, lying between 400 and 500 msecs, is disrupted west of this fault trace on all three sections. This fault plane corresponds well with surface mapped fault scarps, as can be observed on Figure A-2.

Posting the projection of where Fault F1 comes to the surface reveals a stepover to the east in this main fault trace, lying somewhere between Lines EW5 and EW6. A surface fault scarp through this area (provided on a map obtained from Ram Power) was used as a guide for filling in the fault location between these two seismic lines.

Faults F2, F3 and F4 are most readily apparent on Line NS2, which reveals a synclinal feature running along an axis trending roughly perpendicular to Fault F1. Correlating these faults with EW5, EW6 and EW5.5 reveals that the surface projection of F2 through F4 trends to the northeast. There is plenty of room for alternative interpretations here, and more faults are apparent on line NS2 than have been highlighted in this interpretation.

Faults F5 and F6 appear to be major fault planes extending northeast from the point where F1 makes its stepover. These two faults can be traced across four lines, from EW4 to EW1, and correlate into lines NE1 and NS1. Between these two faults (F5 and F6) and the main fault trace (F1), short segments of coherent dipping reflectors indicate braided crosscutting fault planes. These braided fault planes are shown as dashed black lines on some interpreted sections, and schematically drawn on the surface map as linkages associated with the stepover on F1.

Two faults, F7 and F8, on the west side of the survey area, are interpreted on the seismic sections and posted on the surface map. These faults, evident on EW1 though EW4.5, dip steeply to the west, and correlate across all of the EW lines in the New River leasehold. In this area, faulting severely disrupts coherent reflections, and the general pattern is suggestive of flower structures associated with strike-slip motion.

Note that some of the apparent dip to the fault planes on all of these sections is due to the non-linear relationship between time and depth.

Zones of disrupted reflection events appear to be associated with the major fault structures and could potentially represent areas where soft-sediment deformation has occurred due to the movement of subsurface fluids.

5 VIBRATION MONITORING

During the course of data acquisition, vibration monitoring was conducted by ZAPATA on an as-needed basis. Two vibration monitors were used to limit peak particle velocity to less than 2 inches per second (Cal Trans Vibration Standards) near sensitive infrastructure such as bridges and concrete lined canals. The results of the vibration monitoring are included in electronic format in Appendix B. In instances where peak particle velocity approached or began to exceed 2 inches per second, the EnviroVibe either were moved further away from sensitive infrastructure or had their drive levels reduced.

6 CONCLUSIONS

The seismic data collected in Imperial Valley by ZAPATA for Ram Power has imaged the overall structural features of the subsurface in this area, along with providing a delineation of faulting. Making sense of the complex patterns of faulting presents an interpretational challenge. All of the seismic lines time-tie at their intersections.

Time to depth conversion was accomplished using a synthetic seismogram derived from a sonic log recorded in the Holly Sugar 44P well. The synthetic seismogram correlates with the seismic data nicely; however, some error in time to depth conversion may result from changes in reflector elevation between the well location and the tie point on the seismic line, possibly due to intervening faults.

Faults are easily discerned as narrow zones of disruption between otherwise coherent reflection events. In this report, major faults were identified, correlated across seismic sections, projected to the surface and posted in plan view on a map (Figure A-2). A myriad of smaller faults are present in the data, but are not included in this interpretation.

7 REFERENCES

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APPENDIX A

MAPS AND SEISMIC SECTIONS

APPENDIX B

DATA DVD