MULTICOMPONENT SEISMIC ANALYSIS AND CALIBRATION TO IMPROVE RECOVERY FROM ALGAL MOUNDS: APPLICATION TO THE ROADRUNNER/TOWAOC AREA OF THE PARADOX BASIN, UTE MOUNTAIN UTE RESERVATION, COLORADO

First Technical Report – September 23, 2002 through April 31, 2003

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ABSTRACT

This report describes the results made in fulfillment of contract DE-FG26-02NT15451, "Multicomponent Seismic Analysis and Calibration to Improve Recovery from Algal Mounds: Application to the Roadrunner/Towaoc Area of the Paradox Basin, Ute Mountain Ute Reservation, Colorado".

Optimizing development of highly heterogeneous reservoirs where porosity and permeability vary in unpredictable ways due to facies variations can be challenging. An important example of this is in the algal mounds of the Lower and Upper Ismay reservoirs of the Paradox Basin in Utah and Colorado. It is nearly impossible to develop a forward predictive model to delineate regions of better reservoir development, and so enhanced recovery processes must be selected and designed based upon data that can quantitatively or qualitatively distinguish regions of good or bad reservoir permeability and porosity between existing well control.

Recent advances in seismic acquisition and processing offer new ways to see smaller features with more confidence, and to characterize the internal structure of reservoirs such as algal mounds. However, these methods have not been tested. This project will acquire cutting edge, three-dimensional, nine-component (3D9C) seismic data and utilize recently-developed processing algorithms, including the mapping of azimuthal velocity changes in amplitude variation with offset, to extract attributes that relate to variations in reservoir permeability and porosity. In order to apply advanced seismic methods a detailed reservoir study is needed to calibrate the seismic data to reservoir permeability, porosity and lithofacies. This will be done by developing a petrological and geological characterization of the mounds from well data; acquiring and processing the 3D9C data; and comparing the two using advanced pattern recognition tools such as neural nets. In addition, should the correlation prove successful, the resulting data will be evaluated from the perspective of selecting alternative enhanced recovery processes, and their possible implementation.

The work is being carried out on the Roadrunner/Towaoc Fields of the Ute Mountain Ute Tribe, located in the southwestern corner of Colorado. Although this project is focused on development of existing resources, the calibration established between the reservoir properties and the 3D9C seismic data can also enhance exploration success.

During the time period covered by this report, the majority of the project effort has gone into the permitting, planning and design of the 3D seismic survey, and to select a well for the VSP acquisition. The business decision in October, 2002 by WesternGeco, the projects' seismic acquisition contractor, to leave North America, has delayed the acquisition until late summer, 2003. The project has contracted Solid State, a division of Grant Geophysical, to carry out the acquisition. Moreover, the survey has been upgraded to a 3D9C from the originally planned 3D3C survey, which should provide even greater resolution of mounds and internal mound structure.

The project has also developed the initial Project Web Page.

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1 INTRODUCTION

1.1 Project Background

This section describes the project background. The first section summarizes the petroleum potential and geological habitat of the algal mound play in the Paradox Basin, while the second subsection summarizes the technical approach.

1.1.1 UNDISCOVERED OIL POTENTIAL IN THE ISMAY ALGAL MOUNDS

The U. S. Geological Survey reported in their most recent national assessment of undiscovered petroleum in the United States (Gautier and others, 1996) that the mean estimate of undiscovered oil in Porous Carbonate Buildup Play (Figure 1-1) in the Paradox Basin (Play No. 2102), of which the Ismay is the major established reservoir, is approximately 153 MMBO. They also estimate that there is a 5% probability that an undiscovered field will contain 40 MMBO, and that there would be a minimum of 10 undiscovered fields, a median of 20 undiscovered fields, and a maximum of about 50 undiscovered fields. The play is an oil and gas play. Discoveries are typically in the 1 MMBO to 10 MMBO, although the Aneth Field may contain an order of magnitude more oil in these facies

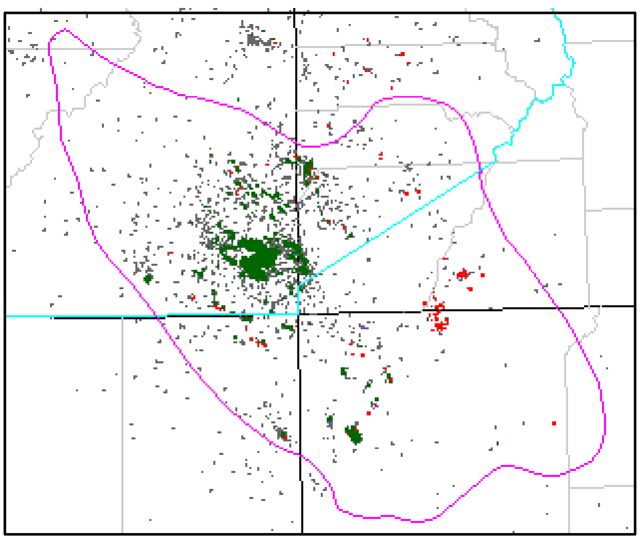

Figure 1-1 (above). Location of USGS's Carbonate Buildup Play (purple outline) and locations where wells have produced oil (green squares) and gas (red squares) from this play.

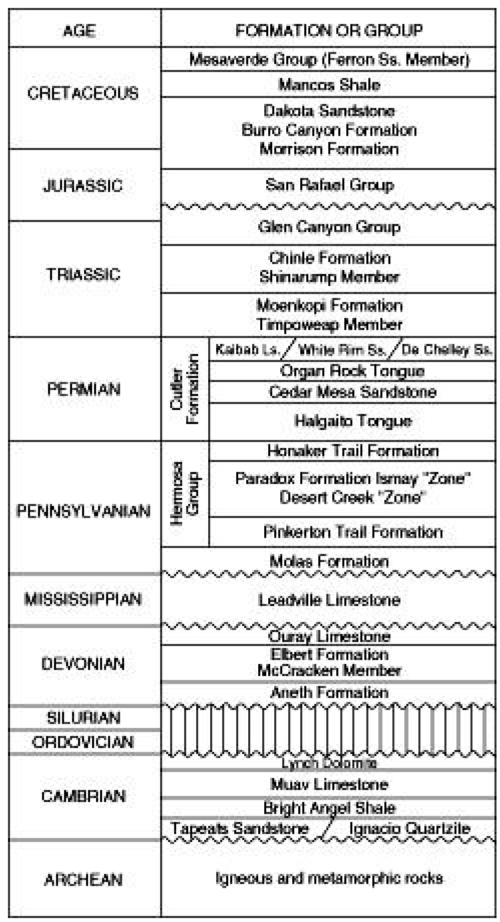

Figure 1-2 (right). Stratigraphic column for the prospective region.

Figure 1-1 shows the outline of this play, along with the locations of discovered oil and gas accumulations. The Ute Mountain Ute Tribe reservation includes the southwestern Colorado portion of the play that has discovered accumulations of oil. The reservoirs are typically mounds of algal (Ivanovia) limestone associated with organic-rich black dolimtic shale and mudstone rimming evaporite sequences of the Paradox Formation of the Hermosa Group (Figure 1-2). Net pay is on the order of 3 m – 15 m but occasionally reaches a net thickness of 30 m. Porosities typically vary from 5% to 20%. The traps are sourced by interbedded organic-rich dolimtic shales and mudstones. Oil generation occurred from the Late Cretaceous to the Paleocene. After expulsion, oil moved updip or migrated locally. There are a variety of seals, including porosity differences, overlying evaporates and interbedded shale. Most production ranges in depth from 1500 m to 2000 m.

The location of the Ute Mountain Ute tribal lands are shown in Figure 1-3.

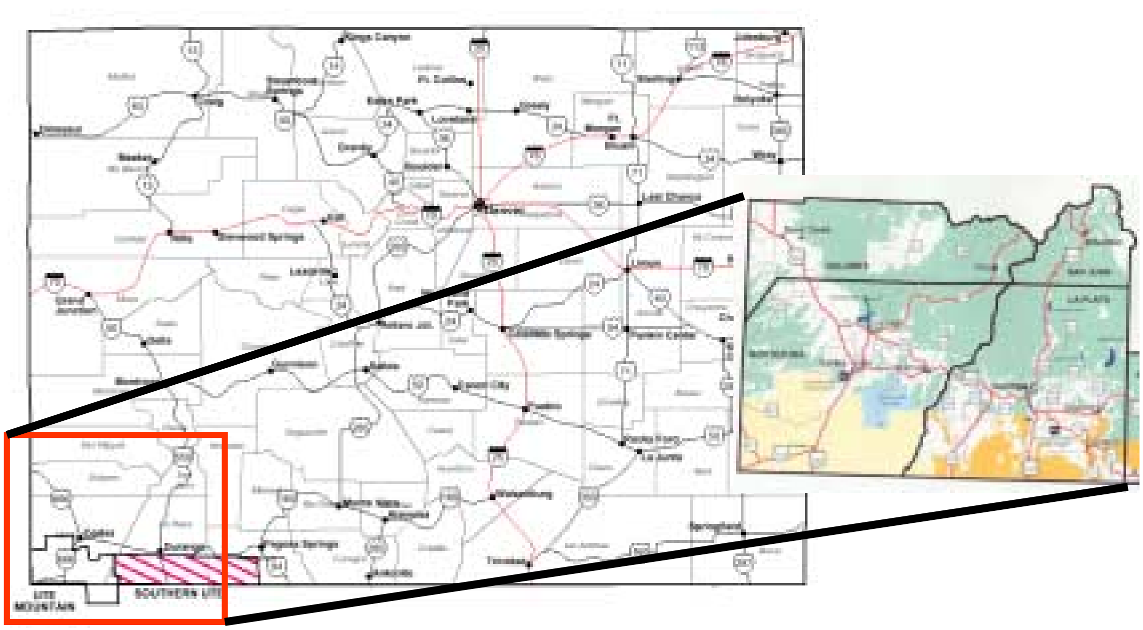

Figure 1-3. Location map for project. The Ute Mountain Ute reservation occupies the southwestern corner of the state of Colorado (unshaded region), adjacent to the Southern Ute reservation (red cross-hatching) to the east.

1.1.2 EXPLORATION AND PRODUCTION CHALLENGES

Game Sixteen: December 23 – Pittsburgh at Tampa Bay.

"After analysis on Warren Sapp playing offense for the Buccs, I liken it to a 3-D seismic data with several types of seismic attributes revealing geologic factors that control the location of productive algal mound reservoirs in the Paradox Basin." *(anonymous posting on sports website http://www.baseballology.com/warrzone/article.php3?ArticleID=788)*

This anonymous posting on a website somewhat whimsically summarizes the technical challenges for improving exploration and production success.

The goal of this project is to detect reliably stratigraphic features that are on the order of 200 to 1000 acres (Figure 1-4). These features have little structural expression. The mounds are surrounded and overlain by massive anhydrite. The reservoir properties of these mounds are not homogeneous throughout. From the standpoint of reservoir development of an existing algal mound field, the critical factors lie in predicting the porosity, permeability, internal mound geometries and fluid content of the mounds. While well information and production data are useful in understanding some of these variations, they cannot alone be used to make more accurate descriptions of the salient reservoir parameters between well control. This requires the use of some tool that provides at least an indirect indication of these properties away from well control. For this purpose, seismic data is the most appropriate technology available.

The usefulness of seismic technology has been exemplified by industry's improved exploration success in the algal mound play in the Paradox Basin (Figure 1-5). 2D seismic was first applied in the early 1980's. Success rates for exploration wells were around 10%. This increased to about 25% in the mid-1990's as conventional 3D seismic data was acquired for use in delineating exploration targets. Advanced multicomponent technology, such as 3D3C and 3D9C, should improve success rates in exploration even more and also provide better static reservoir models for existing fields. The key to developing a better image of the reservoir's internal geometry and flow properties is to utilize fluid saturations and azimuthal processing that can directly respond to oriented heterogeneities and changes in fluid saturations. Thus, acquisition of shear-wave data and advanced azimuthal processing or both shear- and compressional-wave data will potentially provide a much higher resolution of internal mound geometry and, from a reservoir engineering standpoint, a better model of the distribution of reservoir porosity and permeability

Table 1-1 shows the relation between multicomponent attributes and important reservoir properties.

Reservoir Property	Wavefield	Attribute
Porosity	P, S, PS	Amplitude, shear wave splitting
Permeability	P, S	Energy flow[1], shear wave splitting direction
Saturation	S	Shear wave splitting
Viscosity	S	Frequency and attenuation[2]
Density	P, S, PS	Amplitude variation with offset (AVO)[3]
Structure	P	Travel-time

[1] product of P- and S-wave amplitude at zero offset
[2] e.g. Duranti (2001) and Michaud (2001)
[3] Amaral (2001)

Table 1-1. Relationship between reservoir properties and multicomponent attributes. Table prepared by Tom Davis, Colorado School of Mines, Phase IX Proposal, Reservoir Characterization Project (http://www.mines.edu/academic/geophysics/rcp/)

As with any indirect means of detection, such as seismic data, the multicomponent attribute data needs to be calibrated; a connection needs to be made between the indirect data and the parameters of interest, in this case, the facies and their reservoir properties. The relations between 3D9C data and reservoir properties like porosity, permeability, internal mound geometry and fluid content of the mounds have not yet been exhaustively established through years of experience. There need to be calibration studies carried out to support the establishment of these links. For this reason, the proposed project also contains work by a petrologist highly familiar with Paradox Basin algal mound fields, and by geologists who are experienced in developing sophisticated predictive reservoir models to help establish these linkages. The proposed project not only includes a geological and petrological description, but goes an important step further and examines the relation of these parameters to quantitative production measures of individual wells and the field as a whole.

The project will develop and test a method to improve reservoir development by utilizing a new and appropriate seismic technique (3D9C) and carrying out the necessary work to relate this indirect data arising from the 3D9C survey to the reservoir parameters and ultimately the producing characteristics of an algal mound field. As a result, the proposed multidisciplinary technical approach is both reasonable and adequate to meet the project goal of improving recovery from algal mound fields through better reservoir characterization presented in a way that helps production engineers plan wells or design recovery processes.

Likewise, exploration success can be improved using the calibrated Multicomponent data. The resulting processed and calibrated seismic data should provide much more accurate and higher resolution of the lithologic facies variations that delineate mounds

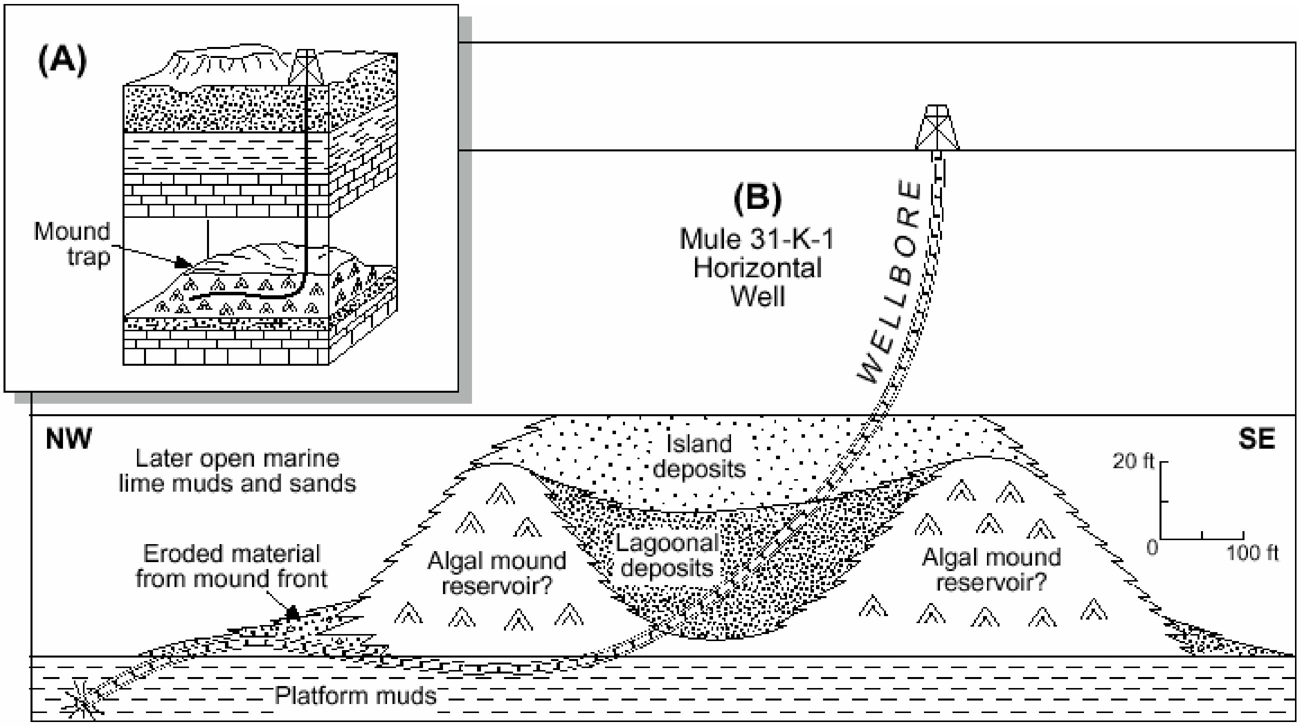

Figure 1-4. Hypothetical Algal Mound cross-section

(A) Schematic block diagram of a horizontal well penetrating a small algal-mound oil trap, and (B) a vertical cross section of the rocks below ground surface in the Mule mound penetrated by the Mule No. 31-K-1 horizontal well.

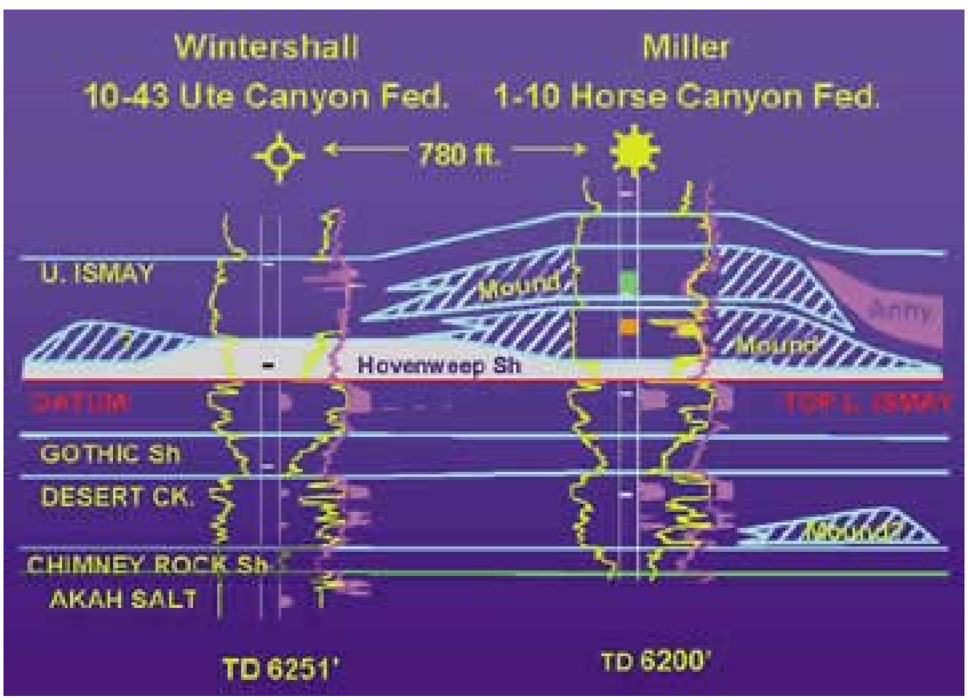

Figure 1-5. Cross section of two wells, one drilled on 2D seismic, the other on conventional 3D seismic. The Horse Canyon Federal # I - I 0 well was drilled just south of the Blanding Prospect Area by Miller Energy in 1998. This well location was based on 3D seismic data, and is only 700 feet away from a dry hole drilled in the 1980s based on 2D seismic data. The well IP'd for 960 BOPD and 3 MMCFGPD. This is a good case history illustrating that the older 2D seismic data did reliably detect a mound, but the 3D seismic data was required to image the productive portion of the mound and resulted in a prolific new discovery.

1.2 Technical Approach

1.2.1 MAIN PROJECT PHASES

The main steps in the project are outlined below:

1. Acquire 3D Multi-Component data over existing algal mound production as well as off-mound area (Towaoc & Roadrunner Fields)
2. Acquire a Multi-Component VSP (vertical seismic profile) in a well to help calibrate 3D processing and acquisition
3. Process 3D data for P-wave, S-wave, P-S wave, AVO and anisotropic velocity attributes
4. Calibrate processed seismic data against core a facies interpretations
5. Calibrate processed seismic data against reservoir engineering data

The seismic data will be acquired over portions of two existing fields, Towaoc and Roadrunner (**Figure 1-6**), as well as non-productive acreage in between, as calibration needs both positive and negative information.

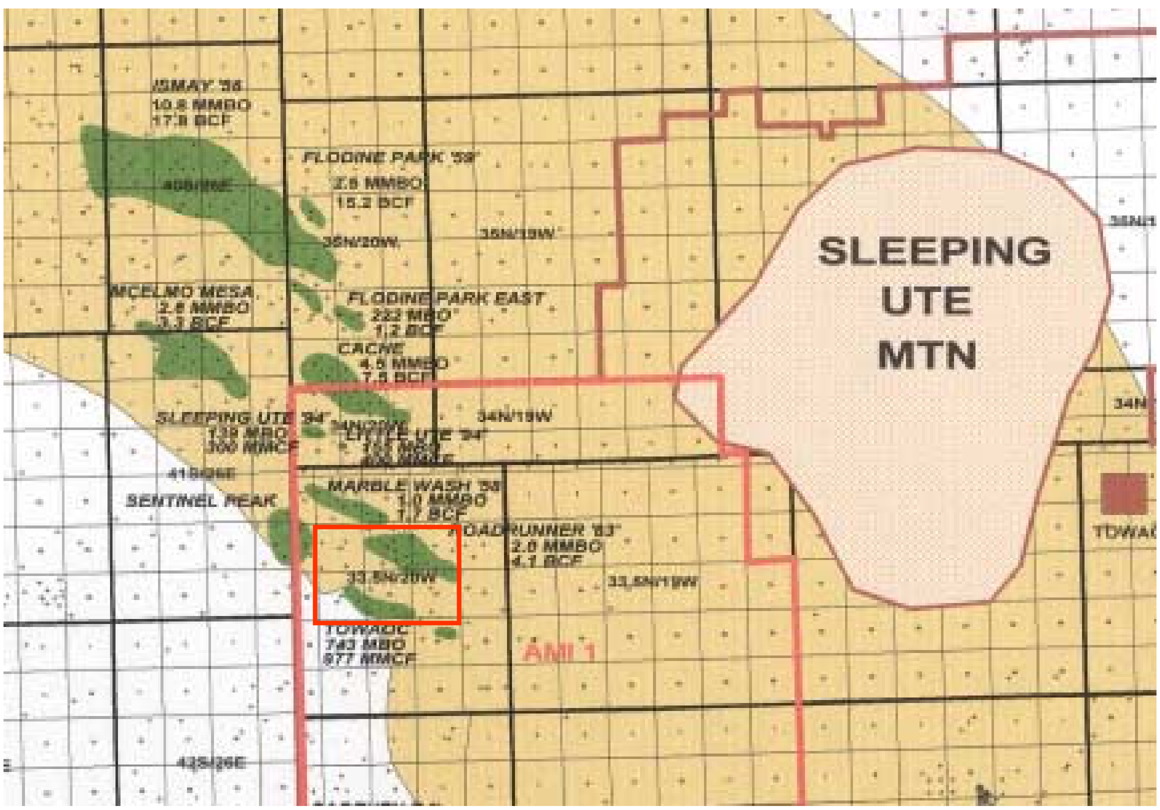

Figure 1-6. Location of the 6 square miles (outlined by red rectangle) where 3D9C seismic data will be obtained. Also shown are the outlines of existing algal mound fields.

In addition to the seismic data to be acquired, additional existing data, listed below, may be used as needed.

Core and Well Data

- 10 cores in either the Upper or Lower Ismay in the immediate area. Including relevant core from the surrounding area a total of 500 feet of core.
- 34 wells with well histories and conventional logs. 19 of the 34 wells are producing wells and have production data
- Detailed tops database and subsurface mapping (Red Willow)

Existing Seismic Data

- 600 miles of conventional 2-D data already acquired. 100 miles of which have been reprocessed by Red Willow.

1.2.2 REPORT OUTLINE

The remainder of this report describes the progress made to date. In the fall of 2002, WesternGeco, who had been the project's seismic acquisition contractor, decided to no longer provide this service in North America. The contract was opened to re-bid among those companies able to acquire this type of data, and SolidState, a division of Grant Geophysical has been selected based on cost and crew availability. Also during the re-bid process, the project was able to upgrade the seismic survey from 3D3C to 3D9C. The difference between these two surveys is that the 3D9C survey uses orthogonal shear wave sources, as well as records the seismic waves using orthogonal horizontal geophones. Shear wave sources are oriented inline and crossline to the receiver lines, as are the horizontal geophones. Additional information concerning 3D9C surveys, acquisition and processing can be found in Simmons and Backus (2001).

Section 2 describes the experimental methods used to date, which consists of the design of the seismic survey and the seismic processing approach.

Section 3 describes and discusses results to date. As the seismic data have not yet been acquired, the primary project accomplishments have been in the permitting process leading to the acquisition and establishment of the project website.

Section 4 describes conclusions.

2 EXPERIMENTAL METHODS

2.1 Seismic Acquisition

Figure 2-1 shows a more detailed view of the area over which the 3D9C seismic data will be acquired for the project pending approval of all permits. In this figure, the six square miles (approx. 15.54 km^2) are shaded.

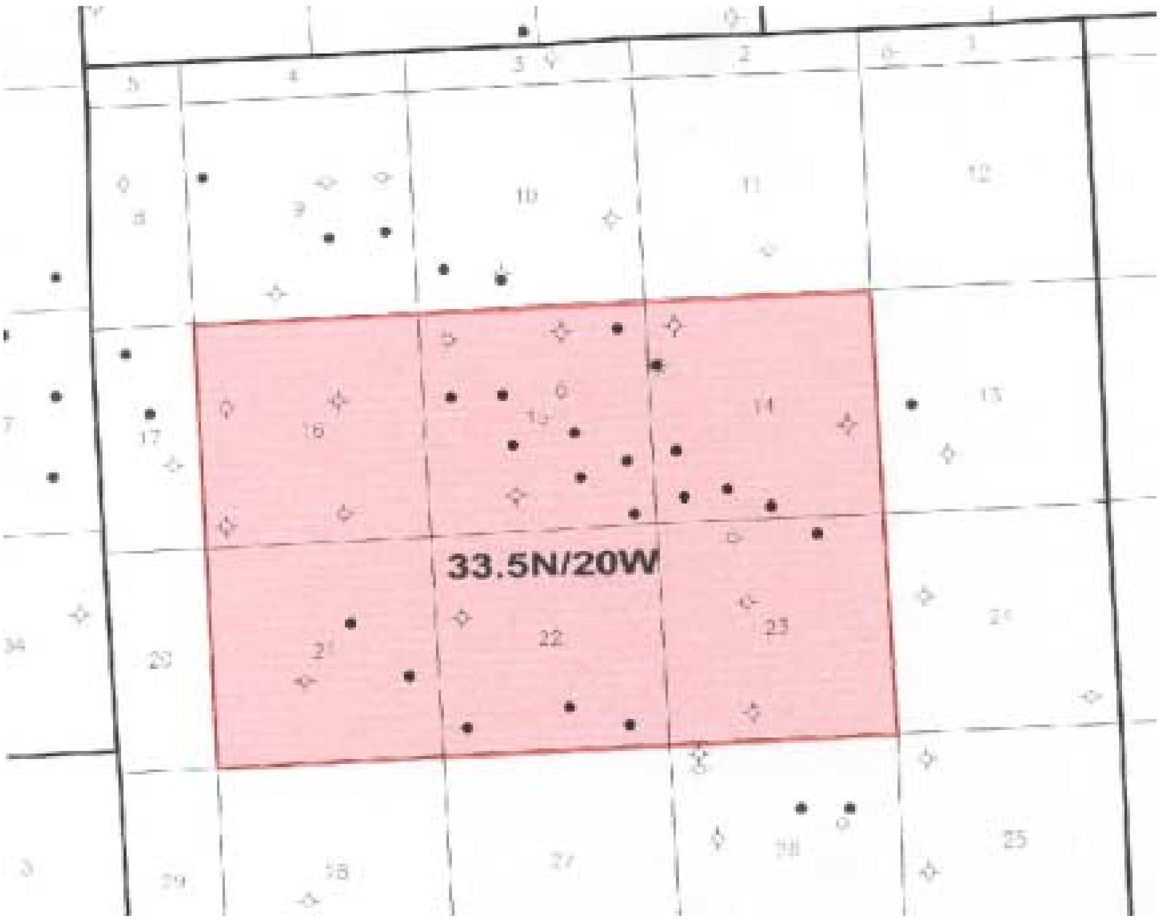

Figure 2-1. Close-up view of the 6 square miles over which 3D9C seismic data will be acquired for the project. Also shown are wells within the immediate project area.

Table 2-1 shows the data acquisition parameters for the 3D9C shoot.

Program Size:	6.0 square miles
Line Parameters	
Receiver point interval	220 ft
Source point interval	220 ft
Total receiver points	1225
Total source points	576
Source Type for programs	
P Waves	4 sweeps x 10 seconds
Shear 1	4 sweeps x 10 seconds
Shear 2	4 sweeps x 10 seconds
I.V.I Triax Vibrator	
Record Length	6 seconds
Recording Parameters	
Geophone array	6 over 45 ft
Live patch	18 lines X 60 channels
Roll on / roll off	Yes
Filters	½ Niquist
Sample Rate	2 ms

Table 2-1. Data acquisition parameters.

2.2 Seismic Processing

The seismic data processing will be carried out by WesternGeco and by AXIS. A description of the processing carried out by Western Geco is described in Section 2.2.1; the processing carried out by AXIS is described in Section 2.2.2.

2.2.1 WESTERNGECO PROCESSING

2.2.1.1 Compressional Wave Processing

The following 14 steps describe the compressional wave processing:

1. Pre-processing, consisting of
    - data transfer
    - display of shot records and deletion of bad traces
    - define geometry, compute field static corrections
    - spherical divergence compensation and trace balance
    - grid data in appropriate surface bins
2. Noise attenuation (any combination)
    - f-x Coherent Noise Suppression

  - Adaptive Noise Cancellation
  - f-k Filter
3. Signal processing (any combination)
    - Surface-consistent or trace-by-trace deconvulation
    - Model-based wavelet processing
    - Time variant spectral whitening
4. Preliminary stack
    - Stack with signal processing and regional velocity
5. 3-D refraction statics
    - First-break picking of all records
    - Offset and weathering velocity testing
    - Stack with signal processing and refraction statics
6. 3-D velocity analysis
7. Surface-consistent 3D residual reflection statics
8. NMO and trim statistics, if appropriate
9. EQ DMO and stack
10. Spectral whitening
11. Random noise attenuation (f-xy deconvolution)
12. Time-variant filter and scaling
13. Time migration
14. Spectral whitening

2.2.1.2 Shear Wave Processing

1. Pre-processing
    - Data transfer
    - Display shot records and delete bad traces
    - Define geometry – compute field static corrections
    - Extract S-wave components
    - Spherical divergence compensation and/or trace balance
    - Grid data
2. Noise attenuation (any combination)
    - f-x Coherent Noise Suppression
    - Adaptive Noise Cancellation
    - f-k filter
3. Signal processing (any combination)
    - Determine S1/S2 orientation of the overburden and rotate to S1/S2 coordinate system
    - Surface-consistent amplitude compensation
    - Surface-consistent deconvolution
    - Model-based wavelet procession
    - Model-based Q compensation
    - Time-variant spectral whitening
4. Preliminary stack
    - Stack with signal processing and regional velocity

5. 3-D refraction statics
    - First-break picking of all records
    - Offset and weathering velocity testing
    - 3D refraction tomography
    - Use PS detector statics or hand statics as applicable
6. 3-D velocity analysis
    - Azimuth limited as needed
7. Surface-consistent 3D residual reflection statics
8. 3-D velocity analysis
    - Azimuth limited as needed
9. Surface-consistent 3D residual reflection statics
10. NMO and mute
11. EQ DMO and stack
12. Spectral whitening, as needed
13. Random noise attenuation (f-xy deconvolution)
14. Time-variant filter and scaling
15. Time migration
    - Full wavefield Extended Stolt
    - Modified residual method

2.2.1.3 P to S Converted Wave

1. Pre-processing
    - Data transfer
    - Display shot records and delete bad traces
    - Define geometry – compute field static corrections
    - Spherical divergence compensation and/or trace balance
    - Grid data
    - Verify orientation of H1 and H2
2. Noise attenuation (any combination)
    - f-x Coherent Noise Suppression
    - f-k filter
3. Receiver rotation to radial and transverse
4. Determine S1 and S2 from supergathers and restrict azimuths (if appropriate)
    - Receiver rotation to S1 and S2 (if appropriate)
    - Proceed with limited-azimuth volumes for statics, CCP binning and velocities
5. Signal Processing (any combination)
    - Surface-consistent deconvolution
    - Model-based wavelet procession
    - Time-variant spectral whitening
6. Preliminary stack
    - Estimate preliminary γ_o
    - Stack with signal processing and regional velocity
7. P-wave source statics application

8. 3-D velocity analysis
9. Receiver statics computed from common-receiver gathers/stacks
10. Surface-consistent 3D residual reflection statics
11. P-S common conversion point (CCP) binning
    - Depth-dependent correction
    - Measure γ_o from P-wave stack and preliminary PS-wave stack
    - Compute CCP locations using $\gamma_{o\text{ and }}\gamma_{eff}$
12. 3-D velocity analysis
13. Surface-consistent 3D residual reflection statics
14. Multi-window P-S common conversion point (CCP) binning
    - Depth-dependent correction
    - Measure γ_o from P-wave stack and preliminary PS-wave stack
    - Compute CCP locations using $\gamma_{o\text{ and }}\gamma_{eff}$
15. 3-D velocity analysis
16. Iterate steps 13-15 as needed
17. Higher order moveout (if necessary)
18. 3-D velocity analysis
19. Final CCP bin
20. P-S DMO (if necessary)
21. Stack
22. Random noise attenuation (f-xy deconvolution)
23. Time-variant filter and scaling
24. P-S migration
25. Process transverse (or S2) component using parameters from radial (or S1)

2.2.1.4 Azimuthal Anisotropy Analysis (S-wave only)

1. 2Cx2C Alford rotation of volumes to S1/S2 and two off-diagonal components
2. Rotation and layer stripping analysis at horizons of interest

2.2.1.5 Azimuthal Anisotropy Analysis (PS-wave only)

1. Receiver rotation to radial and transverse
2. Azimuth limit radial and transverse volumes to 8 azimuth sectors (0-360 x 45 degrees); 16 total volumes
3. NMO and stack
4. Random noise attenuation (f-xy deconvolution)
5. Time-variant filtering and scaling
6. P-S time migration
7. 2C x 2C Alford rotation of volumes to S1/S2 and two off-diagonal components
8. Combine all azimuth volumes into one 2C by 2C set
9. Rotation and layer stripping analysis at horizons of interest

2.2.1.6 Summary of Data Deliverables from Processing

1. Final PP DMO stack and migration volumes – P-wave
2. Final ShSh DMO stack and migration volumes – S-wave
3. Final SvSv DMO stack and migration volumes – S-wave
4. Final ShSv DMO stack and migration volumes – Off-diagonal S-wave
5. Final SvSh DMO stack and migration volumes – Off-diagonal S-wave
6. Final PS CCP stack and migration volumes – mode-converted wave (radial component or S1)
7. Final PS CCP stack and migration volumes – mode-converted wave (transverse component or S2)
8. Fold map – CMP binning
9. Fold map – CCP binning at target horizon)
10. Vp stacking velocity field
11. Vsh stacking velocity field
12. Vsv stacking velocity field
13. Vps stacking velocity field
14. Vp/Vs voloume from PS CCP binning run
15. Detailed processing report

2.2.2 AXIS PROCESSING

2.2.2.1 Azimuthal Processing Approach

AXIS will additionally process the 3D9C seismic data to further extract useful information. Without azimuthal processing the following problems can occur if the rock possesses azimuthally-varying velocity and this is not taken into account during processing:

- Affects processing quality and resolution
- Requires high-resolution velocity analysis
- Causes a regional velocity overprint
- Causes mis-stacking near faults
- Affects 2-D and narrow azimuth 3-D data
- Causes acquisition footprint when uncorrected
- Affects time-lapse 3-D comparisons
- Makes AVO analysis impossible
- Bleeds into azimuthal AVO analysis

On the other hand, when the azimuthal velocity is properly taken into account during processing, the resulting data has much greater utility for a variety of exploration and production uses. In particular, the data can be used to provide much more reliable data on:

- Fracturing below isotropic seals
- Analysis for water coning
- Analysis for water and CO2 floods
- Drilling hazard analysis and horizontal well planning
- Analysis for tight gas sweet spots
- Correct velocities for depth conversion and pressure/gas saturation prediction
- Subtle structure depth conversion
- Less 3-D footprint
- Better data quality because of higher useful fold
- Better frequency content because of proper stacking
- Better surface consistent statics solutions
- Zero offset well ties

2.2.2.2 Data Processing Steps & Resulting Data Sets

The processing can be separated into three portions: azimuthal velocity analysis, isotropic AVO, and azimuthal AVO.
During the azimuthal velocity analysis every 3x3 CDP will be analyzed. This will result in seven data volumes:

- RMS Vfast (RMS velocity of fast propagation direction)
- RMS Vfast minus Vslow (RMS velocity magnitude difference)
- RMS Error (Estimated error in RMS Vfast)
- RMS Azimuthal Direction (Direction of Vfast)
- Interval Vfast (Interval velocity of fast propagation direction)
- Interval Vfast minus Vslow (Interval velocity magnitude difference)
- Interval Vfast Azimuthal Direction

The isotropic AVO analysis will employ a three-term fit for all angles. This will produce:

- Migrated intercept
- Migrated gradient
- Migrated Third Term
- Damped Migrated Third Term in high confidence areas

The final stage of processing, azimuthal AVO, will produce an additional three data sets:

- Migrated G1-G2 (High minus low gradient)
- Migrated G1 Azimuthal Direction
- Migrated G1-G2 Error

Some of these data volumes produced during processing will be used to develop the calibration for detecting algal mounds and delineating their internal geological and fluid geometries. Other data volumes serve the role as quality checks, so that the areas where a particular data volume may be less reliable can be assessed and identified.

3 RESULTS AND DISCUSSION

3.1 Seismic Acquisition & Processing

At this point, permitting for the seismic acquisition is nearing completion, and as such, no data have yet been acquired or processed.

Permitting of the 3D9C seismic survey was initiated in April, 2003. Initial surveying of source and receiver points has been completed. Field archeological and biological work was conducted in May and June of 2003. The final Archaeological Report and Environmental Assessment are currently being prepared. All permit documents and maps are scheduled to be submitted to the Bureau of Indian Affairs (BIA) in the week of July 14th.

The BIA will review the Environmental Assessment and then provide for a 30-day public comment period. The Colorado State Historical Preservation Office (SHIPO) will have 30 days to review the Archeological Report and make comments or suggestions. This suggests that permitting could be completed as early as late August.

Red Willow Production met with Rim Operating Company in April to discuss wellbore access for the VSP. Rim has agreed to provide access and Red Willow has prioritized potential wells for the VSP. Currently, a Red Willow engineer is evaluating candidate wells to insure that the wellbores are adequate for the VSP data collection

3.2 Project Website

A project website has been initiated for the project. The homepage for this project is at: http://thebe.golder.com/utemtn/Home/. Figure 3-1 shows the homepage (with a view of Ute Mountain), along with some of the basic structure of the web site. On the homepage, there is a navigation bar that takes the visitor to Background, Gallery, Documents Feedback and Links subpages. Also shown in the figure is the Documents subpage and one of its subpages, “Other”. There is also a scrolling window on the right that lists the latest project news.

Documents contains the written record of the project, including Progress Reports, informal and professional society presentations, and others, such as the bibliography (see Section 6 of this report) prepared by team member Claudia Rebne of Legacy Energy.

Figure 3-2 shows some of the content being assembled for the subpages. For example, in the Background section, there is a description of the project Task by Task; project data available for download as it becomes available); the project schedule and the project team. It is here that the visitor can learn about the technical workflow of the project, why the project is being done, who the principal participants are, and download selected data.

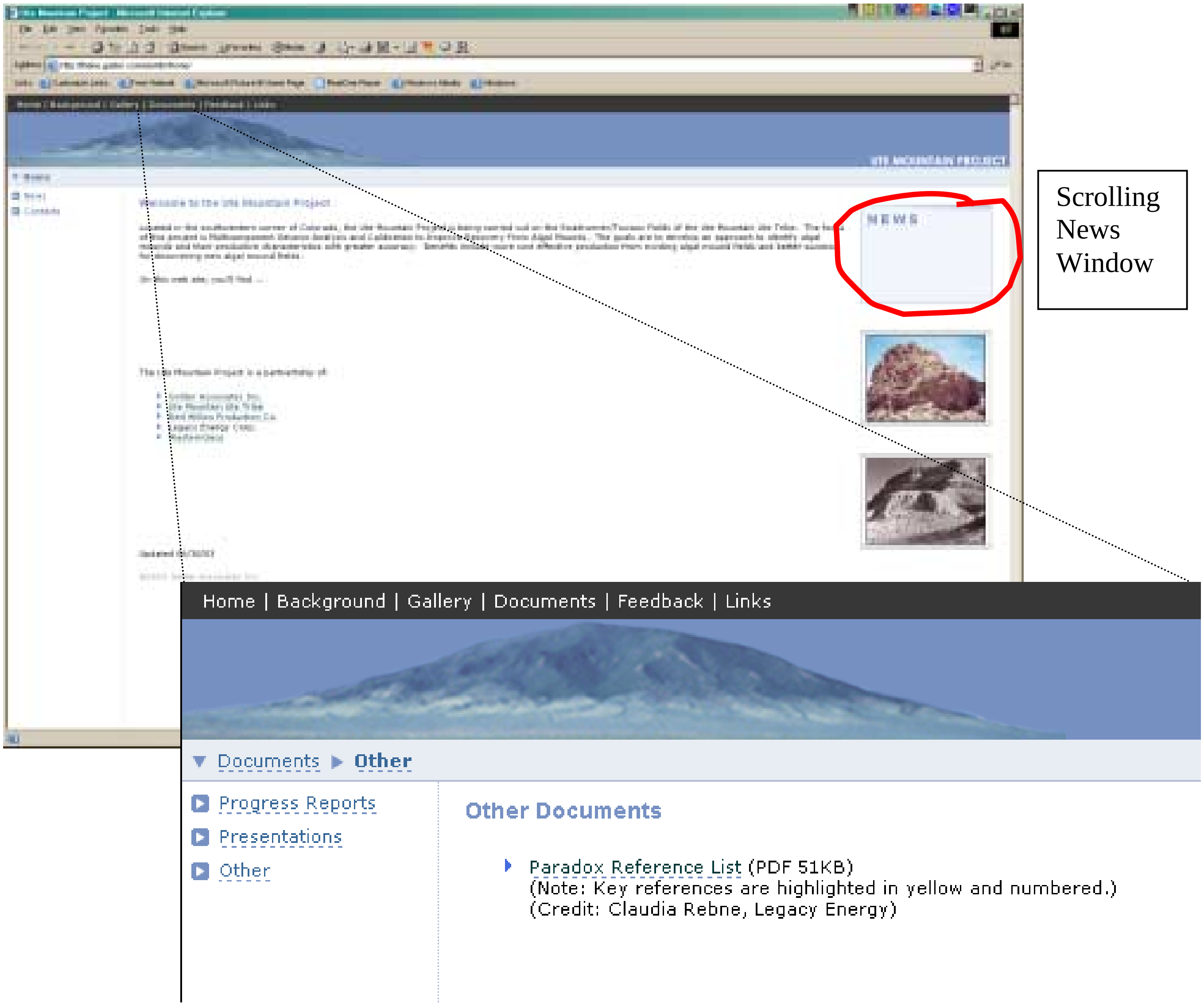

Figure 3-1. Homepage and example of "Documents" subpage reached from navigation bar.

The Gallery will contain photos, drawings and other graphic material related to the project. Currently there are three subdivisions in this page for showing the project location, with particular reference to the seismic grid, and will contain photos of the seismic shoot when it occurs and other photos having to do with the Paradox Basin, the geological data obtained that is of a graphic nature, and other project-related photos.

Documents contains the written record of the project, including Progress Reports, informal and professional society presentations, and other, such as the bibliography prepared by team member Claudia Rebne of Legacy Energy, and listed also in this report.

The Feedback subpage allows visitors to email questions, comments or requests to the project team members, to assist in communicating the technical achievements and findings of the project to others.

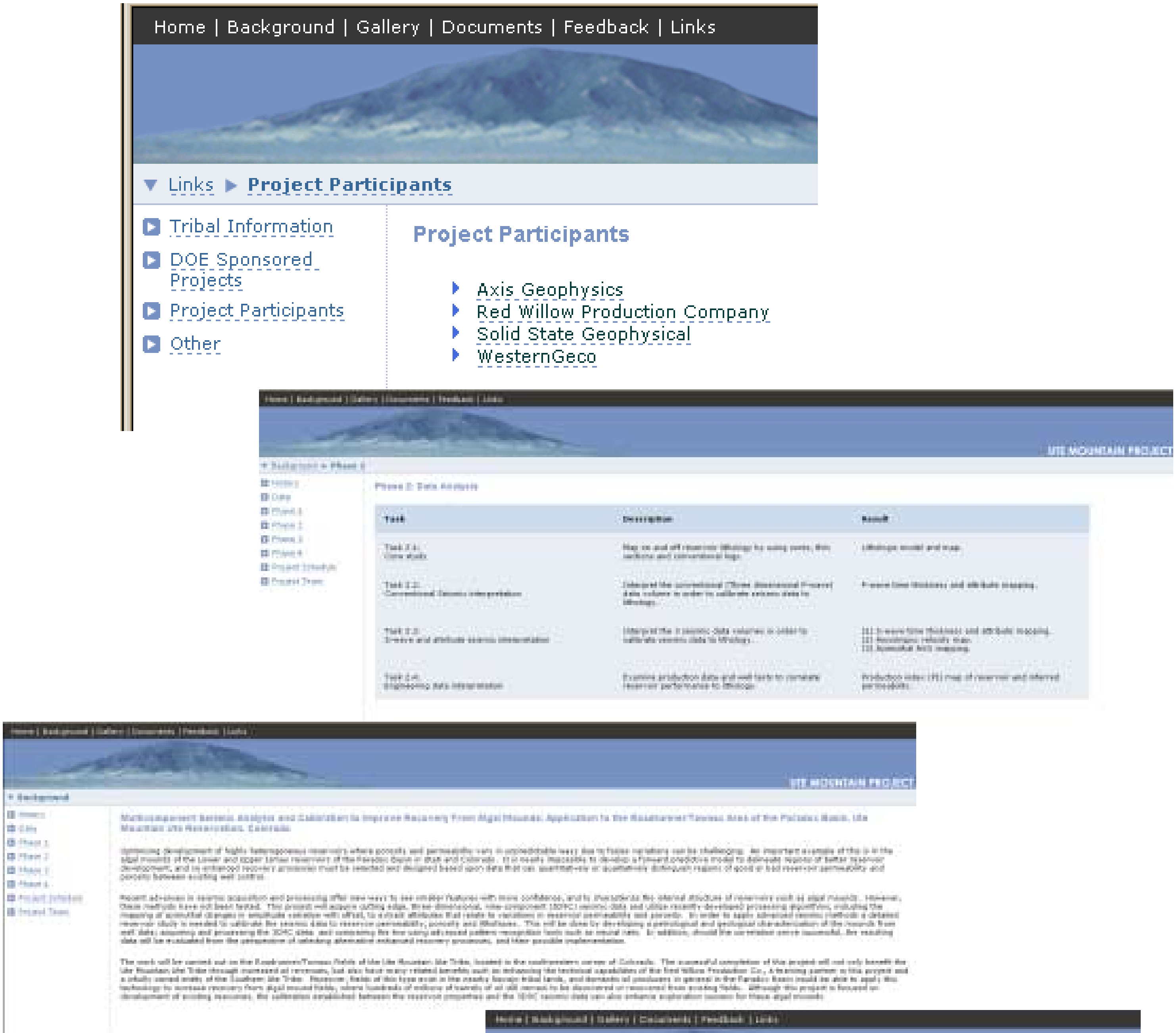

Figure 3-2. Additional subpages from the website showing the type of information that is being posted for each of the other remaining first level categories shown in the navigation bar.

The Links section provides links to project member web pages, to the DOE's Fossil Energy sites of interest, to the Ute Mountain and Southern Ute Tribes' homepages, and to other websites that might be of general interest. New content is being added on a regular basis, and with the approaching field acquisition program, the amount of content should greatly increase over the next few months.

3.3 Presentations

No formal professional society presentations have been made at this point, and this current report is the first technical Progress Report.

In March, a brief informal presentation on the project was made in Durango, CO to a representative of the Ute Mountain Ute Tribe and the Tribe's chief production engineer at their Tribal Facility. Team members from Legacy Energy and Red Willow were also in attendance, and planning for the field acquisition was carried out. The presentation has been posted to the project website under the Documents > Presentations > Other subpage. The file is ***overview.ppt***, and contains a brief overview of the project activities, structure, participants and goals.

Also, in April, Claudia Rebne of Legacy Energy made an informational presentation of the project to the Colorado School of Mines Reservoir Characterization Group. Approximately 100 industry participants, students and faculty were in attendance.

4 CONCLUSIONS

4.1 Seismic Acquisition & Processing

Despite the loss of the original seismic acquisition contractor in the Fall of 2002, the project was successful in obtaining a new contractor at an equivalent cost. Permitting is nearing completion, and acquisition is planned for late August or early September, with processing taking place immediately following.

4.2 Technology Transfer

The project website has been published, and currently contains background information on the project, with the structure to accommodate substantial additional project content as it becomes available from the acquisition and processing.

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6.4 Field summaries in Clem & Brown, 1984:

20. Ismay
21. Ismay South
22. McElmo Mesa
23. Rockwell Flat

Fields summaries in Hill & Bereskin, 1993:

- Alkali Canyon – Upper Ismay
- Bartlett Flat/Big Flat – Cane Creek, Leadville
- Bluff – Lower Ismay, Desert Creek
- Boundary Butte – De Chelly, Lower Ismay (low BTU)
- Cave Canyon – Upper Ismay
- Cherokee – Upper Ismay
- Deadman – Upper Ismay
- Greater Aneth – Desert Creek
- Hatch – Desert Creek
- Kachina – Upper Ismay
- Kiva – Upper Ismay
- Lightning Draw – Lower Ismay
- Lisbon - Leadville
- Little Nancy – Upper Ismay
- McCracken Spring – Upper Ismay
- Mexican Hat - Pennsylvanian
- Salt Wash - Leadville
- Tin Cup Mesa – Upper Ismay

7 LIST OF ACRONYMS AND ABBREVIATIONS

3D3C – three dimensional, three component

3D9C – three dimensional, nine component

AVO - amplitude variation with offset

RMS - Root Mean Square

RW – Red Willow Production

SU – Southern Ute Tribe

UM – Ute Mountain Ute Tribe