



Figure 1: Seismic Backscatter Acquisition Design and Data

Fracture Density	Metric Tons of Oil per Day	Barrels of Oil per Day
-405	35.9	262.07
-826	9.6	70.08
1540	340.7	2,560.00
412	30.6	223.38
535	45.0	328.50

Table 1: Summary of Fractured Reservoir Production Rates

## Seismic Backscatter Technology to Monitor Fracture Permeability

TMI-04 is a new approach to seismic acquisition. It derives time-lapse, or 4-D seismic, from seismic backscatter. The technology was developed in Russia and is being licensed to Lyas, Inc. for distribution in the America's. Yury Lyasch, the President of Lyas, Inc., was formerly a Vice-President of Conoco International Petroleum Company and was involved in developing Conoco's operations in the Soviet Union. Yury became aware of this technology through the director of the Russian Academy.

The left side of Figure 1 shows the seismic acquisition geometry and a schematic of what is being recorded. Standard seismic receivers and vibroseis sources are used for the data collection. The receiver array is designed based on the depth and location of the target relative to the source-receiver positions. Once the equipment is in place, recordings are made at several times throughout the data. This backscatter seismic technology was developed to monitor fracture permeability by looking at the fractures from the side. The right image in Figure 1 is a processed seismic section colored according to fracture density (-826 blue to 1540 red). Table 1 summarizes the results of wells from this field. The well shown was drilled based on the predicted fracture density and has an order of magnitude more production than other wells in the field.

Time lapse movies of horizontal seismic sections through the 3-D seismic volume show faults in this field opening and closing in sync with lunar tides. A Russian reservoir engineer has taken this data and modified the production plan for the field, timing secondary and tertiary stimulation with open fractures at high lunar tide. The result has been a spectacular improvement in production rates. Other DRC technologies support this conclusion. This component of TMI-04 is considered to still be an area of research.

DRC proposes an investment of \$5,000,000 to collect backscatter seismic surveys over known fractured reservoir fields, to calibrate results with production histories, to obtain control of Lyas, Inc or form a new company to control licensing of the technology, and to prove out the technology in the Americas. The exit strategy is to sell the new LLC to Schlumberger or Haliburton for several hundred million dollars, and to retain the right to use the technology on DRC projects. Yury Lyasch is the technical team lead on TMI-04.