"In-Situ Sampling and Characterization of Naturally Occurring Marine Methane Hydrate Using the D/V JOIDES Resolution."

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ODP Leg 204 Shipboard Scientific Party

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ODP Leg 204 Shipboard Scientific Party* (see attached list of participants provided at the end of this report)

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Marine High-Technology Bureau of the State Science and Technology Commissions of the People's Republic of China

ABSTRACT

The primary accomplishments of the JOI Cooperative Agreement with DOE/NETL in this quarter were that: (1) Leg 204 scientific party members presented preliminary results and operational outcomes of ODP Leg 204 at the American Geophysical Union Fall meeting, which was held in San Francisco, CA; and, (2) a report was prepared by Dr. Gilles Guerin and David Goldberg from Lamont-Doherty Earth Observatory of Columbia University on their postcruise evaluation of the data, tools and measurement systems that were used for vertical seismic profiling (VSP) experiments during ODP Leg 204. The VSP report is provided herein.

Intermediate in scale and resolution between the borehole data and the 3-D seismic surveys, the Vertical Seismic Profiles (VSP) carried during Leg 204 were aimed at defining the gas hydrate distribution on hydrate ridge, and refining the signature of gas hydrate in the seismic data.

VSP surveys were attempted at five sites, following completion of the conventional logging operations. Bad hole conditions and operational difficulties did not allow to record any data in hole 1245E, but vertical and constant offset VSP were successful in holes 1244E, 1247B and 1250F, and walk-away VSP were successfully completed in holes 1244E, 1250F and 1251H. Three different tools were used for these surveys.

The vertical VSP provided the opportunity to calculate interval velocity that could be compared and validated with the sonic logs in the same wells. The interval velocity profiles in Holes 1244E and 1247B are in very good agreement with the sonic logs.

Information about the Leg 204 presentations at the AGU meeting are included in a separate Topical Report, which has been provided to DOE/NETL in addition to this Quarterly Report.

Work continued on analyzing data collected during ODP Leg 204 and preparing reports on the outcomes of Phase 1 projects as well as developing plans for Phase 2.

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INTRODUCTION

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EXECUTIVE SUMMARY

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RESULTS AND DISCUSSION

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General Overview of VSP Experiments on ODP Leg 204

Intermediate in scale and resolution between the borehole data and the 3-D seismic surveys, the Vertical Seismic Profiles (VSP) carried during Leg 204 were aimed at defining the gas hydrate distribution on hydrate ridge, and refining the signature of gas hydrate in the seismic data.

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The vertical VSP allowed to calculate interval velocity that could be compared and validated with the sonic logs in the same wells. Figure 2 shows that, after a 5-sample smoothing, the interval velocity profiles in Holes 1244E and 1247B are in very good agreement with the sonic logs.

Operations and data overview

Hole 1245E

After completion of the standard wireline logs, rig up of the VSI for the VSP survey started on 08/15/02 at 0830 local time. The plan was to conduct three types of survey during this run: vertical, constant offset and walk-away. The *R/V Maurice Ewing* was navigating nearby to provide support for the constant offset and the walk-away surveys. Despite the generally good hole conditions that were observed during the standard log runs, it became clear after a few attempts that it would prove difficult to get a proper clamping for any of the shuttles, even less three. The average hole size (ranging from 12 to 16 in) exceeded the maximum operational hole size for the VSI (12 in). Multiple shots were fired from the *Resolution* and from the *Ewing* without ever recording a consistent signal, at any of the attempted depth. It was then decided to abort this run and to try to use the one-component WST to conduct at least a vertical VSP. When the VSI reached the rigfloor it appeared that the arms of the three shuttles had been damaged during our numerous clamping attempts. The WST was then lowered in the hole, but the geophone stopped soon to work properly and the tool was brought back to replace the geophone. During the following lowering, and despite the proper behavior of the WST, it became obvious that the hole was too large and the formation too soft to get a good clamping. The survey was aborted, and the final rig down was complete at 0200 on August 16, 2002.

Hole 1251H

After completion of conventional logs in Hole 1251H, rig up for the VSP survey started at 0345 on August 18, 2002. The triple combo and FMS/Sonic calipers had shown that the hole was irregular, which suggested that the three component WST-3 would be the most likely to provide data. This tool had been flown in since the previous failure of the VSI in Site 1245. It proved again difficult to get a consistently good clamping. However the signal appeared of good enough quality to proceed with a systematic vertical and constant offset VSP. Stations were made over the entire hole every 7.5 meters, starting at 1405 mbrf. Satisfactory data were recorded for about 25% of the stations, the most consistently between 1350 and 1313 mbrf. After completion of the vertical/constant offset VSP, it was decided to attempt a walk-away VSP. It proved impossible to get good clamping at the initial target depths near the BSR, but a good station was found at 1320 mbrf and the Ewing shot two perpendicular lines, each taking ~2 hours. Final rig down was completed at 2030 on August 18, 2002. Figure 3 shows the data recorded by the three (geophone) components of the WST-3 on the first line (South to North)

Hole 1244E

All the conventionnal logging runs indicated very good hole conditions in Hole 1244E. The WST-3 rig-up started at 0130 local time, 08/21/02, and the vertical/constant offset VSP started without difficulty from the bottom of the hole (~1155 mbrf). Stations were made every 5 meters and the survey was completed without any problem, in excellent hole and sea conditions. Two walk-away stations, including two orthogonal lines each, were made at 1045 mbrf and 1020 mbrf, respectively. The final rig down ended at 0100 local time, 08/22/2002. Figure 4 shows a general overview of the two lines recorded with the vertical component geophone of the WST-3 at 1020 mbrf (=115 mbsf).

Hole 1247B

After completion of standard logs in Hole 1247B, rig-up of the WST-3 started at 0415, local time, 08/24/2002. Considering the good hole conditions, the plan was to conduct a complete survey including two walk-away stations. Initial tests before lowering the assembled tool string indicated serious problems, including the impossibility to properly close and open the arm, and it was decided to use the one component WST to perform only a vertical VSP. After lowering the tool, several unsuccessful attempts to record a decent signal indicated that the geophone was damaged. Because no spare geophone was available, and considering the extremely good hole and sea conditions, we decided to try using one of the shuttles of the VSI, which had been restored to its original configuration. The tool reached the bottom of the hole (1066 mbrf), and a vertical / constant offset survey was acquired without difficulties between 1060 mbrf and 930 mbrf, with stations every 5 meters. After completion of this survey, it proved impossible to get a satisfactory station that would allow us to perform a walk-away VSP. Considering the poor quality of the signal, it was suspected that the tool had been damaged and it was brought back to the rig floor for inspection. This confirmed that the arm had been damaged, possibly while the tool was on station too close to the bottom of the pipe. It was decided to abort any further attempt in order to preserve the remaining shuttles for the final VSP survey in Site 1250. Final rig-down was complete at 1730, 08/24/2002.

Hole 1250F

After completion of the standard logs in Hole 1250F, rig-up of a the single-shuttle VSI started at 0610, August 26, 2002. The tool was lowered to the bottom of the hole (980 mbrf) and the vertical/constant-offset survey was recorded every 5 meters up to 890 mbrf. Coupling between the arm and the formation was poor in the upper part of the hole, and no reliable shots were recorded above 930 mbrf. Because of the generally poor signal, it

was suspected that the tool had been damaged and it was brought back to the surface. Inspection showed that it was in working order, and it was lowered again to try to find possible walkaway stations. After systematic attempts along most of the hole, three walkaway surveys were recorded at 945 mbrf, 898 mbrf and 979 mbrf. Final rig down was completed at 0630 on August 27, 2002, a few hours before the Schlumberger VSP engineer was to leave the ship. Figure 5 shows the data recorded by the three geophone components of the VSI on the first line (South to North)

Table 1: Summary of VSP operations during Leg 204

Hole	VSP spacing (m)	VSP interval (mbsf)	Tool used	Walkaway depth (mbsf)	Walkaway shots (S-N, W-E)
1251H	7.5	85-185	WST-3	100	591, 344
1244E	5	85-250	WST-3	140 115	563,560 474,543
1247B	5	85-215	VSI	N/A	N/A
1250F	5	85-175	VSI	90 140 170	445, 412 461, 458 424,337

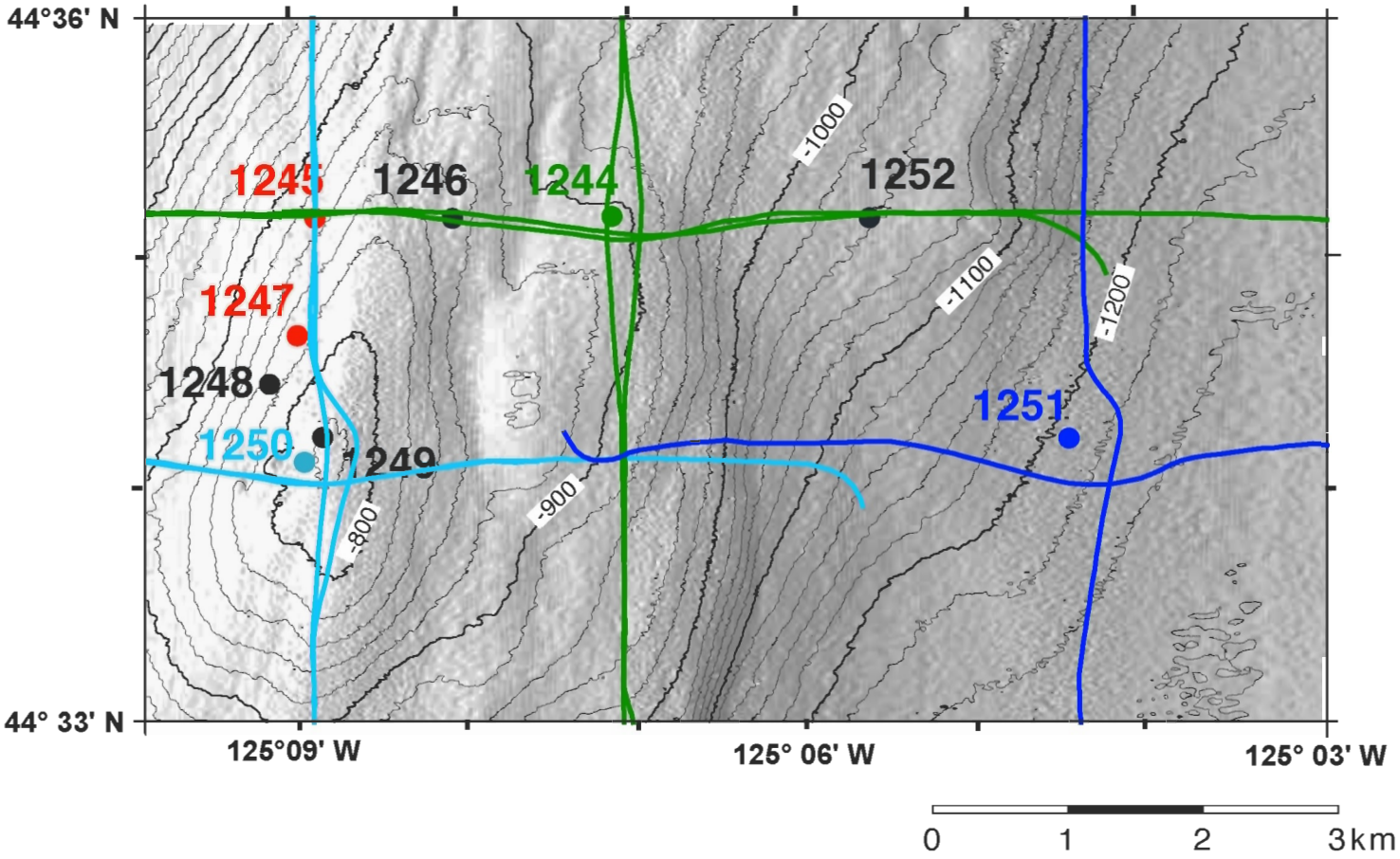

Figure 1: General overview of the VSP operations during Leg 204 around Hydrate Ridge. The sites in red indicate where vertical and constant offset VSP were recorded, but no walkaway. The colored lines dhow the path of the walkaway lines for the site of matching color.

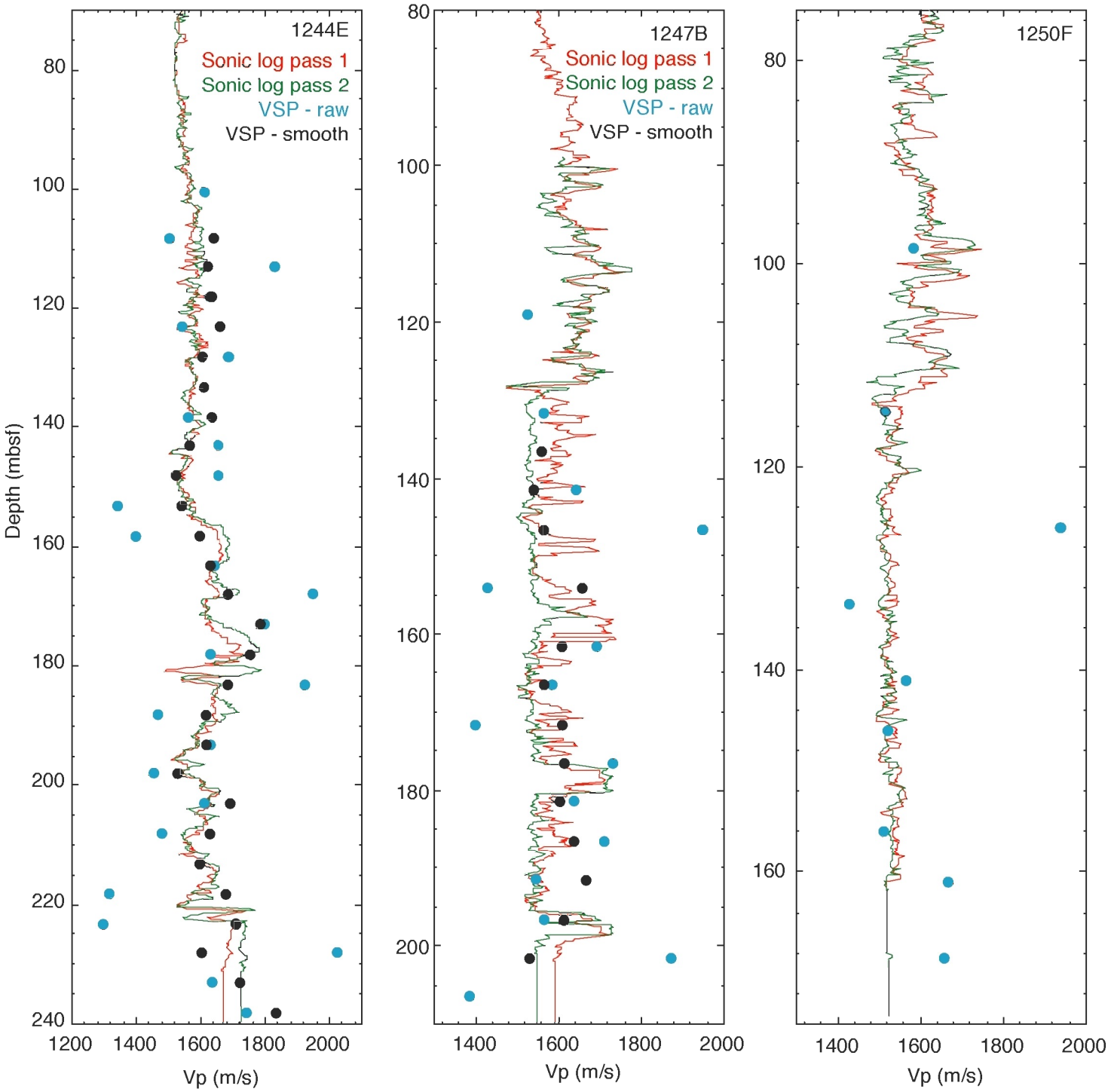

Figure 2: Comparison of the interval celocity values derived from the VSP with the logs in holes 1244E, 1247B and 1250F. In all figures, the first pass of the sonic log is in red, the second pass in green, the raw interval velocity in light blue and the 5-samples smoothed interval velocity in black

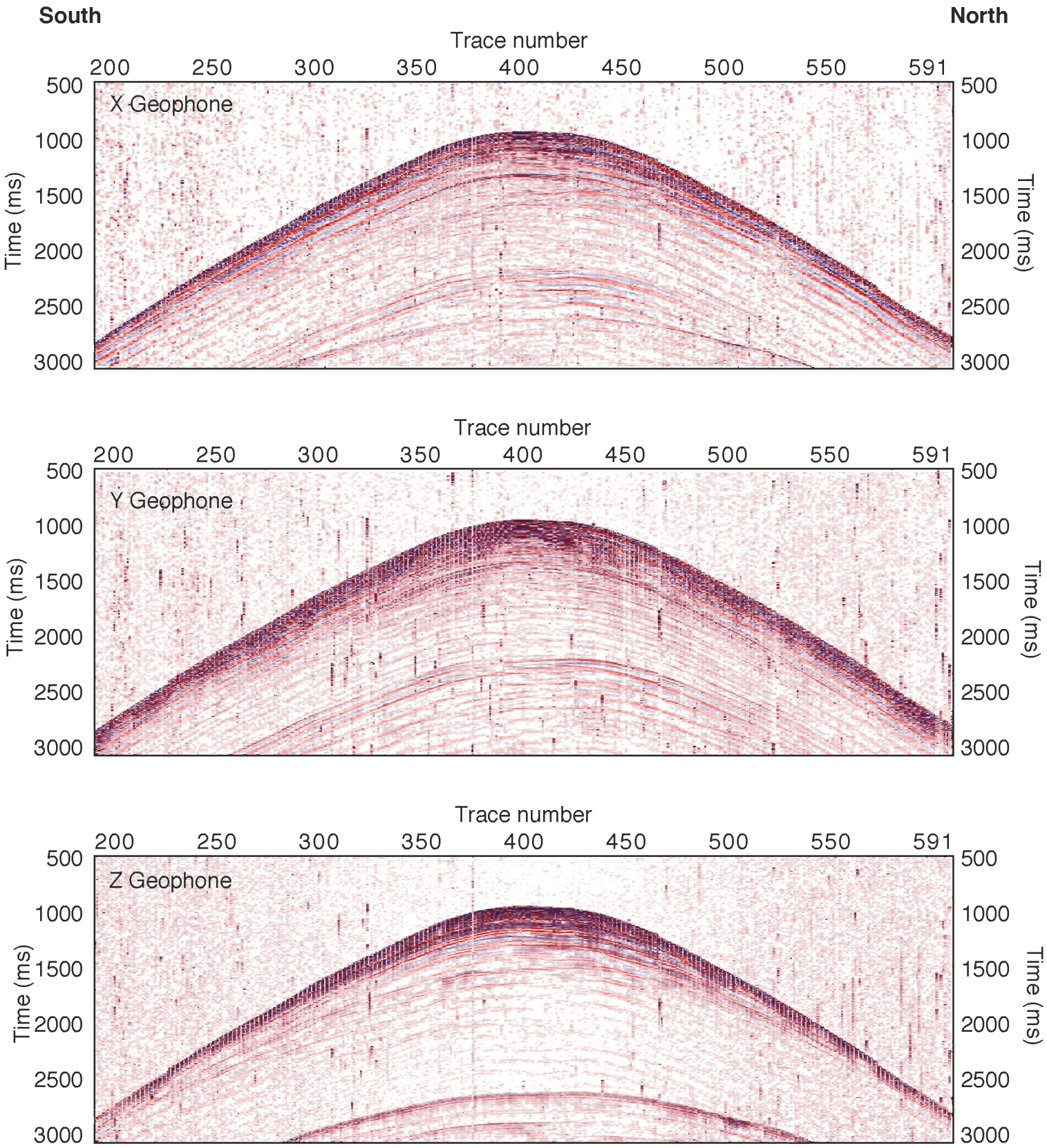

Figure 3: Walkaway line South-North recorded by the three geophones of the WST-3 at 1320 mbrf (=100 mbsf) in Hole 1251H.

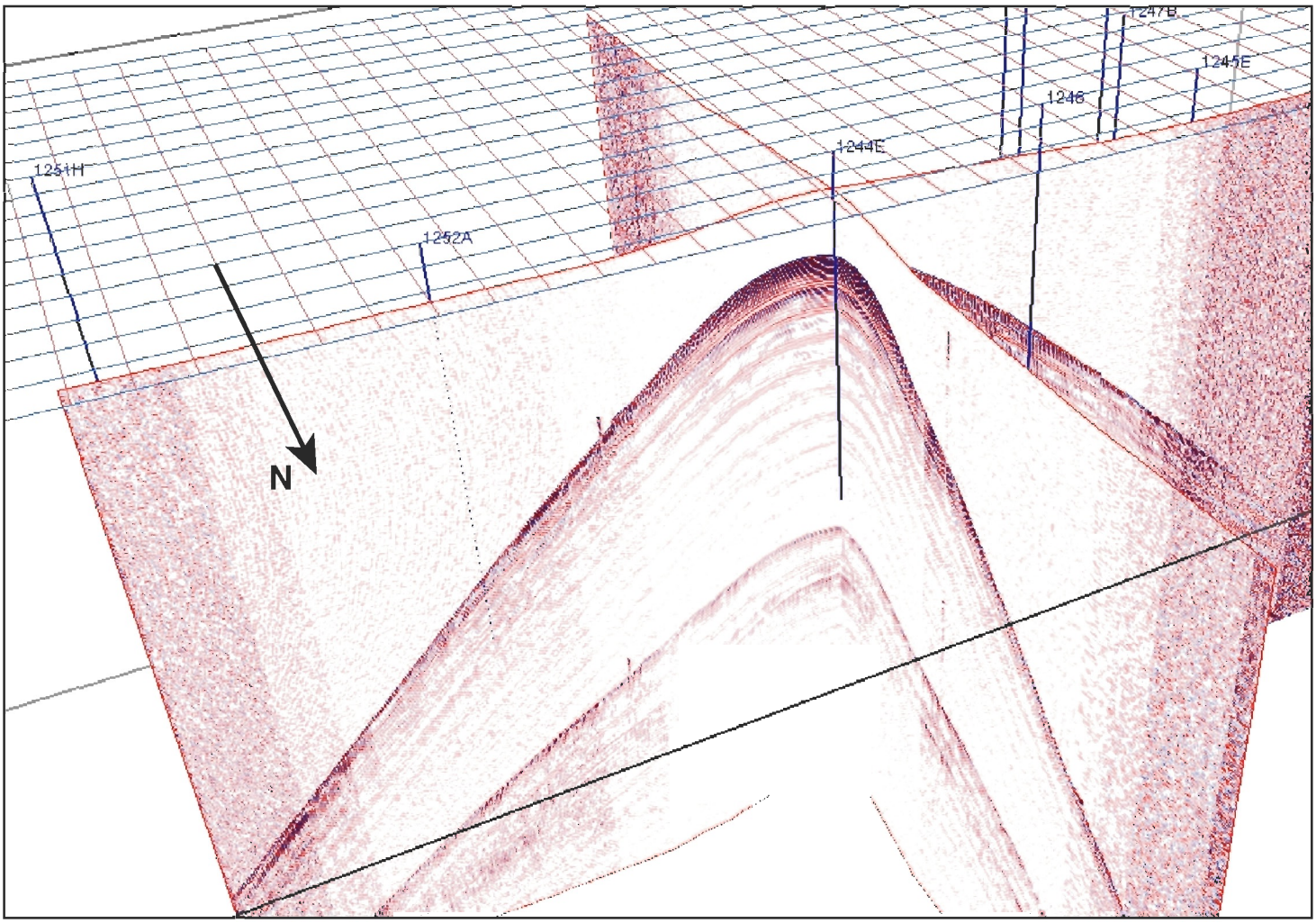

Figure 4: General overview of the two lines recorded with the vertical component geophone of the WST-3 at 1020 mbrf (=115 mbsf) in Hole 1244E.

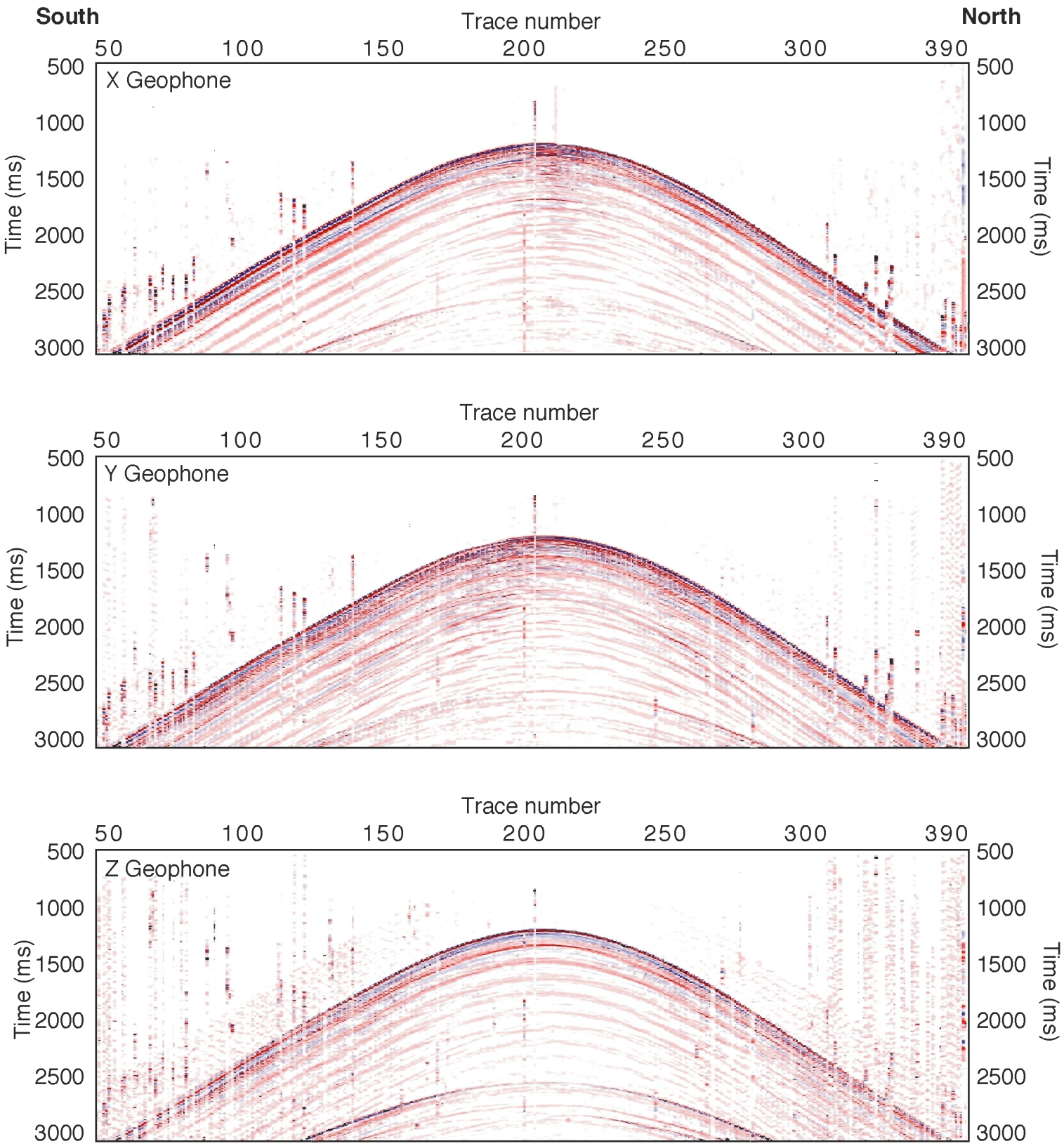

Figure 5: Walkaway line South-North recorded by the three geophones of the VSI at 979 mbrf (=172 mbsf) in Hole 1250F

CONCLUSION

The primary accomplishments of the JOI Cooperative Agreement with DOE/NETL in this quarter were that: (1) Leg 204 scientific party members presented preliminary results and operational outcomes of ODP Leg 204 at the American Geophysical Union Fall meeting, which was held in San Francisco, CA (these results are summarized in a Topical Report submitted separately); and, (2) a report was prepared by Dr. Gilles Guerin and David Goldberg from Lamont-Doherty Earth Observatory of Columbia University on their postcruise evaluation of the data, tools and measurement systems that were used for vertical seismic profiling (VSP) experiments during ODP Leg 204.

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LIST OF ACRONYMS AND ABBREVIATIONS

APC	Advanced Piston Corer
APC-M	Advanced Piston Corer-methane tool
APC-T	Advanced Piston Corer-temperature tool
BHA	Bottom Hole Assembly
BSR	Bottom Simulating Reflector
DOE	Department of Energy
DVTP	Davis Villinger Temperature Probe
DVTP-P	Davis Villinger Temperature Probe with Pressure
FMMG	Fugro-McCleland Marine Geosciences
FPC	Fugro Pressure Corer
GHSZ	Gas Hydrate Stability Zone
HR	Hydrate Ridge
HRC	HYACE Rotary Corer
HYACE	Hydrate Autoclave Coring Equipment
HYACINTH	Deployment of HYACE tools In New Tests on Hydrates
IR-TIS	Infrared Thermal Imaging System
JOI	Joint Oceanographic Institutions
JOIDES	Joint Oceanographic Institutions for Deep Earth Sampling
LDEO	Lamont Doherty Earth Observatory (Columbia University)
L/L	Liters per Liter
LTC	Laboratory Transfer Chamber
LWD	Logging While Drilling
MBRF	Meters Below Rig Floor
MBSF	Meters Below Sea Floor
MH	Methane Hydrate
MPa	Mega-Pascals
MSCL-V	Multi-Sensor Core Logger - Vertical
NETL	National Energy Technology Laboratory
NSF	National Science Foundation
ODP	Ocean Drilling Program
ODP-LC	Ocean Drilling Program – Logging Chamber
PCS	Pressure Core Sampler
PSI	Pounds per Square Inch
RAB	Resistivity at the Bit
RAB-c	Resistivity at the Bit with Coring
RCB	Rotary Core Barrel
R/V	Research Vessel
TAMU	Texas A&M University
XCB	Extended Core Barrel

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