Data report: penetrometer measurements of in situ temperature and pressure, IODP Expedition 308[1]

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Chapter contents

Abstract

We conducted temperature and pore pressure measurements using the Davis-Villinger Temperature-Pressure Probe and the temperature/dual pressure probe penetrometers during Integrated Ocean Drilling Program Expedition 308. In Ursa Basin, 18 measurements were used to determine that the geothermal gradient at Site U1324 is bilinear. The temperature gradient is 18.6°C/km in lithostratigraphic Unit I and 16.7°C/km in Unit II. Based on nine measurements at Site U1322, the geothermal gradient is 21.9°C/km. In Brazos-Trinity Basin IV, the geothermal gradient at Site U1320 is 23.1°C/km. In Ursa Basin, significant overpressures (overpressure ratio = ~0.7) are observed in the sediments above ~200 meters below seafloor (mbsf) at Sites U1322 and U1324. At Site U1324, pore pressure decreases with increasing depth between 200 and 300 mbsf. Below 300 mbsf and within lithostratigraphic Unit II, overpressure is approximately constant (~1 MPa). Unit II is composed of silty claystone interbedded with beds of silt and very fine sand. In Brazos-Trinity Basin IV, only two penetrometer deployments were made and the data are inconclusive.

Introduction

The objective of this report is to present in situ pressure and temperature data measured using downhole pressure penetrometers during Integrated Ocean Drilling Program (IODP) Expedition 308 (see the **"Expedition 308 summary"** chapter). These data have also been presented and interpreted in Long et al. (2007a) (see the "DOWNHOLE" folder in **"Supplementary material"**). Pressure and temperature data are critical for constraining fluid flow, heat flow, and hydraulic and thermal diffusivity. In addition, temperature affects sediment diagenesis and microbial activity. Expedition 308 is dedicated to the study of overpressure and fluid flow on the Gulf of Mexico continental slope. Knowledge of the pore pressure, and stress regime in general, is critical for evaluating submarine slope stability. It has been hypothesized that overpressure, pore pressures in excess of hydrostatic pressure, can weaken the strength of sediments and thus cause slope instability near the seafloor (Davis et al., 1983; Dugan and Flemings, 2002). Overpressure and the shallow-water flow frequently cause operational problems during drilling (Ostermeier et al., 2001).

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Three sites were drilled in Brazos-Trinity Basin IV and three sites were drilled in Ursa Basin during Expedition 308 (Figs. F1, F2, F3). To document the in situ pore pressure and temperature, we deployed two types of pressure penetrometers: the temperature/dual pressure probe (T2P) and the Davis-Villinger Temperature-Pressure Probe (DVTPP) (Fig. F4). The DVTPP was deployed previously during Ocean Drilling Program Legs 190, 201, and 204 (D'Hondt, Jørgensen, Miller, et al., 2003; Long et al., 2007a; Moore, Taira, Klaus, et al., 2001; Tréhu, Bohrmann, Rack, Torres, et al., 2003). The T2P is a new tool under development as a cooperative effort between Pennsylvania State University, Massachusetts Institute of Technology (MIT), and IODP-Texas A&M University (TAMU) (Expedition 308 Scientists, 2005; Flemings et al., 2006; see also the "PHYSPROP" folder in **"Supplementary material"**).

Method

The DVTPP and T2P penetrometers interface with the colleted delivery system (CDS). The CDS is lowered by wireline and engages with the bottom-hole assembly (BHA). Once the CDS is engaged in the BHA, the drill string is used to push the probe into the formation. The drill string is then raised 3–4 m and the CDS telescopes to decouple the probe from the drill string. The probe remains in the formation to measure pressure and temperature for 30–90 min. After measurement, the wireline pulls the CDS to its extended position and then pulls the penetrometer out of the formation. A detailed description of the deployment procedure is presented in **"Appendix A."** The data are downloaded from the data acquisition unit when the tool is retrieved.

When the penetrometers penetrate the formation, the temperature (resulting from friction on the tool) and pressure (resulting from deformation of the soil) are raised relative to their in situ values. Subsequently, the tools are left in place in order to dissipate toward the equilibrium values (Fig. F5). Temperature decay can be used to infer the formation temperature and thermal conductivity (Davis et al., 1997; Villinger and Davis, 1987). Decay of the penetration-induced pore pressure can be used to infer formation pressure, hydraulic diffusivity, and permeability (Baligh and Levadoux, 1986; Gupta and Davidson, 1986; Long et al., 2007a; Whittle et al., 2001).

Rates of pressure and temperature decay are functions of the probe diameter and the hydraulic/thermal diffusivity of the sediment (Bullard, 1954; Long et al., 2007a; Villinger and Davis, 1987). Pressure decay is much slower than temperature decay in low-permeability mudstones (Long et al., 2007a). Because of the restricted time available for deployment, we must interpret in situ pressure from partial dissipation records. If detailed soil properties are available, the in situ pressure and hydraulic diffusivity of the sediment can be inferred from modeling of soil behavior for different penetrometer geometries. However, in many cases soil properties are not available or there are insufficient resources to pursue soil modeling. In these cases, in situ pressure is inferred from simple extrapolation approaches such as inverse time ($1/t$) extrapolation (Davis et al., 1991; Lim et al., 2006; Long et al., 2007b; Villinger and Davis, 1987; Whittle et al., 2001) and inverse square root of time ($1/\sqrt{t}$) extrapolation (Long et al., 2007b).

Results

Sites U1319, U1320, and U1321 were drilled in the Brazos-Trinity Basin IV (Figs. F1, F2). Sites U1319 and U1320 were cored and penetrometer measurements were made. Sites U1322, U1323, and U1324 were drilled in the Ursa Basin (Figs. F1, F3). Sites U1322 and U1324 were cored and penetrometer measurements were made.

We present the temperature and pressure data from the penetrometer deployments at the four sites in this report. In the main text, we present our best estimate of the in situ temperature and pressure. In **"Appendix A,"** we describe how the DVTPP was calibrated and present a detailed description of each DVTPP deployment. In **"Appendix B,"** we describe how the T2P was calibrated and we describe each T2P deployment. In **"Appendix C,"** we present a discussion of the pressure state within the drill pipe based on the DVTPP pressure measurements.

The temperature and pressure data are available in Microsoft Excel format in the "APP_A" and "APP_B" folders in **"Supplementary material."** These data have been recalibrated and consequently are different and improved relative to the data discussed in the Expedition Reports section of this volume. The original raw data can be found in the "DOWNHOLE" folder in **"Supplementary material."** The penetrometer data are integrated with the rig instrumentation system data ("TruView data") in order to better understand and assess the quality of each measurement.

Summary of deployments

Twenty DVTPP deployments and twenty-eight T2P deployments were completed during Expedition 308 (Table T1). The deployment number (Table T1) reflects the deployment sequence of each tool during

Expedition 308 (Expedition 308 Scientists, 2005). Deployments are divided into three types: Type I, Type II, and Type III (Table **T1**; Fig. **F6**).

Figure **F7A** illustrates ideal penetrometer deployments for the DVTPP and the T2P (Type I; Table **T1**). The tip pressure is at maximum during insertion and, subsequently, pressure declines with time. At the end of the deployment, the shaft pressure of the T2P is much greater than that of the tip pressure. This is because the shaft has a much larger diameter. As a result it disturbs a greater region around the penetrometer and this takes a greater amount of time to subside to the in situ pressure. A detailed comparison of the DVTPP and the T2P geometries and their consequent behavior during insertion and dissipation is presented by Long et al. (2007a).

Figure **F7B** presents deployments for both the DVTPP and the T2P that were slightly dislodged when the drill string was raised subsequent to penetration to decouple itself from the penetrometer through the CDS (Types IIA and IIB). In this situation, the tool pressure dropped abruptly when the bit was raised. Analysis of the temperature record from both tools and the accelerometer record from the DVTPP shows that coincident with the abrupt drop in pressure there was frictional heating and movement of the tool (Flemings et al., 2006; Long et al., 2007b). The pressure either decayed toward the formation pressure after it rebounded to a certain level (Type IIA; Table **T1**) or kept building during the dissipation phase (Type IIB; Table **T1**; Fig. **F7B**).

Type III includes all the unsuccessful deployments that failed to yield useful information about the in situ conditions. Type III deployment problems are three-fold. First, in early cases there was an internal hydraulic leak in the DVTPP and the tip pressure of the T2P. The leaks resulted in abrupt and erratic drops in pressure during the dissipation phase (Fig. **F7C**). Eventually, the internal hydraulic leak was repaired. Second, in the worst case the tool dislodgement weakened the seal around the probe and created communications with the borehole fluid, ruining the pressure and temperature measurements (see **"Appendix A," "Appendix B"**). Third, the tool did not record any reliable data because of electronic and/or mechanical failure. The latter was especially true for the T2P, as it was prone to bending because of its very narrow diameter tip.

During several deployments, the DVTPP was not fully decoupled from the BHA because of friction in the CDS (in **"Appendix A,"** see DVTPP Deployments 1, 2, 3, 8, 12, and 13). In these cases, the tool moved during the dissipation phase. Frictional heating caused by these tool movements may have compromised the temperature measurement. Continuous movement of the tool may also have affected the pressure measurements. In several T2P deployments, circulation of the drilling fluid resumed during the dissipation phase. In these cases, it is often possible to see a slight pressure and temperature increase at the onset of circulation. (in **"Appendix B,"** see T2P Deployments 2, 3, 4, 5, and 12). In some cases, the onset of circulation resulted in further tool insertion (in **"Appendix B,"** see T2P Deployments 6 and 7). The tool disturbance caused by pumping fluid may affect the accuracy of the pressure and temperature measurements.

Data extrapolation

During Expedition 308, T2P temperatures equilibrated to formation temperatures (see **"Appendix B"**). In contrast, temperatures measured with the DVTPP did not equilibrate to in situ temperatures (see **"Appendix A"**). The reason for this is that the DVTPP has a significantly larger geometry. We use inverse time ($1/t$) extrapolation to estimate the in situ temperature for the DVTPP deployments (Davis et al., 1997; Villinger and Davis, 1987).

Pressures measured by both the T2P and the DVTPP penetrometers did not reach in situ pressures during the dissipation phase (see **"Appendix A," "Appendix B"**). In the absence of detailed soil properties, we used two empirical approaches to infer the in situ pressure from the partial dissipation records: $1/t$ extrapolation and $1/\sqrt{t}$ extrapolation. Accuracy of the extrapolated in situ pressures depends on the tool that was used, pressure port, type of deployment, depth of deployment, and the pressure decay time (Long et al., 2007b). Long et al. (2007b) showed that $1/t$ extrapolation more closely matches theoretical modeling results than the extrapolation does when pressure decays <80% of the penetration-induced pressure. The error of a good (Type I) deployment with long dissipation time (e.g., 90 min) should be within 0.1 MPa, whereas the error of a deep deployment with short decay time could be more than 0.5 MPa.

Table **T2** presents the interpreted in situ pressure and temperature for the T2P and the DVTPP deployments during Expedition 308.

In situ temperature

Brazos-Trinity Basin IV

Figure **F8** presents the in situ temperatures taken at Sites U1319 and U1320. The geothermal gradient at Site U1320 is 23.1°C/km. The only measurement at Site U1319 suggests a higher geothermal gradient than that at Site U1320.

Ursa Basin

Figure F9 presents the in situ temperatures taken at Sites U1322 and U1324. The geothermal gradient at Site U1324 is bilinear. The thermal gradient is 18.6°C/km in the sediments above 360 meters below seafloor (mbsf), corresponding to lithostratigraphic Unit I, which is predominantly composed of terrigenous clay and mud with a marked paucity of silt and sand (see the "Site U1324" chapter). The geothermal gradient is 16.7°C/km in lithostratigraphic Unit II, which extends from 360 to 600.8 mbsf and includes interbedded silt and very fine sand with beds and laminae of mud and clay (see the "Site U1324" chapter). Sediments are predominantly clay and mud at Site U1322. The geothermal gradient is 21.9°C/km, which is significantly higher than that at Site U1324.

In situ pressure

We present our pressure results with respect to hydrostatic pressure and overburden stress. The hydrostatic pressure is calculated starting from the seafloor and assuming a seawater density of 1.024 g/cm^3. Bulk density data from shipboard moisture and density (MAD) measurements were integrated to calculate the overburden stress. The static pressure of the water column above seafloor was subtracted from the pressure results.

Brazos-Trinity Basin IV

We have only one pressure measurement at Site U1319. The T2P penetration was completed at 80.5 mbsf. The last recorded pressure of the T2P tip equals the overburden stress, whereas that of the shaft exceeds the overburden stress. This clearly shows that pressures had not dissipated to in situ pressure (Fig. F10B). The pressure dissipation time was only 35 min for this deployment. The $1/\sqrt{t}$ extrapolation of the tip pressure, which should give a better estimation of in situ pressure (Long et al., 2007b), suggests that the formation pressure is 0.37 MPa higher than hydrostatic (Fig. F10D). The $1/\sqrt{t}$ extrapolated in situ pressure suggests that the formation pressure at 80.5 mbsf is 0.37 MPa higher than the hydrostatic pressure (Fig. F10D). The shaft pressure was still higher than the overburden stress after $1/t$ and $1/\sqrt{t}$ extrapolation (Fig. F10C, F10D).

We made two T2P and two DVTPP deployments at Site U1320, but only one deployment can be used to estimate the in situ pressure. The last recorded pressure was slightly greater than the hydrostatic pressure (Fig. F11B). The estimated in situ pressure by both $1/t$ and $1/\sqrt{t}$ extrapolation suggests that formation pressure at 126.3 mbsf is close to hydrostatic pressure (Fig. F11C, F11D).

Ursa Basin

Figure F12 presents the pore pressure measurements at Site U1322, where sediments are predominantly clay and mud. The last recorded pressures are scattered, with some of them equal to or exceeding the overburden stress (σ_v) (Fig. F12B). This indicates that pressures had not dissipated to the in situ pressure at the end of the deployments.

The $1/t$ extrapolation predicts consistently higher pressure at the shaft sensor of the T2P than that at the tip sensor (Fig. F12C). Some shaft pressures are still equal to or even higher than the overburden stress (Fig. F12C). These indicate that $1/t$ extrapolation of the shaft pressure overestimates the in situ pressure, consistent with theoretical modeling presented by Long et al. (2007b).

Application of $1/\sqrt{t}$ extrapolation drives the shaft pressure closer to the tip pressure (Fig. F12D). The results make more physical sense because ultimately the shaft pressure and tip pressure converge at the in situ pressure. We believe the $1/\sqrt{t}$ extrapolation provides more accurate in situ pressure estimate than the $1/t$ extrapolation does for the shaft pressure.

Nevertheless, both extrapolation approaches predict significant overpressure and similar trends. The overpressure ratio ($\lambda^* = [u_0 - u_h]/[\sigma_v - u_h]$) is as high as 0.75. Overpressure starts to drop from ~200 mbsf.

Figure F13 presents the pore pressure measurements at Site U1324. Both extrapolation approaches predict significant overpressure in the sediments above ~200 mbsf (Fig. F13C, F13D) that correspond to hemipelagic silty claystone. Within this section, the magnitude and trend of the overpressure are similar to those at Site U1322 (Fig. F14). The sediments below 300 mbsf have less overpressure (Fig. F13). The overpressure seems to be constant within lithostratigraphic Unit II, in which sediments are composed of silty claystone interbedded with beds of silt and very fine sand. The transition occurs at the section from 200 to 300 mbsf.

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Figure F1. Bathymetric map of study areas.

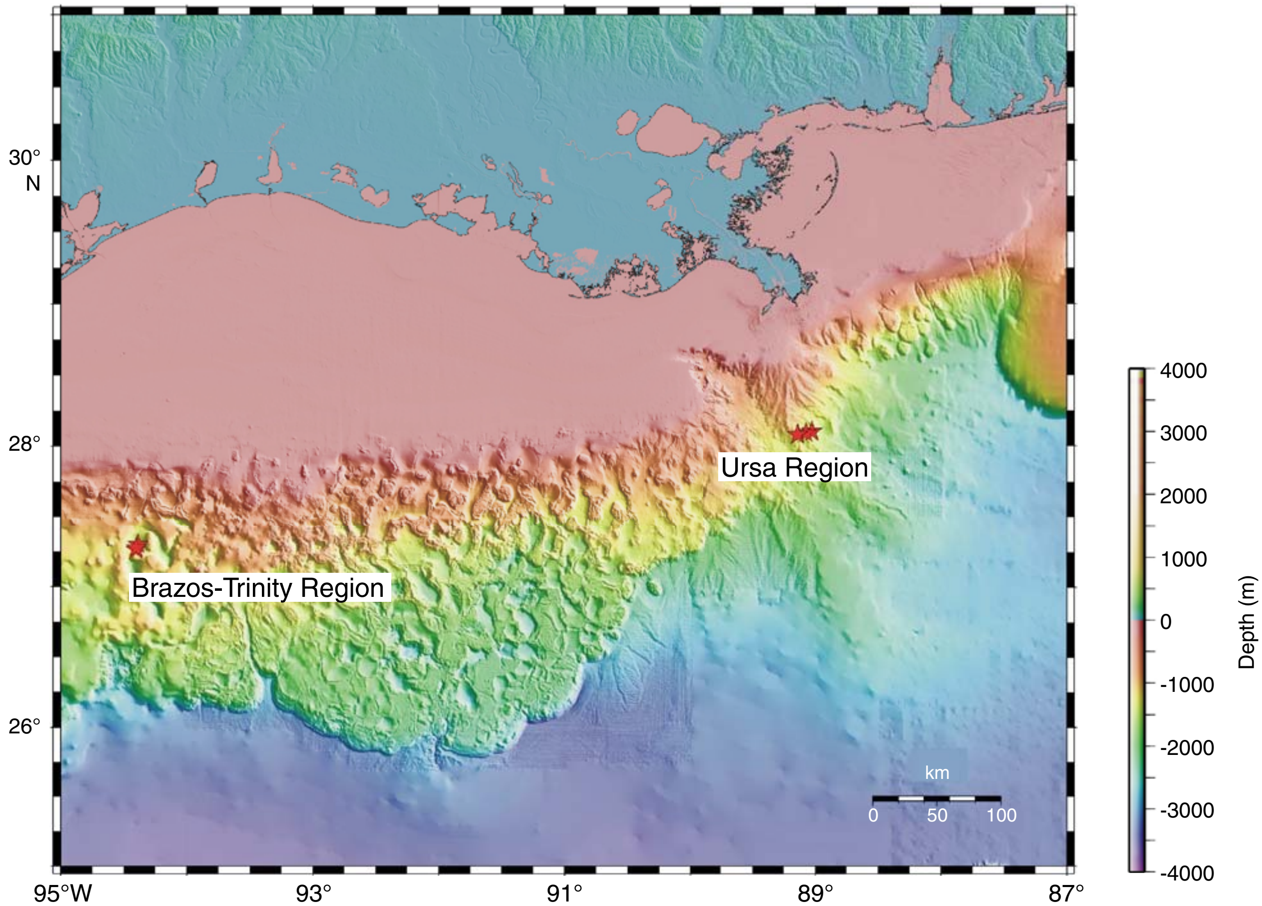

Figure F2. Seismic cross section of Brazos-Trinity Basin IV showing locations of Sites U1319, U1320, and U1321. SF = seafloor.

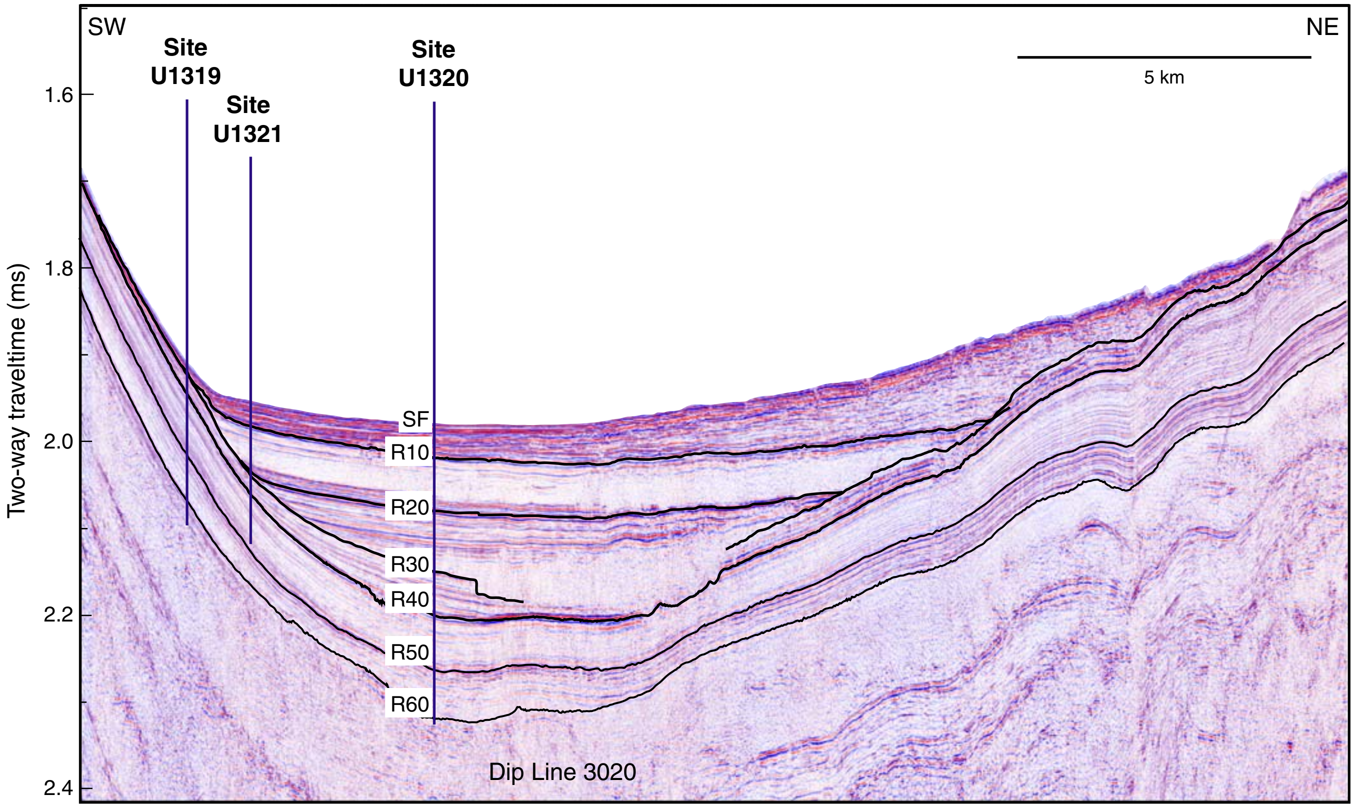

Figure F3. Seismic and interpreted cross section of Ursa Basin and locations of Sites U1322, U1323, and U1324 (Sawyer et al., 2007). **A.** East–west seismic cross section A–A′. **B.** Interpreted cross section A–A′. Light and dark gray = mud-rich levee, rotated channel-margin slides, and hemipelagic drape; yellow = sand-rich channel fill; light blue = Blue Unit; red = detachment surfaces. Mass transport deposits have occurred in the mud-rich levee deposits above the Blue Unit, which is composed of sand and mud. MTD = mass transfer deposits.

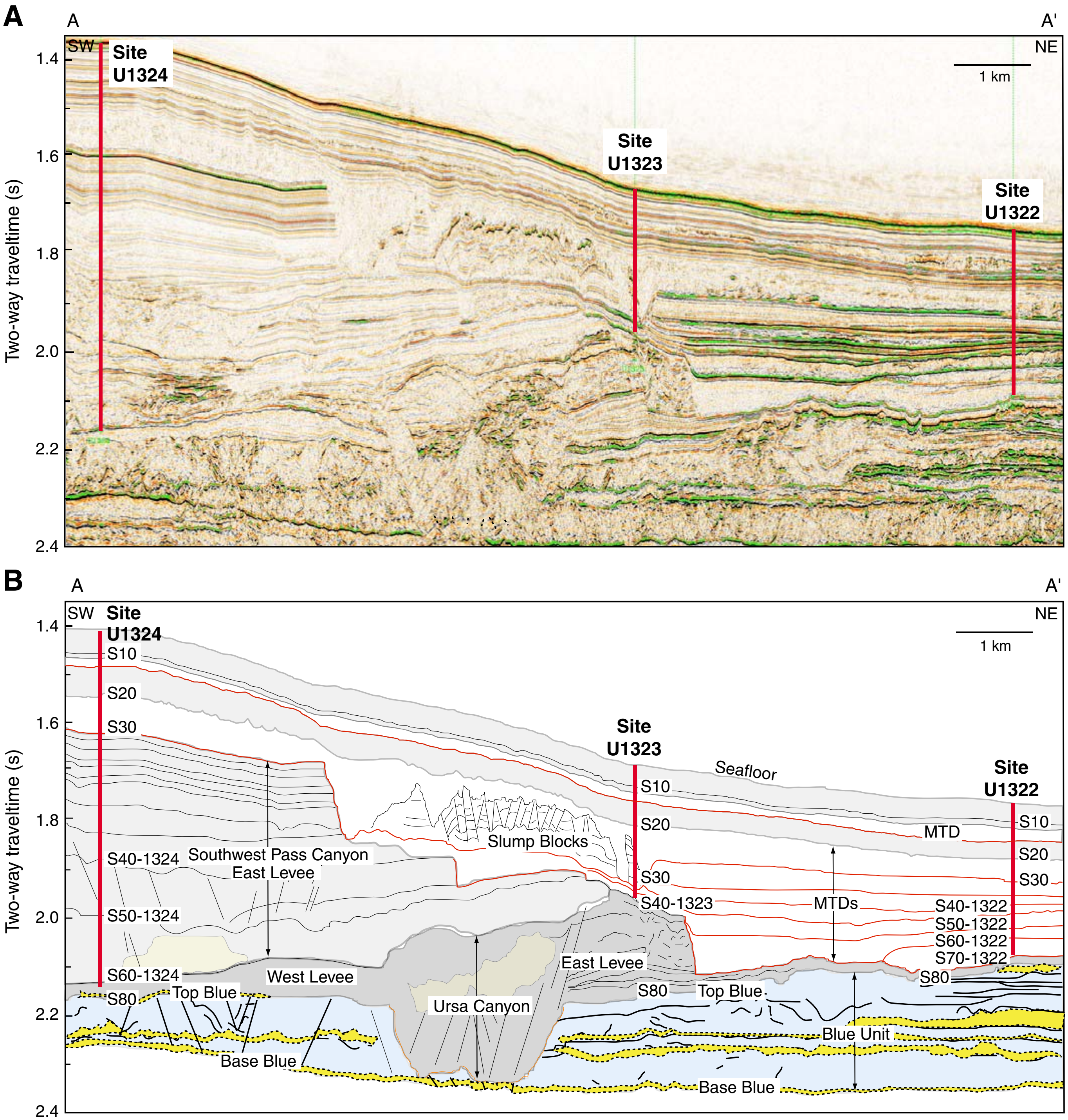

Figure F4. Davis-Villinger Temperature-Pressure Probe (DVTPP) and temperature/dual pressure (T2P) probe penetrometers.

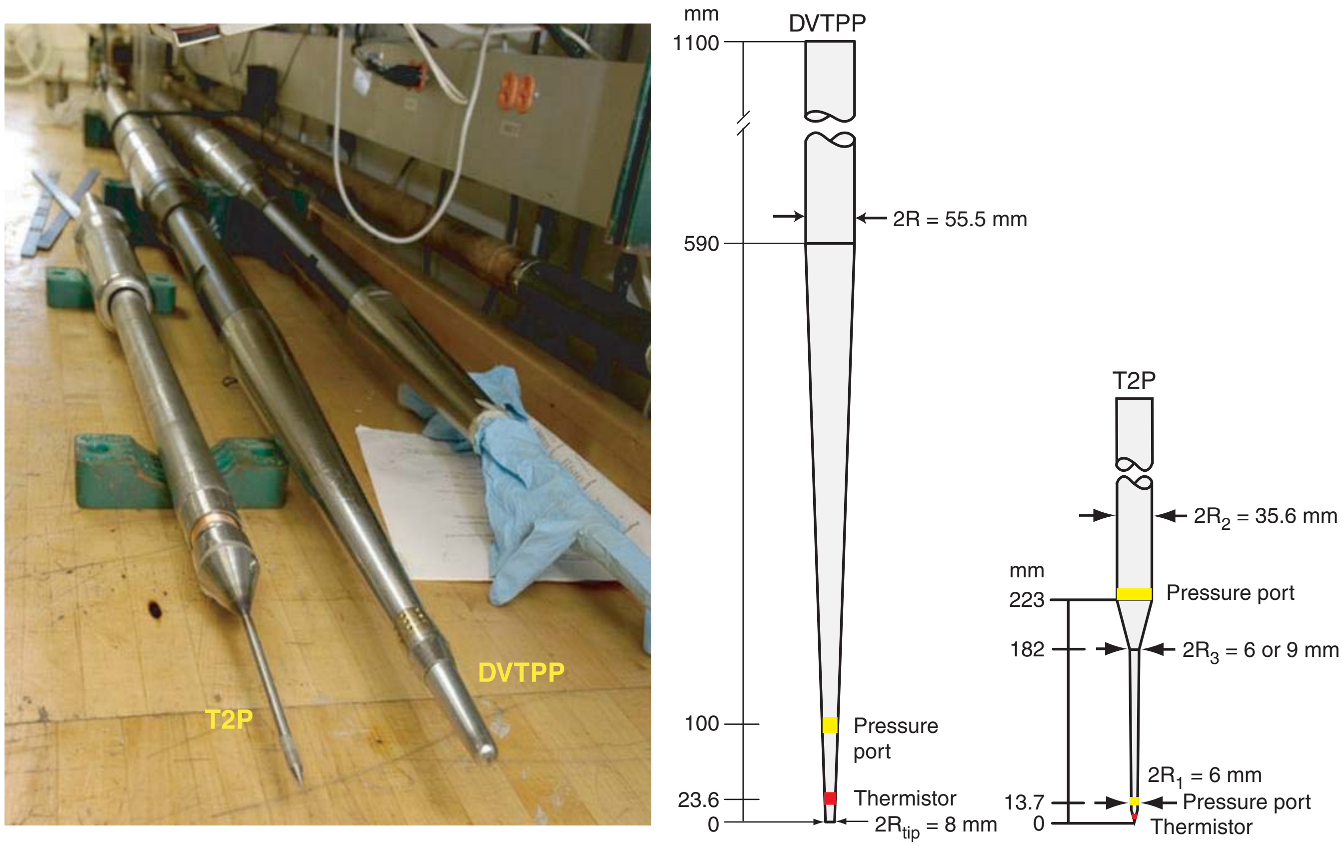

Figure F5. Procedure for probe penetration. Drill string pushes the probe into the formation. After penetration, the drill string is raised and the colleted delivery system telescopes to decouple the drill string from the tool. The probe stays in the formation to monitor the temperature and pressure. A good measurement is indicated by an abrupt increase in pressure and temperature during penetration and then a slow dissipation of pressure and temperature as the tool stays in the formation.

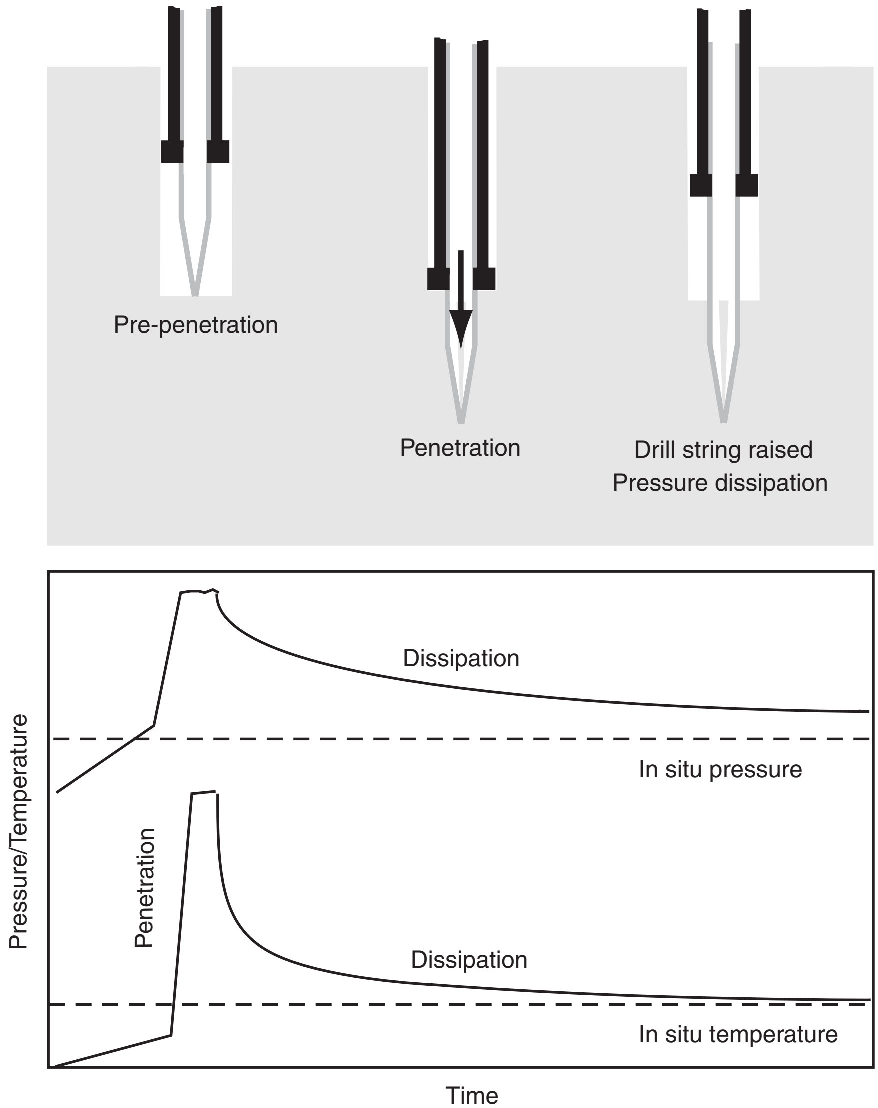

Figure F6. Summary of temperature/dual pressure (T2P) probe and Davis-Villinger Temperature-Pressure Probe (DVTPP) deployments during Expedition 308. Type I, II, and III deployments are defined in Figure **F7.** Type I and II deployments can give insight into in situ conditions. Type III deployments do not provide useful information about in situ conditions.

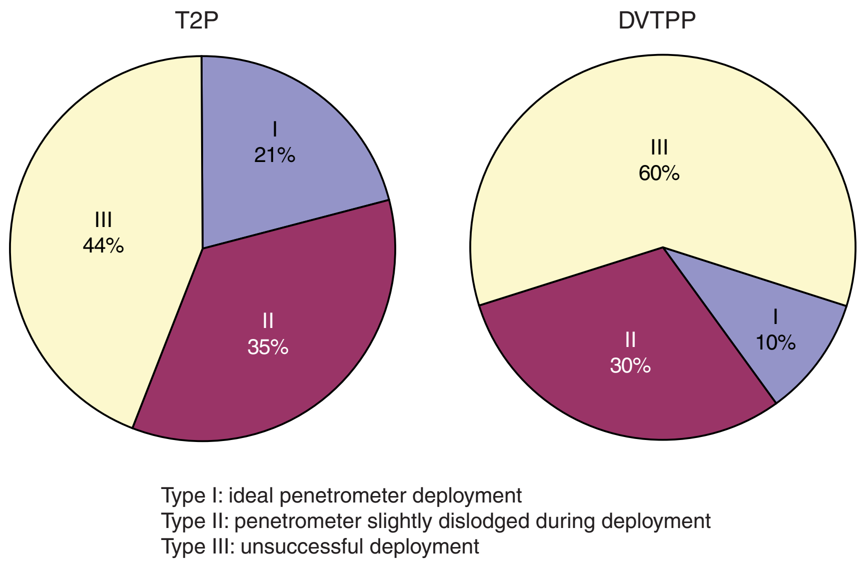

Figure F7. Characteristic deployments of Davis-Villinger Temperature-Pressure Probe (DVTPP) and temperature/dual pressure (T2P) probe. **A.** Type I deployment showing typical pressure record for a penetration test with clear pressure buildup and clean pressure dissipation. **B.** Type II deployment showing dramatic drop in pressure caused by decoupling of the drill string from the tool. Type II deployments can either show pressure decaying toward in situ pressure after the pressure drop (Type IIA) or pressure building to in situ pressure after the pressure drop (Type IIB). **C.** Type III deployment showing abrupt and erratic changes in pressure during the dissipation phase ("leak" deployment). Type III deployments include unsuccessful deployments resulting from hydraulic leaks, electronics failure, or tool damage and communication with borehole fluid.

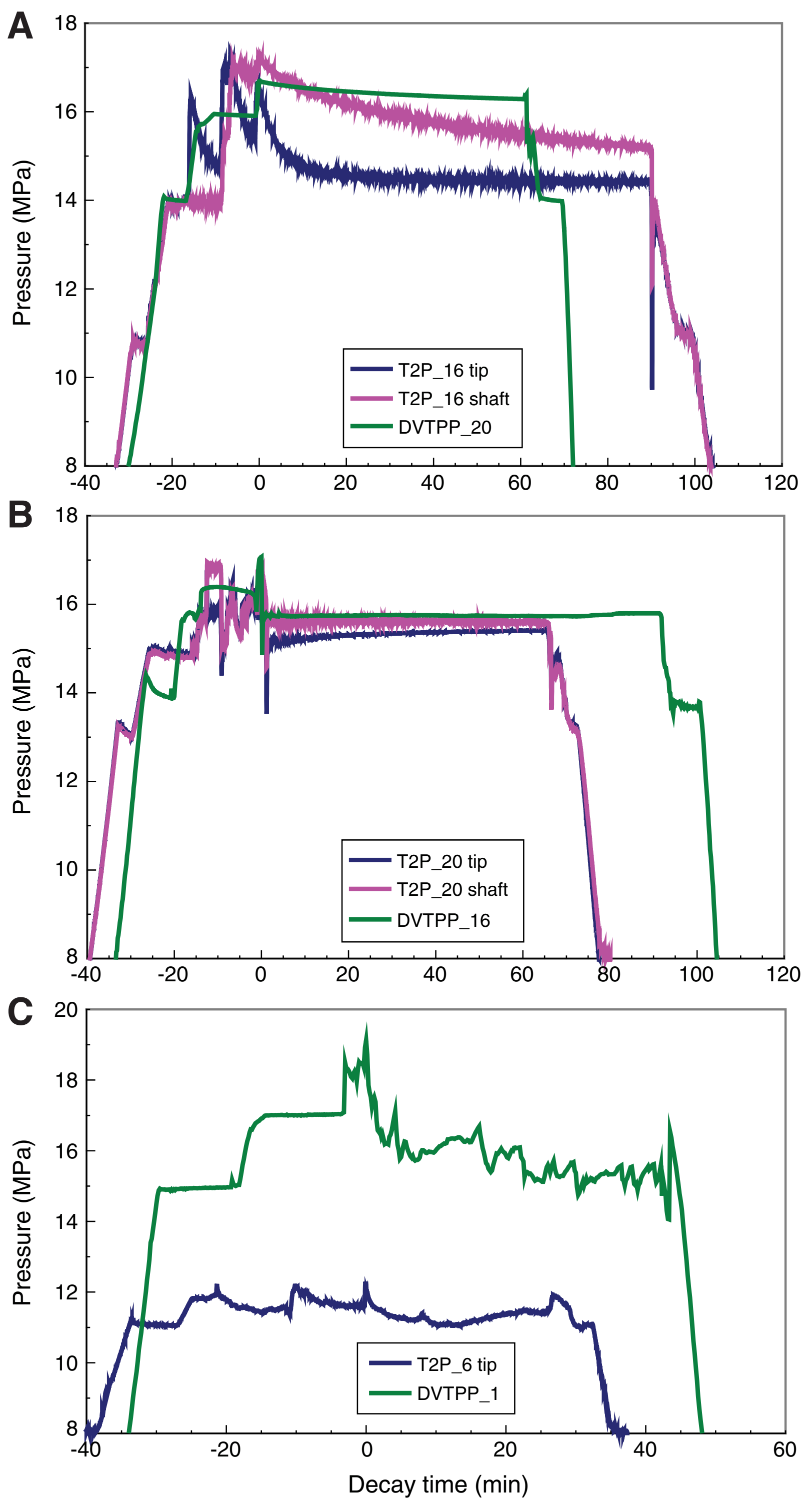

Figure F8. In situ temperature in Brazos-Trinity Basin IV, Sites U1319 and U1320. Temperature/dual pressure (T2P) probe temperature reached equilibrium with the formation temperature at the end of the deployment (Table T2). Davis-Villinger Temperature-Pressure Probe (DVTPP) temperature did not equilibrate with the formation temperature at the end of the deployment. In situ temperatures were estimated using 1/*t* extrapolation (Table T2). Red = temperature measurements subjected to influence of tool movements during dissipation phase.

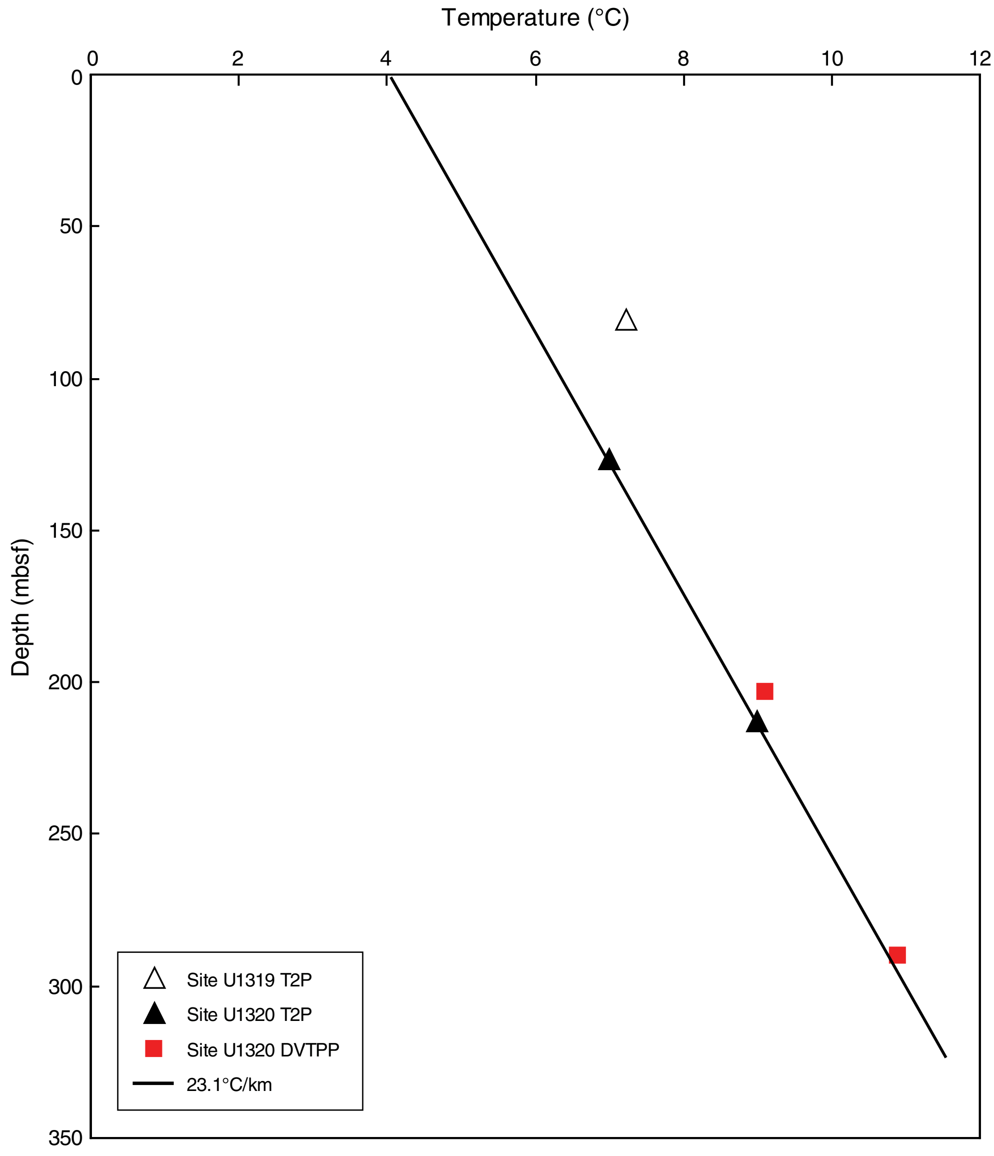

Figure F9. Temperature data for Ursa Basin, Sites U1322 and U1324. Temperature/dual pressure (T2P) probe temperature reached equilibrium with the formation temperature at the end of the deployment (Table T2). Davis-Villinger Temperature-Pressure Probe (DVTPP) temperature did not equilibrate with the formation temperature at the end of the deployment. In situ temperatures were estimated using 1/*t* extrapolation (Table T2). Red symbols = temperature measurements subjected to influence of tool movements during dissipation phase.

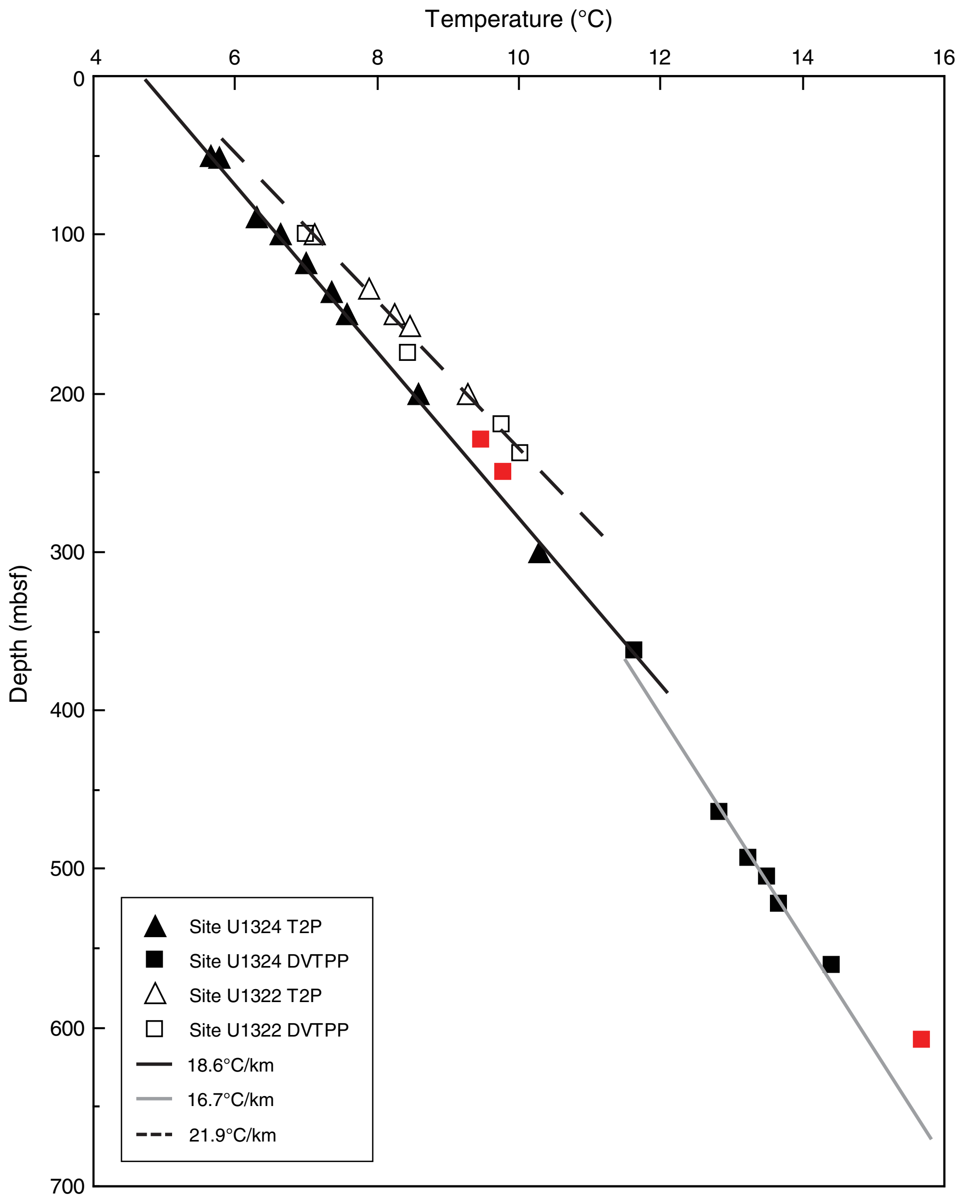

Figure F10. Pore pressure measurements, Site U1319. Hydrostatic pressure calculated starting from the seafloor assuming a seawater density of 1.024 g/cm³. Bulk density data from shipboard moisture and density (MAD) measurements were integrated to calculate the overburden stress. The static pressure resulting from the water column above seafloor was subtracted from the pressure results. **A.** Porosity obtained from shipboard MAD measurement. **B.** Last recorded penetrometer pressure measurement (Table T2). **C.** In situ pore pressure estimated by $1/t$ extrapolation (Table T2). **D.** In situ pore pressure estimated by $1/\sqrt{t}$ extrapolation (Table T2). T2P = temperature/dual pressure probe.

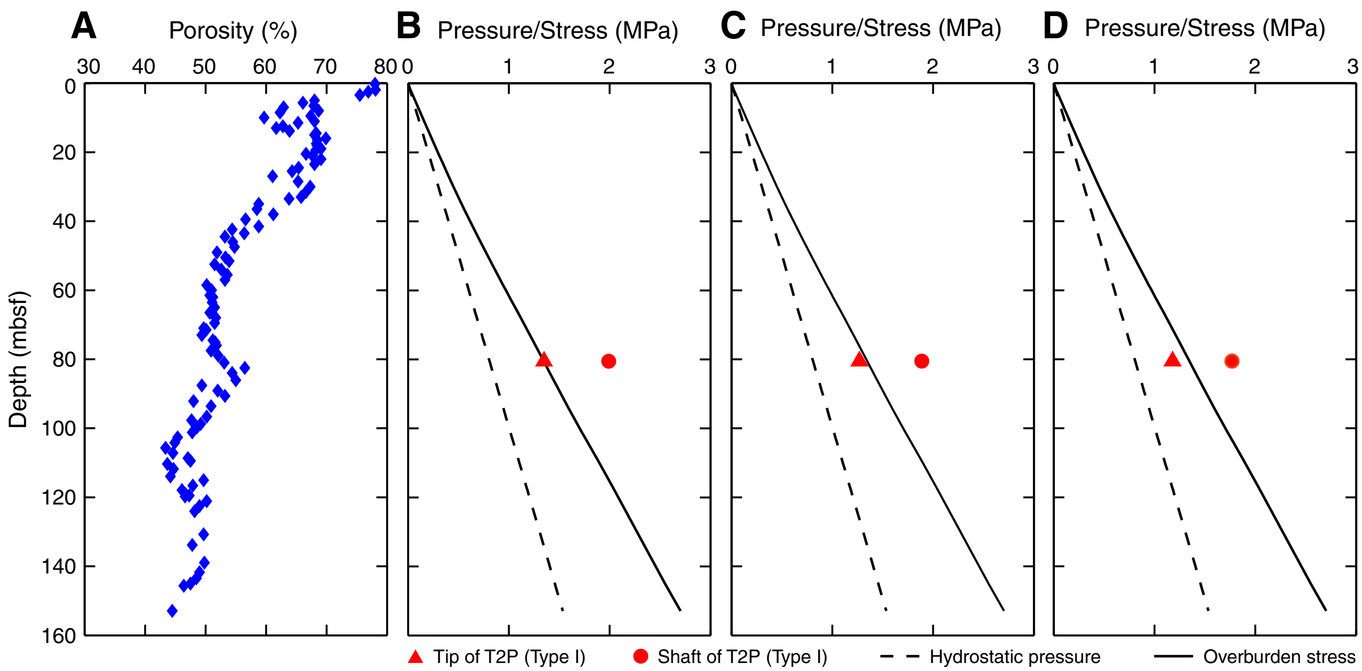

Figure F11. Pore pressure measurements, Site U1320. Hydrostatic pressure calculated starting from the seafloor assuming a seawater density of 1.024 g/cm³. Bulk density data from shipboard moisture and density (MAD) measurements were integrated to calculate the overburden stress. The static pressure caused by the water column above seafloor was subtracted from the pressure results. **A.** Porosity obtained from shipboard MAD measurement. **B.** Last recorded penetrometer pressure measurement (Table T2). **C.** In situ pore pressure estimated by 1/*t* extrapolation (Table T2). **D.** In situ pore pressure estimated by $1/\sqrt{t}$ extrapolation (Table T2). T2P = temperature/dual pressure probe.

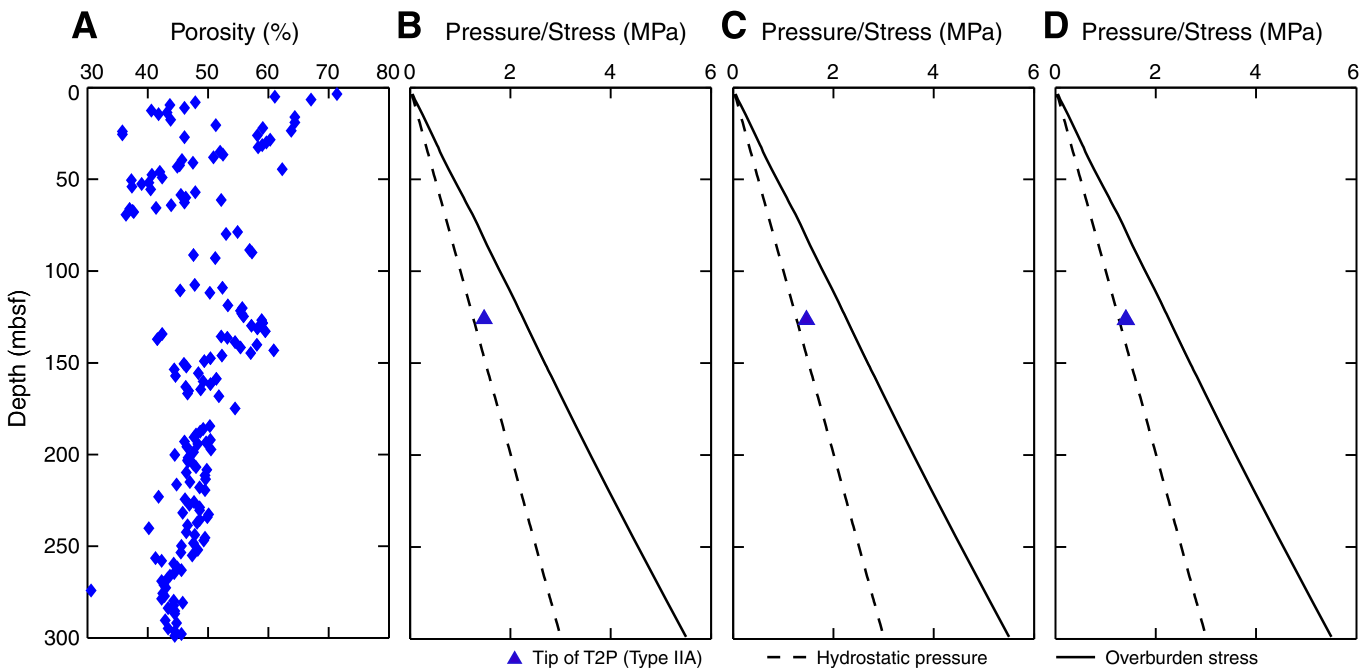

Figure F12. Pore pressure measurements, Site U1322. Hydrostatic pressure calculated starting from the seafloor assuming a seawater density of 1.024 g/cm³. Bulk density data from shipboard moisture and density measurements (MAD) were integrated to calculate the overburden stress. The static pressure caused by the water column above seafloor was subtracted from the pressure results. **A.** Porosity obtained from shipboard MAD measurement. **B.** Last recorded penetrometer pressure measurement (Table T2). **C.** In situ pore pressure estimated by $1/t$ extrapolation (Table T2). **D.** In situ pore pressure estimated by $1/\sqrt{t}$ extrapolation (Table T2). Red = Type I deployment, blue = Type IIA deployment, green = Type IIB deployment. T2P = temperature/dual pressure probe, DVTPP = Davis-Villinger Temperature-Pressure Probe.

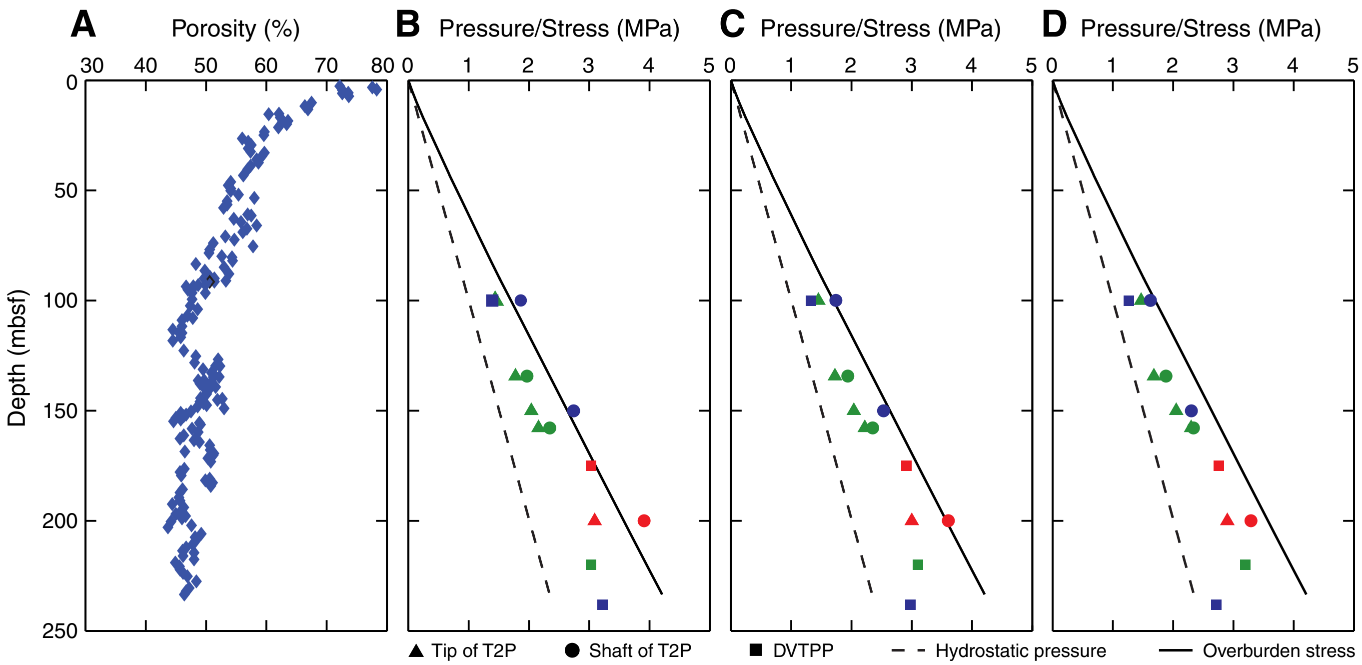

Figure F13. Pore pressure measurements, Site U1324. Hydrostatic pressure calculated starting from the seafloor assuming a seawater density of 1.024 g/cm³. Bulk density data from shipboard moisture and density measurements (MAD) were integrated to calculate the overburden stress. The static pressure caused by the water column above seafloor was subtracted from the pressure results. **A.** Porosity obtained from shipboard MAD measurement. **B.** Last recorded penetrometer pressure measurement (Table T2). **C.** In situ pore pressure estimated by $1/t$ extrapolation (Table T2). **D.** In situ pore pressure estimated by $1/\sqrt{t}$ extrapolation (Table T2). Red = Type I deployment, blue = Type IIA deployment, green = Type IIB deployment. T2P = temperature/dual pressure probe, DVTPP = Davis-Villinger Temperature-Pressure Probe.

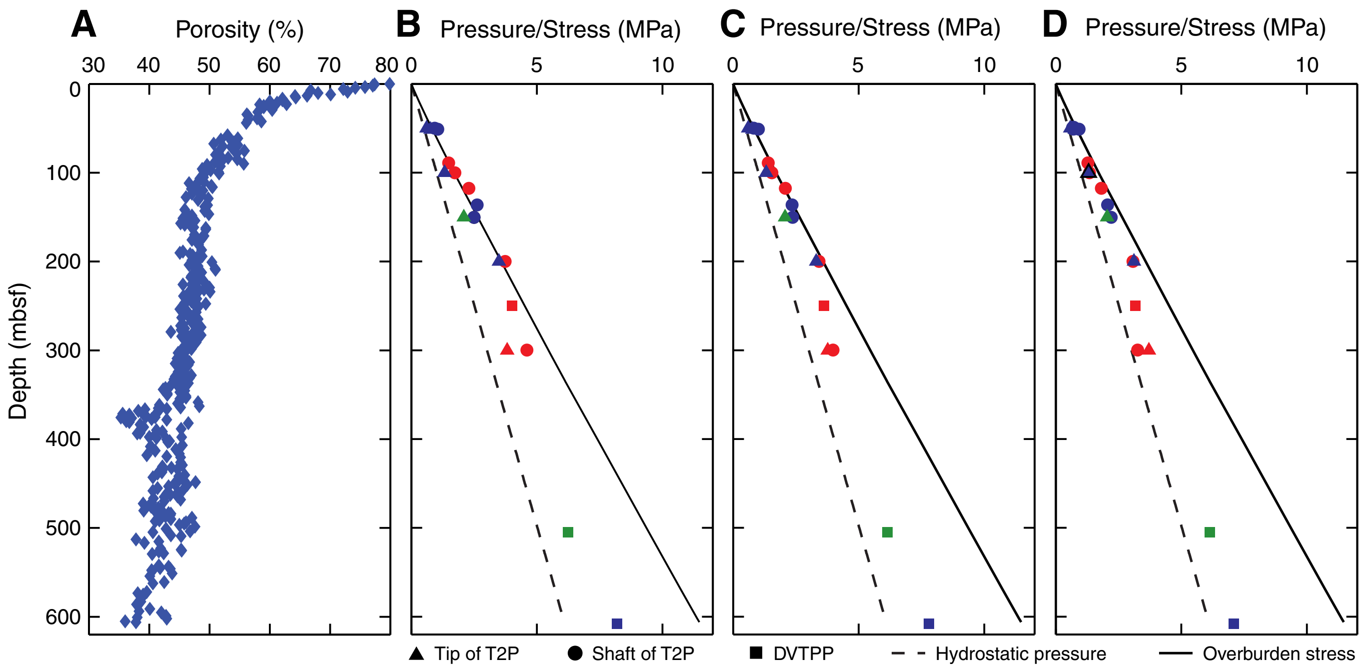

Figure F14. In situ pressure estimates by $1/\sqrt{t}$ extrapolation in the upper 250 mbsf at Sites U1322 and U1324. The hydrostatic pressure is calculated starting from the seafloor assuming a seawater density of 1.024 g/cm³. Bulk density data from shipboard moisture and density measurements were integrated to calculate the overburden stress. The static pressure caused by the water column above seafloor was subtracted from the pressure results. T2P = temperature/dual pressure probe, DVTPP = Davis-Villinger Temperature-Pressure Probe.

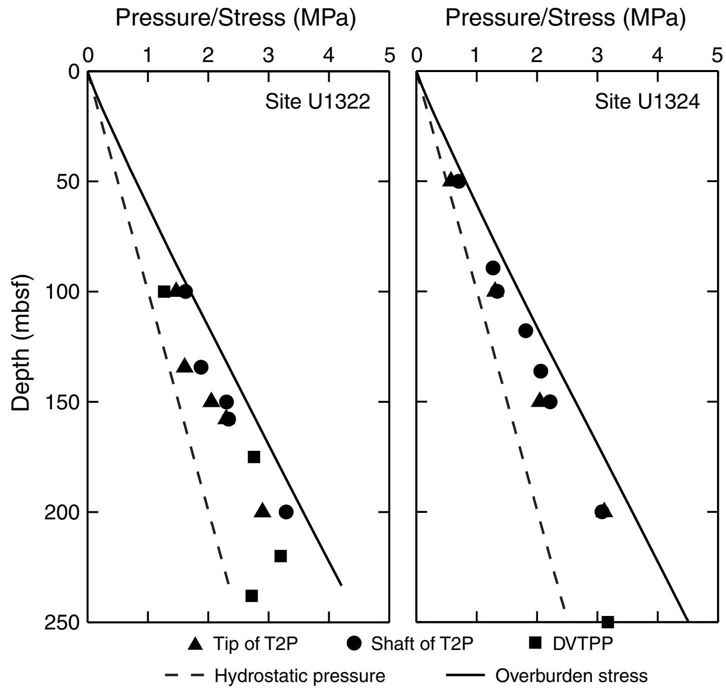

Table T1. Summary of the DVTPP and T2P deployments during IODP Expedition 308. (See table notes.) (Continued on next page.)

Deployment number	Hole	File name	Depth (mbsf)	Depth (mbsl)	TruView data	Decay time (min)	Type	Date (2005)	Tool	Remarks
DVTP-P1	U1320A	1320a24	203.4	1673.4	LF	42	III	9 Jun	9367; 88587; 0226-3	Hydraulic leak; tool vibrating during decay
DVTP-P2	U1320A	1320a33	289.9	1759.9	LF	13	III	9 Jun	9367; 88587; 0226-3	Hydraulic leak; tool vibrating during decay
DVTP-P3	U1324B	1324b27	229.1	1285.9		50	III	22 Jun	9367; 88587; 0226-3	Hydraulic leak; tool vibrating during decay
DVTP-P4	U1324B	1324b45	362.4	1419.2	No match	47	III	23 Jun	9367; 88587; 0226-3	Hydraulic leak; good T
DVTP-P5	U1324B		387.9	1444.7	NA	10	III	23 Jun		Failed; no data recorded
DVTP-P6	U1324B	1324b59	464.3	1521.1	No match	34	IIB	24 Jun	9368; 88579; 0226-2	Pullout/void; good T
DVTP-P7	U1324B	1324b62	493.1	1549.9	No match	31	III	24 Jun	9368; 88579; 0226-2	Dilatant soil?, good T
DVTP-P8	U1324B	1324b64	521.9	1578.7	HF	41	III	24 Jun	9368; 88579; 0226-2	Weird pressure; tool movements during decay
DVTP-P9	U1324B		541.1	1597.9		30	III	25 Jun		Programing error; no data recorded
DVTP-P10	U1324B	1324b68	560.4	1617.2	HF	32	IIA	25 Jun	9367; 88587; 0226-3	Good T; unusual decay curve
DVTP-P11	U1324B	1324b72	589.2	1646.0	HF	45	III	25 Jun	9367; 88587; 0226-3	Unreliable data
DVTP-P12	U1324B	1324b74	608.2	1665.0	HF	61	IIA	25 Jun	9367; 88587; 0226-3	Pullout/void; tool vibrating during decay
DVTP-P13	U1324C	1324c05	250	1305.7	HF	90	I	27 Jun	9367; 88587; 0226-3	Tool vibrating during decay
DVTP-P14	U1324C	1324c07	405	1460.7	HF	94	III	27 Jun	9367; 88587; 0226-3	Pullout/void; communication with borehole
DVTP-P15	U1324C	1324c08	505	1560.7	HF	93	IIB	28 Jun	9367; 88587; 0226-3	Pullout/void; commination with borehole?; further tool insertion during decay
DVTP-P16	U1322B	1322b19	166.7	1486.2	HF	92	III	29 Jun	9367; 88587; 0226-3	Pullout/void; commination with borehole
DVTP-P17	U1322C	1322c02	100	1418.9	LF	91	IIA	1 Jul	9368; 88579; 0226-2	Pullout/void; good T
DVTP-P18	U1322C	1322c03	220	1538.9	HF	62	IIB	1 Jul	9368; 88579; 0226-2	Pullout/void; good T
DVTP-P19	U1322C	1322c04	238	1556.9	HF	93	IIA	1 Jul	9368; 88579; 0226-2	Pullout/void; good T
DVTP-P20	U1322D	1322d04	175	1493.9	HF	60	I	2 Jul	9368; 88579; 0226-2	Type pressure/temperature decay
T2P_1	U1319A	t2p_1						7 Jun	Sn4; S50-73; Z59-72; 0509-3; straight	Pressure test in water column
T2P_2	U1319A	t2p_2	80.5	1510.1	LF	35	Tip: I; Shaft: I	7 Jun	Sn4; S50-73; Z59-72; 0509-3; straight	Tip broken; lost thermistor 3; insignificant pressure/temperature response caused by pumping
T2P_3	U1320A	t2p_3	126.3	1596.3	LF	52	Tip: IIA; Shaft: III	8 Jun	Sn2; S50-75; S50-74; 0509-2; taper	Tip bent; shaft had no response; insignificant pressure/ temperature response caused by pumping
T2P_4	U1320A	t2p_4	213	1683.0	LF	25	Tip: I; Shaft: III	9 Jun	Sn4; S50-73; Z59-72; 0509-6; straight	installed by its own weight; slight pressure and temperature increase caused by pumping
T2P_5	U1324B	t2p_5	51.3	1108.1	LF	34	Tip: IIA; Shaft: IIA	21 Jun	Sn2; S50-75; Y67-16; 0509-2; straight	Tip broken; lost thermistor 2; slight pressure increase due to pumping
T2P_6	U1324B	t2p_6	89.3	1146.1	LF	25	Tip: III; Shaft: I	21 Jun	Sn4; S50-73; Z59-72; 0509-6; taper	Further insertion caused by pumping; internal leak at tip
T2P_7	U1324B	t2p_7	117.8	1174.6	LF	31	Tip: III; Shaft: I	21 Jun	Sn4; S50-73; Z59-72; 0509-6; taper	Further insertion caused by pumping; internal leak at tip
T2P_8	U1324B	t2p_8	136.3	1193.1	LF	30	Tip: III; Shaft: IIA	22 Jun	Sn4; S50-73; Z59-72; 0509-6; taper	Shaft was not stable; internal leak at tip
T2P_9	U1324B	t2p_9	368	1424.8	LF	40	Tip: III; Shaft: III	23 Jun	Sn2; S50-75; S50-74; 0509-1; taper	Communication with borehole fluids
T2P_10	U1324B	t2p_10	394.5	1451.3		30	Tip: III; Shaft: III	23 Jun	Sn2; S50-75; S50-74; 0509-1; taper	Lost communication with sensors
T2P_11	U1324B	t2p_11	593.2	1650.0	Bad data	15	Tip: III; Shaft: III	25 Jun	Sn4; S50-73; S50-74; 0509-6; taper	Tool test; weird T
T2P_12	U1324C	t2p_12	50	1105.7	LF	60	Tip: IIA; Shaft: IIA	26 Jun	Sn4; S50-73; S50-74; 0509-6; taper	Slight pressure increase caused by pumping
T2P_13	U1324C	t2p_13	100	1155.7	LF	60	Tip: IIA; Shaft: I	26 Jun	Sn4; S50-73; S50-74; 0509-6; taper	Slight pressure pulses during decay
T2P_14	U1324C	t2p_14	150	1205.7	LF	60	Tip: IIB; Shaft: IIA	26 Jun	Sn4; S50-73; S50-74; 0509-6; taper	Pressure perturbations during decay
T2P_15	U1324C	t2p_15	200	1255.7	LF	60	Tip: IIA; Shaft: I	27 Jun	Sn4; S50-73; S50-74; 0509-6; taper	Shaft has typical decay
T2P_16	U1324C	t2p_16	300	1355.7	HF	90	Tip: I; Shaft: I	27 Jun	Sn2; Z59-72; S50-75; 0509-1; taper	Typical decay on both tip and shaft
T2P_17	U1322B	t2p_17	42	1361.5	HF	60	Tip: III; Shaft: III	28 Jun	Sn2; S50-74; S50-73; 0509-1; taper	Communication with borehole fluid
T2P_18								29 Jun		Bench test
T2P_19	U1322B	t2p_19	134.3	1453.8	HF	30	Tip: IIB; Shaft: IIB	29 Jun	Sn2; S50-74; S50-73; 0509-1; taper	Nearly constant pressure during decay
T2P_20	U1322B	t2p_20	157.8	1477.3	HF	60	Tip: IIB; Shaft: IIB	29 Jun	Sn2; S50-75; S50-73; 0509-1; taper	Nearly constant shaft pressure during decay
T2P_21	U1322C	t2p_21	50	1368.9		60	Tip: III; Shaft: III	30 Jun	Sn4; S50-72; S50-75; 0509-4; taper	Memory card was ajar; no data recorded
T2P_22	U1322C	t2p_22	75	1393.9		60	Tip: III; Shaft: III	30 Jun	Sn2; S50-74; S50-73; 0509-1; taper	Flooded the electronics; no data recorded
T2P_23	U1322C	t2p_23	150	1468.9	HF	60	Tip: IIB; Shaft: IIA	1 Jul	Sn4; S50-72; S50-75; 0509-4; taper	TruView data are only available for decay phase
T2P_24	U1322C	t2p_24	200	1518.9	HF	60	Tip: I; Shaft: I	1 Jul	Sn4; S50-72; S50-75; 0509-4; taper	Typical decay on both tip and shaft
T2P_25	U1322D	t2p_25	40	1358.9	N/A	60	Tip: III; Shaft: III	2 Jul	Sn4; S50-72; S50-75; 0509-4; taper	Communication with borehole fluid

Table T1 (continued).

Deployment number	Hole	File name	Depth (mbsf)	Depth (mbsl)	TruView data	Decay time (min)	Type	Date (2005)	Tool	Remarks
T2P_26	U1322D	t2p_26	70	1388.9	LF	45	Tip: III; Shaft: III	2 Jul	Sn4; S50-72; S50-75; 0509-4; taper	Communication with borehole fluid
T2P_27	U1322D	t2p_27	100	1418.9	HF	45	Tip: IIB; Shaft: IIA	2 Jul	Sn4; S50-72; S50-75; 0509-4; taper	Pullout/void
T2P_28	U1322D	t2p_28	134	1452.9	HF	45	Tip: III; Shaft: III	2 Jul	Sn4; S50-72; S50-75; 0509-4; taper	Communication with borehole fluid; broken tip; bent drive tube

Notes: LF = low frequency data (1 min period); HF = high frequency data (1 s period), T = temperature. N/A = not available. Sequence of elements in tool column follows logger, tip transducer, shaft transducer, thermistor, and geometry. Shaft transducer and geometry are not applicable for DVTPP.

Table T2. In situ temperature and pressure results interpreted from the DVTPP and T2P deployments during IODP Expedition 308. (See table notes.)

Deployment number	Hole	BOH (mbsf)	BOH (mbsl)	u_h (MPa)	σ_v (MPa)	Decay time (min)	μ_{end} (MPa)	$\mu_0 - 1/t$ (MPa)	$\mu_0 - 1/\sqrt{t}$ (MPa)	Temperature (°C) T_{end}	Temperature (°C) $T_{1/t}$
DVTP-P1	U1320A	203.4	1673.4	16.81	18.43	42				9.22	9.10
DVTP-P2	U1320A	289.9	1759.9	17.68	20.09	13				11.08	10.90
DVTP-P3	U1324B	229.1	1285.9	12.92	14.72	50				9.49	9.47
DVTP-P4	U1324B	362.4	1419.2	14.26	17.26	47				11.68	11.63
DVTP-P6	U1324B	464.3	1521.1	15.28	19.27	34	14.80	15.07	15.69	12.96	12.82
DVTP-P7	U1324B	493.1	1549.9	15.57	19.83	31				13.40	13.25
DVTP-P8	U1324B	521.9	1578.7	15.86	20.39	41				13.81	13.67
DVTP-P10	U1324B	560.4	1617.2	16.25	21.15	32	19.97	18.41	16.58	14.54	14.42
DVTP-P12	U1324B	608.2	1665.0	16.73	22.11	61	18.80	18.39	17.69	16.09	15.70
DVTP-P13	U1324C	250	1305.7	13.12	15.11	90	14.61	14.22	13.78	10.00	9.79
DVTP-P15	U1324C	505	1560.7	15.68	20.06	93	16.84	16.74	16.74	12.31	13.50
DVTP-P17	U1322C	100	1418.9	14.25	14.95	91	14.64	14.58	14.52	7.04	6.99
DVTP-P18	U1322C	220	1538.9	15.46	17.20	62	16.28	16.35	16.45	9.84	9.75
DVTP-P19	U1322C	238	1556.9	15.64	17.55	93	16.47	16.23	15.97	10.03	10.03
DVTP-P20	U1322D	175	1493.9	15.01	16.35	60	16.28	16.16	16.01	8.45	8.43
T2P_2	U1319A	80.5	1510.1	15.17	15.71	35	15.71; 16.35	15.63; 16.25	15.54; 16.13	7.23	
T2P_3	U1320A	126.3	1596.3	16.04	17.04	52	16.27	16.23	16.17	6.99	
T2P_4	U1320A	213	1683.0	16.91	18.61	25				8.99	
T2P_5	U1324B	51.3	1108.1	11.13	11.44	34	11.37; 11.65	11.37; 11.61	11.36; 11.54	5.78	
T2P_6	U1324B	89.3	1146.1	11.51	12.11	25	12.09	12.00	11.88	6.31	
T2P_7	U1324B	117.8	1174.6	11.80	12.63	31	12.90	12.68	12.42	7.00	
T2P_8	U1324B	136.3	1193.1	11.99	12.98	30	13.23	12.96	12.67	7.35	
T2P_12	U1324C	50	1105.7	11.11	11.42	60	11.21; 11.56	11.20; 11.44	11.18; 11.31	5.66	
T2P_13	U1324C	100	1155.7	11.61	12.30	60	11.93; 12.39	11.92; 12.21	11.91; 12.01	6.65	
T2P_14	U1324C	150	1205.7	12.11	13.24	60	12.69; 13.10	12.67; 12.97	12.65; 12.82	7.57	
T2P_15	U1324C	200	1255.7	12.61	14.18	60	14.09; 14.44	13.91; 14.12	13.72; 13.77	8.58	
T2P_16	U1324C	300	1355.7	13.62	16.06	90	14.42; 15.20	14.37; 14.58	14.31; 13.87	10.29	
T2P_19	U1322B	134.3	1453.8	14.60	15.60	30	15.08; 15.22	15.02; 15.19	14.95; 15.13	7.89	
T2P_20	U1322B	157.8	1477.3	14.84	16.04	60	15.41; 15.60	15.47; 15.60	15.55; 15.59	8.47	
T2P_23	U1322C	150	1468.9	14.76	15.89	60	15.29; 15.99	15.29; 15.78	15.30; 15.55	8.26	
T2P_24	U1322C	200	1518.9	15.26	16.83	60	16.34; 17.16	16.25; 16.86	16.15; 16.54	9.28	
T2P_27	U1322D	100	1418.9	14.25	14.95	45	14.69; 15.11	14.70; 14.99	14.72; 14.87	7.11	

Notes: BOH = bottom of hole. Only deployments used to interpret the in situ conditions are included in this table. The temperature/dual pressure (T2P) probe has two pressure ports. The T2P temperature reached equilibrium with the formation temperature at the end of the deployment; therefore, no extrapolation was applied. See Table T3 for heading definitions.

Table T3. Nomenclature.

Symbol	Definition	Unit
H_w	Water depth at hole location	L
P	Fluid pressure	$M/L/T^2$
T	Temperature	θ
t	Time	T
g	Acceleration of gravity	M/T^2
μ_0	In situ pressure	$M/L/T^2$
μ_h	Hydrostatic pressure	$M/L/T^2$
μ_{end}	Final pressure	$M/L/T^2$
z	Target depth	L
λ^*	Overpressure ratio	
ρ_c	Density of fluid with drilling cuttings	M/L^3
ρ_m	Density of drilling mud	M/L^3
ρ_w	Density of seawater	M/L^3
σ_v	Overburden stress	$M/L/T^2$

Appendix A

Davis-Villinger Temperature-Pressure Probe

In Appendix A, we present the DVTPP deployments during Expedition 308, which includes five sections: (1) instruments that were used; (2) temperature calibration; (3) pressure calibration; (4) example DVTPP deployment showing the detailed deployment procedure; and (5) detailed description of each DVTPP deployment. Figures showing pressure, temperature, and TrueView data for each DVTPP deployment are in the "APP_A" folder in **"Supplementary material."**

Instruments

During Expedition 308, two data logger/pressure transducer/thermistor combinations were used: (1) logger 9368-PXDCR 88579-thermistor 0226-2 (DVTPP2) and (2) logger 9367-PXDCR 88587-thermistor 0226-3 (DVTPP3). In the "DOWNHOLE" folder in **"Supplementary material,"** PXDCR 79481 and thermistor 0226-1 were listed together with logger 9367. However, this is not correct.

Temperature calibration

Temperature calibrations were carried out on the data logger and the thermistor separately. The data logger response to resistance was determined using a highly stable resistance box that simulates the resistance variation of the thermistor over its full temperature range. The calibration coefficients of the data logger were provided by the U.S. Implementing Organization (USIO) (Table **AT1A**). Table **AT1B** presents the commercial calibration of the thermistors. The Steinhart-Hart relationship is used to describe the temperature as a function of the thermistor resistance (Table **AT1A**) (Davis et al., 1997).

During Expedition 308, the DVTPP temperature data were not always reduced correctly. For example, the DVTPP3 temperature data was calibrated using the calibration coefficients of thermistor 0226-1 (see the "DOWNHOLE" folder in **"Supplementary material"**). However, thermistor 0226-1 was not used in either of the DVTPP tools that were deployed during Expedition 308. This problem was also reported during IODP Expedition 311 (A.M. Tréhu, pers. comm., 2007). In a similar fashion for DVTPP2, the temperature calibrations of several deployments were done using coefficients of thermistor 0226-1 or 0226-3 instead of 0226-2 (see the "DOWNHOLE" folder in **"Supplementary material"**). In this report, we recalculated the temperature for all deployments using the correct calibration coefficients provided by the USIO (Table **AT1**).

Pressure calibration

The calibration factors for all pressure transducers are illustrated in Table **AT2.** The calibration factors of the pressure transducers are stored in the central processing unit of the pressure interface module mounted to the DVTPP logger. Two frequency (or period) output signals are sent from the pressure transducer. Pressure is measured with a force-sensitive quartz crystal whose output period changes with applied load. A second period output comes from a quartz crystal temperature sensor used for temperature compensation. The last calibration of the two transducers was made in 2002 by the manufacturer (Table **AT2**).

In December 2006, the USIO performed a calibration verification of the DVTPP pressure transducers using a deadweight tester that was recently calibrated by the manufacturer. DVTPP2 and DVTPP3 recorded pressures 7 and 4 psi greater, respectively, than that measured by the deadweight tester. In this report, we subtracted the average atmosphere pressure recorded by the DVTPP from the pressure data. After the correction, the calibration offsets are excluded and the DVTPP pressure is comparable to the hydrostatic pressure calculated from an assumed seawater density of 1.024 g/cm^3 in which the atmosphere pressure is not accounted.

DVTPP deployment procedure

Every DVTPP deployment is slightly different. We present DVTPP Deployment 20 to illustrate our approach to interpreting the deployment history. This deployment was at 175 mbsf in Hole U1322D. The operational sequence for this deployment is illustrated in Table **AT3,** and a graphical representation of the pressure, temperature, coreline depth, block position, accelerometer, pump strokes, coreline tension, and hookload are illustrated in FIGUREA1_1322D04.XLS in the "APP_A" folder in **"Supplementary material."** For reasons that we do not understand, some of the bit depth data shifted during deployment. Instead, we use the traveling block position to constrain movements of the drill bit during tool deployment whenever it is available. The traveling block is attached to the top end of the drill string above the rig floor. Its position was recorded in meters above rig floor.

Prior to deployment, the BHA was located 5.5 m above the bottom of the hole (BOH). The DVTPP was connected to the CDS and lowered into the borehole with the wireline (Event 1). The DVTPP was stopped at the seafloor for 5 min to record the fluid pressure and temperature in the pipe (Event 2). Fluid circulation was stopped during the tool stop to remove the effect of pump pressure on the measured pressure.

The pump flux is proportional to the pump stroke rate (1.654 gal/stroke) (Graber et al., 2002).

The CDS was then lowered by wireline (Event 3). At this time, the CDS was fully extended and hanging inside the drill pipe. The BHA was moved downward to 7 m above BOH (Event 4). As the CDS approached the BHA, it was decelerated and slowly lowered to latch into the BHA. This can be identified by a sharp decrease in coreline tension (Event 5). For this deployment, when fully extended the CDS was 21.84 m including the DVTPP probe. When the CDS was fully retracted, the tip of the DVTPP extended 1.1 m below the BHA. This length can vary depending on how many spacers (92 cm long) are connected to the DVTPP. The CDS was retracted ~2 m when latched in (Event 5).

Next, the BHA was lowered to further retract the CDS stoke (Event 6). The probe was pushed into the formation. This induced increases in pressure and temperature after the CDS was fully retracted. The operator stopped the insertion when the hookload dropped by ~5,000 lb (Event 7), indicating that the BHA reached BOH or that the formation is too firm for further penetration. In this case, the probe was pushed ~1.1 m into the formation. Subsequently, the BHA was raised 2.4 m and the CDS was partially extended to decouple the DVTPP from the BHA (Event 8).

In this deployment, the tool was left in place for 60 min. Tool acceleration was recorded during the deployment, which is a measure of tool movement during the dissipation phase. The tool was then recovered by wireline (Event 9) and stopped at the mudline for 5 min to register the fluid pressure in the pipe (Event 10).

DVTPP deployments during Expedition 308

Deployment 1: Hole U1320A, 203.4 mbsf

Table **AT4** and FIGUREA2_1320A24.XLS in the "APP_A" folder in **"Supplementary material"** present the sequence of operations and the tool response to particular events for DVTPP Deployment 1. Fluid circulation was kept on for the entire deployment. The tool was stopped at the seafloor for 10 min to record the fluid pressure in the pipe. When the probe was pushed into the formation, the temperature and pressure increased. After the penetration pressure pulse, the pressure decreased rapidly and erratically. The last pressure reading was 1 MPa less than the hydrostatic pressure.

We interpreted that this was caused by an internal hydraulic leak in the DVTPP; when pressure reached a high value, fluid leaked into the pressure housing, causing a rapid decrease. The pressure then slowly increased and leakage once again occurred. Because of the internal leak, no in situ pressure can be ascertained. Unfortunately, this internal leak was not identified and fixed until DVTPP Deployment 4. The temperature record appears reasonable. The last temperature reading was 10.2°C. However, the accelerometer recorded slight tool movement throughout the dissipation phase. The tool movements resulted in a very slight oscillation (magnitude < 0.01°C, period ≈ 50 s) in the temperature record. This suggests minor coupling (through the CDS) with the BHA. The frictional heat caused by tool movement may have affected the temperature measurement.

Deployment 2: Hole U1320A, 289.9 mbsf

Table **AT5** and FIGUREA3_1320A33.XLS in the "APP_A" folder in **"Supplementary material"** present the sequence of operations and the tool response to particular events for DVTPP Deployment 1. As the probe was pushed into the formation, the temperature and pressure increased. The pressure then decreased rapidly to less than the hydrostatic pressure. Once again, an internal leak is interpreted to be present; no in situ pressure can be inferred from Deployment 2. The temperature record was reasonable, and the last temperature reading was 11.08°C. The accelerometer recorded tool movements throughout the dissipation phase. The frictional heat caused by tool movement may have affected the temperature measurement.

Deployment 3: Hole U1324B, 229.1 mbsf

Table **AT6** and FIGUREA4_1324B27.XLS in the "APP_A" folder in **"Supplementary material"** present the sequence of operations and the tool response to particular events for DVTPP Deployment 3. The TruView data are missing for this deployment. Key deployment events are derived from the shipboard DVTPP Downhole Tool Data Sheet (see the "DOWNHOLE" folder in **"Supplementary material"**) and the pressure and temperature data.

When the probe was pushed into the formation, the temperature and pressure increased. After the penetration pressure pulse, the pressure decreased rapidly and erratically. Because of the internal leak, no in situ pressure could be inferred from Deployment 3. The temperature record looks reasonable, and the last temperature reading was 9.5°C. The accelerometer recorded tool movements throughout the dissipation phase. The tool movements resulted in a slight oscillation (magnitude ≈ 0.05°C, period ≈ 1 min) in the temperature record. This most likely was due to some coupling between the BHA and the tool. The frictional heat caused by tool movement may have affected the temperature measurement.

Deployment 4: Hole U1324B, 362.4 mbsf

Table AT7 and FIGUREA5_1324B45.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 4. The TruView data do not match this deployment. Key deployment events are derived from the shipboard DVTPP Downhole Tool Data Sheet (see the "DOWNHOLE" folder in "Supplementary material") and the pressure and temperature data.

As the pressure decay started, the pressure decreased rapidly and erratically. This was the fourth consecutive deployment where erratic pressures were recorded. After this deployment the tool was inspected and an internal hydraulic leak was found and fixed. No in situ pressure could be inferred from Deployment 4 because of the leak. The temperature record was reasonable, and the last reading was 11.68°C. The temperature record had a very slight oscillation (magnitude ≈ 0.01°C, period ≈ 1 min) during the dissipation phase, whereas the accelerometer did not record significant tool acceleration. This indicates some minor coupling between the BHA and the tool.

Deployment 5: Hole U1324B, 387.9 mbsf

No data were recorded for this deployment.

Deployment 6: Hole U1324B, 464.3 mbsf

Table AT8 and FIGUREA6_1324B59.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 6. The TruView data do not match this deployment. Key deployment events are derived from the shipboard DVTPP Downhole Tool Data Sheet (see the "DOWNHOLE" folder in "Supplementary material") and the pressure and temperature data.

As the probe was pushed into the formation, the temperature and pressure increased (Table AT8). When the BHA was lifted to decouple the BHA through the CDS, the pressure decreased dramatically to subhydrostatic pressure. A pressure rebound then occurred. We interpret that the tool was pulled up with the BHA, creating a void around the probe tip. As the void equilibrated with the formation, the pressure increased to 14.86 MPa at the end of the deployment. This deployment recorded a good temperature decay curve. The last temperature reading was 12.96°C.

Deployment 7: Hole U1324B, 493.1 mbsf

Table AT9 and FIGUREA7_1324B62.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 7. The TruView data do not match this deployment. Key deployment events are derived from the onboard DVTPP Downhole Tool Data Sheet (see the "DOWNHOLE" folder in "Supplementary material") and the pressure and temperature profiles.

As the probe was pushed into the formation, the temperature and pressure increased (Table AT9). After penetration, the pressure decreased to a value significantly below hydrostatic pressure and then slowly rebounded to a final value of 12.72 MPa. The pressure data may be explained by either a slow tool pullout after penetration or penetration in a dilatant sediment. Core photos show that the sediment at this location is clayey silt to silt. Probe penetration could generate an annular dilation zone around the probe, which could have significant negative excess pore pressure. The drop to subhydrostatic pressure may reflect this negative excess pore pressure migrating to the pressure port. The temperature record looks very good, and the last temperature reading was 13.4°C.

Deployment 8: Hole U1324B, 521.9 mbsf

Table AT10 and FIGUREA8_1324B64.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 8. The measured pore pressure was less than the hydrostatic pressure throughout the deployment, and there was no record of penetration. As a result, during the next DVTPP deployment, the DVTPP3 was deployed and the DVTPP2 was rebuilt.

The temperature record was reasonable. The last temperature reading was 13.84°C. However, the DVTPP Downhole Tool Data Sheet (see the "DOWNHOLE" folder in "Supplementary material") documented a tool pullout operation 5 min after the end of the penetration. At this time, the BHA moved upward 4 m and the hookload increased. The BHA then moved upward 2 m and lowered and raised again. All of this occurred during the dissipation phase. The raising and lowering of the BHA were recorded by increases and decreases in the hookload and the accelerometer record. The thermistor did not record any significant temperature change during those operations. A second pullout occurred 41 min after the penetration. These observations suggest that the first "pullout" and the following bit movements were within the retraction/extension limit of the CDS and thus did not cause significant tool movement.

Deployment 9: Hole U1324B, 541.1 mbsf

A programming error occurred during this deployment and no data were recorded.

Deployment 10: Hole U1324B, 560.4 mbsf

Table AT11 and FIGUREA9_1324B68.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 8. Pressure and temperature both increased sharply during penetration. When the BHA was lifted to decouple the BHA, the pressure decreased rapidly by ~1 MPa and then decayed to a value of 20 MPa while the tool was in the formation. The pressure decayed linearly with time, which was unusual. Additionally, the pressure did not decrease to atmospheric pressure when the DVTPP was raised to the rig floor. In situ pressure may not be inferred from this deployment. The temperature decreased to 15.69°C prior to pullout.

Deployment 11: Hole U1324B, 589.2 mbsf

Table AT12 and FIGUREA10_1324B72.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 11. The temperature and pressure sensors both recorded unreliable data during this deployment.

Deployment 12: U1324B, 608.2 mbsf

Deployment 12 was completed at the base of the hole. Table AT13 and FIGUREA11_1324B74.XLS in the "APP_A" folder in "Supplementary material"present the sequence of operations and the tool response to particular events for this deployment. The pressure increased during penetration and then quickly declined, followed by a rapid recovery. The bit movement and acceleration record suggest that the quick pressure drop was related to the decoupling of the tool from the drill string after the insertion, and the rapid recovery was due to reset of the tool on its own weight. The pressure then followed a dissipation profile to a final pressure of 18.9 MPa. The temperature record continuously decayed to a low value of 17.2°C and then slightly increased to 17.34°C. The last temperature reading was 17.15°C. The accelerometer recorded tool movements throughout the dissipation phase. We interpret a coupling between the BHA and the tool. The oscillating pressure and the odd temperature record were caused by tool movements.

Deployment 13: Hole U1324C, 250 mbsf

Table AT14 and FIGUREA12_1324C05.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 13. Similar to Deployment 12, this deployment also recorded tool movement during the dissipation phase. No sharp pressure drop was recorded when the drill bit was raised after insertion. The temperature record increased slightly during the dissipation phase, and the last temperature reading was 11.01°C. This reading may not reflect the formation temperature due to the influence of the tool movement. The pressure also slightly increased during dissipation and then subsided to an end value of 14.7 MPa. This pressure increase may affect the estimate of the formation pressure.

Deployment 14: Hole U1324C, 405 mbsf

Table AT15 and FIGUREA13_1324C07.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 14. The tool insertion generated a relatively small pressure pulse for this depth. The pressure dropped rapidly when the drill bit was lifted. The pressure then rebounded to a final value of 15.82 MPa, which was very close to the recorded pressure at BOH prior to the penetration. The temperature increased when the drill bit was lifted and then decreased rapidly to a value close to the borehole fluid temperature. Near the end of the deployment, the temperature increased to a final value of 11.38°C. The temperature increase was most likely due to tool movement, which can be identified on the acceleration data. We interpret that tool dislodgement weakened the seal around the probe and created communication with the borehole fluid. The sensors recorded the pressure and temperature of the borehole fluids instead of in situ conditions.

Deployment 15: Hole U1324C, 505 mbsf

Table AT16 and FIGUREA14_1324C08.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 15. Similar to Deployment 14, the tool insertion generated a relatively small pressure pulse for this depth. The pressure decreased rapidly when the drill bit was lifted. The pressure then rebounded to a nearly constant value. The temperature only slightly decreased after penetration and then increased to a high value (higher than its penetration temperature) at the end of the deployment. We interpreted that the tool surface temperature was lower than the formation temperature during penetration. The tool temperature had to increase to equilibrate with the formation. The end temperature was 13.5°C.

Deployment 16: Hole U1322B, 166.7 mbsf

Table AT17 and FIGUREA15_1322B19.XLS in the "APP_A" folder in "Supplementary material" present the sequence of operations and the tool response to particular events for DVTPP Deployment 16. The temperature and pressure increased when the CDS latched in position. This suggests that the tip went into the formation slightly while the CDS was latching in. When the drill bit was lowered to insert the tool, it recorded a second temperature and pressure increase. Pressure decreased rapidly when the drill bit was lifted. The pressure then quickly rebounded to a near-constant value that was very close to the recorded pressure at BOH prior to penetration. There may have been communication with the borehole fluid. The temperature dropped rapidly and then slowly increased to 9.06°C. The end temperature of 9.06°C was not representative of in situ conditions.

Deployment 17: Hole U1322C, 100 mbsf

Table AT18 and FIGUREA16_1322C02.XLS in the "APP_A" folder in **"Supplementary material"** present the sequence of operations and the tool response to particular events for DVTPP Deployment 17. The bit depth dramatically shifted during this deployment, and the block position data are not available. The pressure decreased rapidly after the insertion spike and then slowly dissipated to a final value of 14.73 MPa. This dissipation curve may be extrapolated to estimate in situ pressure. The temperature record had good insertion spike and continuous decay curve. The last temperature reading was 7.04°C.

Deployment 18: Hole U1322C, 220 mbsf

Table AT19 and FIGUREA17_1322C03.XLS in the "APP_A" folder in **"Supplementary material"** present the sequence of operations and the tool response to particular events for DVTPP Deployment 18. The pressure increased during penetration and then decreased abruptly when the drill bit was lifted. The pressure then rebounded slowly to a final value of 16.36 MPa. Modeling of the rebound curve may constrain the in situ pressure. The temperature record had good insertion spike and continuous decay curve. The temperature decayed to 9.11°C at the end of deployment.

Deployment 19: Hole U1322C, 238 mbsf

Table AT20 and FIGUREA18_1322C04.XLS in the "APP_A" folder in **"Supplementary material"** present the sequence of operations and the tool response to particular events for DVTPP Deployment 19. The pressure increased during penetration and decreased abruptly when the bit was picked up off BOH. Pressure then slowly dissipated to a final value of 16.55 MPa. Extrapolation of the pressure record may provide an estimate of the in situ pressure. The temperature record had good insertion spike and continuous decay curve. The temperature decayed to 10.03°C at the end of deployment.

Deployment 20: Hole U1322D, 175 mbsf

Table AT3 and FIGUREA1_1322D04.XLS in the "APP_A" folder in **"Supplementary material"** present the sequence of operations and the tool response to particular events for DVTPP Deployment 20. Both pressure and temperature profiles had good insertion spikes and continuous decay curves. The pressure dissipated to 16.37 MPa and the temperature dissipated to 8.68°C at the end of the deployment. Extrapolation of the pressure record will provide estimate of the in situ condition.

Appendix B

Temperature/dual pressure probe

This appendix presents the T2P deployments made during Expedition 308 in four parts: (1) instruments used; (2) temperature calibration; (3) pressure calibration; and (4) detailed description of each T2P deployment. Figures showing pressure, temperature, and TrueView data for each T2P deployment are in the "APP_B" folder in **"Supplementary material."**

Instruments

During Expedition 308, two types of penetrometer tips (Fig. F4), two data loggers, six pressure transducers, and five thermistors were used in combination to form the T2P probes that measured the formation pressure and temperature (Table T1).

Temperature calibration

Temperature calibrations were carried out on the data logger and thermistor separately. The data logger response to resistance was determined using a highly stable resistance box that simulates the resistance variation of the thermistor over its full temperature range. The calibration coefficients of the data logger were provided by the USIO prior to the expedition (Table AT21A). Table AT21B presents the commercial calibration of the thermistors prior to the cruise. Accuracy of the presented data is ±0.05°C between –40° and 125°C. The Steinhart-Hart relationship is used to describe the temperature as a function of the thermistor resistance (Table AT21A) (Davis et al., 1997).

Pressure calibration

The T2P measures pore pressure with steel pressure transducers. The force on the sensing element due to the pressure results in a deformation of the sensing element and a change in the output signal.

Onboard calibration

Five out of six pressure transducers were calibrated using a witness pressure transducer provided by the USIO and a high-pressure oil pump in the downhole tools laboratory on the drillship prior to deployment. We ran the pump pressure from atmospheric pressure to 5000 psi and then stepped down to atmospheric pressure. The hysteresis was insignificant (Fig. AF1). The calibration curve is a straight line that can be characterized by its slope and its intersection on the *y*-axis (Fig. AF1; Table AT22).

Problems in the pressure calibration

All transducers were flooded with seawater whenever the tip of the T2P was broken. The seawater that leaked into the transducer weakened the insulation of the circuit inside the transducer, and the transducers became unstable, rendering the original pressure calibrations invalid.

To remove the moisture and stabilize the pressure transducers on the drill ship, the transducers were oven-dried at up to 60°C for up to 24 h before reuse. After oven drying, the slope of the calibration curve showed no significant change, but the intersection on the *y*-axis was subject to change (Table AT22). We did not recalibrate the transducers each time after being flooded. Therefore, we needed a systematic approach to correct any potential errors related to the change of the intersection as a result of oven drying.

Furthermore, analysis of pressure data calibrated according to the onboard calibrations showed that certain transducers were very sensitive to operating temperature. As an example, for onboard pressure calibration of T2P Deployment 1 (a tool test in water column) (see FIGUREB7_T2P_DEPLOY1.XLS in the "APP_B" folder in "Supplementary material") the measurements were made at temperatures from 4° to 27°C. The tip pressure reading was in good agreement with the hydrostatic pressure calculated by assuming an average fluid density of 1.024 g/cm³. The shaft pressure reading matched the tip pressure closely at ~20°C, the temperature at which the transducers were calibrated. However, at significantly colder temperature, there was discrepancy between the tip and shaft pressures. The discrepancy varied with water temperature, up to 0.6 MPa at ~5°C. In this example, the shaft pressure transducer was much more sensitive to temperature than the tip transducer.

The "compensated temperature range" of the T2P pressure transducers is from 25° to 235°C. Out of this range, the slope (*S*) and intersection (*I*) of the calibration curve are subject to change because of variation in temperature (Fig. AF2). The onboard calibrations were done at the room temperature of the downhole tools laboratory on the vessel. These calibrations are not sufficient to describe the behavior of the transducers over the operating temperature range of the tool. Therefore, the temperature influence on the calibration curve must be tested to achieve accurate pressure calibration.

Postcruise calibration

Two pressure transducers were lost during postcruise shipment between laboratories. We checked the performance of the four available transducers before the recalibration. They were not stable and performed differently on different channels and data loggers. This was similar to the behavior observed immediately after transducers were flooded on the ship. We interpret this as being caused by the salt left in the transducers when they were flooded during deployments.

To correct for this problem, the transducers were baked at 55°C in an oven prior to recalibration to stabilize the transducers. Three of the four available transducers were very stable after oven drying.

In March 2007, we recalibrated the T2P pressure transducers using the same deadweight tester that was used to verify the calibrations of the DVTPP pressure transducers (see "Appendix A"). Calibrations were conducted at controlled temperatures to explore the influence of temperature on the slope and intersection of the calibration curve.

We ran the deadweight tester pressure from atmospheric pressure to 4015 psi and then stepped down to atmospheric pressure. The hysteresis was insignificant and the calibration curves were straight lines (Fig. AF3). No significant difference was observed between loggers Sn2 and Sn4 or between the tip pressure channel and the shaft pressure channel.

The results show that the slope and intersection of the calibration curve are linear functions of temperature (Figs. AF4, AF5, AF6). These relationships allow us to confidently interpret the calibration coefficients (slope and intersection of the calibration curve) for any given temperature within the range.

Recalibration of the T2P pressure data

We present the T2P deployment in the water column (T2P 1) to illustrate how we recalibrated the T2P pressure data using the postcruise calibrations (see FIGUREB7_T2P_DEPLOY1.XLS in the "APP_B" folder in "Supplementary material"). The two pressure transducers (S50-73 at the tip and Z59-72 at the shaft) were recalibrated under controlled temperatures. We used the temperature measured at the T2P tip thermistor to determine the calibration coefficients from the trendlines in Figures AF4 and AF5. We then applied the calibration coefficients to calculate the pressure from the transducer reading.

Neither of the calculated tip and shaft pressures match the hydrostatic pressures at the tool stops. We interpret this is caused by changes of the intersection due to oven drying (Table AT22). The offset from hydrostatic pressure is a constant value regardless of the operating temperature for both transducers. This suggests that the change in the intersection caused by the effects of oven drying is constant for any given deployment (e.g., a constant vertical shift of the *I*-*T* relationship presented in Figs. AF4B, AF5B, and AF6B).

The offset was corrected by matching the tip and shaft pressure records to the hydrostatic pressure at tool stops. After this correction, the tip pressure matches the shaft pressure very well. The hydrostatic pressures at tool stops are calculated from an assumed seawater density of 1.024 g/cm^3 in which the atmosphere pressure is not accounted.

For the three pressure transducers not recalibrated under controlled temperatures, we applied the calibration coefficients obtained from the onboard calibration tests (Table AT22). We then compared these to the pressure data of one of the recalibrated transducers (S50-73, S50-75, and Z59-72). We took the difference between the tip and the shaft pressures as a function of the temperature measured at the probe tip. The temperature influence and the shift of the intersection (a constant value) were then compensated by applying this function (see FIGUREB15_T2P_DEPLOY8.XLS and FIGUREB22_T2P_DEPLOY16.XLS in the "APP_B" folder in "Supplementary material").

T2P deployment procedure

The deployment procedure of the T2P is similar to that of the DVTPP (see "Appendix A"). We integrate TruView data, the shipboard T2P Deployment Log Sheet (see the "DOWNHOLE" folder in "Supplementary material"), and pressure and temperature records to define operation events and understand field measurements.

T2P deployments during Expedition 308

Deployment 1: Hole 1319A, tool test in water column

Deployment 1, completed in the water column prior to drilling, was the first sea deployment of the T2P probe. The deployment was intended to pressure test the T2P probe, to check the pressure transducer calibrations, and to confirm that the T2P probe could successfully pass through the lockable flapper valve (LFV) of the BHA.

The time-event log for T2P Deployment 1 is illustrated in Table AT23, and a graphical representation of the pressure and temperature records is illustrated in FIGUREB7_T2P_DEPLOY1.XLS in the "APP_B" folder in "Supplementary material." The T2P was lowered until the tip was 511 meters below sea level (mbsl), where a hydrostatic reference was recorded for 2 min. The tool was then lowered until the tip was at 1011 mbsl for another 2 min reference. The T2P probe was then lowered through the LFV. The T2P probe tip reached a maximum depth of 1387.5 mbsl (42.1 m above seafloor), where a 7 min reference was recorded. References were also taken during retrieval of the T2P probe when the tip was at 1010 mbsl and at 511 mbsl. No drilling fluid was circulated during the deployment.

The tool test was successful. The tool recorded pressure and temperature for the entire deployment and successfully passed through the LFV. The temperature record showed a downhole decrease in temperature to 4.58°C at 1387.5 mbsl.

Deployment 2: Hole U1319A, 80.5 mbsf

Table AT24 and FIGUREB9_T2P_DEPLOY2.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 2. Traveling block position data are not available for this deployment. The bit depth data dramatically shifted during this deployment. Drilling fluid circulation was stopped when taking the hydrostatic reference, when pushing the probe into the sediment, and for the first 12 min the T2P probe was in the sediment. Fluid circulation resumed 12 min after the penetration at 14 strokes per minute (spm). Corresponding to the onset of fluid circulation, both the tip and shaft pressures increased very slightly (<0.01 MPa).

The temperature and pressure records increased when the CDS was latching into position (Table AT24). This response suggests the tool entered the formation while positioning the CDS to the retracted position. When the drill bit was lowered to insert the tool, it recorded a second temperature and pressure increase. Pressure and temperature records varied during the penetration process. We believe these variations were due to variations of the soil properties. After 35 min in the formation, pressure at the tip was 15.71 MPa, whereas the shaft recorded pressure of 16.35 MPa. Extrapolation of the pressure records may provide an estimate of the in situ pressure. The temperature record provided an in situ formation temperature of 7.23°C at the end of the deployment.

When the T2P probe was recovered on the rig floor, the shroud was not covering the tip. The tip of the tool was damaged and the themistor was missing. The drive tube was bent slightly. We interpret that the shroud never reseated over the tip during retrieval of the tool. Damage of the tip was interpreted to result from bending of the tip during penetration followed by a straightening of the tip when the T2P probe was pulled through the LFV in the BHA. Most likely, the T2P probe and drive tube were damaged because the T2P probe did not enter the sediment vertically. To achieve vertical penetration, future deployments occurred with the drill bit <2 m off BOH instead of 12 m.

Deployment 3: Hole U1320A, 126.3 mbsf

Table AT25 and FIGUREB10_T2P_DEPLOY3.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 3. In contrast to Deployment 2, Deployment 3 used the tapered needle probe and was initiated with the drill bit ~1 m off BOH. These modifications were done to decrease the chance for bending or breaking the needle probe. The quality of the bit depth data is poor. The absolute bit depth value is not reliable. To explore the bit movement during the deployment, the bit depth data have to be used together with Table AT25.

The T2P probe recorded temperature and pressure at the tip, whereas the shaft transducer did not record any data during the deployment. The temperature and pressure records increased while positioning the CDS to retracted position. When the drill bit was lowered to insert the tool, it recorded a second temperature and pressure increase. The tip pressure decreased abruptly when the drill bit was lifted. The fluid circulation resumed at 10 spm 5 min after penetration. No significant pressure and temperature responses were observed as a result of the onset of fluid circulation. Pressure dissipation was recorded at the tip until the probe was pulled out of the formation. The last recorded pressure was 16.27 MPa. Extrapolation of the pressure records will provide an estimate of the in situ pressure. The temperature decay was continuous and provided an in situ formation temperature of 6.99°C.

Deployment 4: Hole U1320A, 213.0 mbsf

Table AT26 and FIGUREB11_T2P_DEPLOY4.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 4. Deployment 4 used the straight needle probe. Operational procedures were similar to Deployment 3 except we did not use the drill string to push the T2P into the formation. Instead, we used the weight of the tool to push the tool into the formation. The tip pressure and temperature recorded spikes during penetration by the tool weight, whereas the shaft pressure did not record any penetration response. This indicates that the shaft pressure port did not go into the formation throughout the deployment. Fluid circulation resumed 6 min after the insertion spike, causing slight increases in both pressure and temperature. The final tip pressure was 17.19 MPa, the same as the shaft pressure. This suggests that the borehole fluid communicated with the tip pressure because of the short penetration distance (<0.25 m). The temperature reached an equilibrium value of 8.99°C. The temperature measurement may be subject to the influence of the borehole fluid.

Deployment 5: Hole U1324B, 51.3 mbsf

Table AT27 and FIGUREB12_T2P_DEPLOY5.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 5. The bit depth data shift dramatically, whereas the bit movement directions match the bit movements recorded in the T2P log sheet. To explore the bit position during the deployment, the bit depth data should be used together with Table AT27.

The BHA was positioned 0.5 m off BOH before the CDS latch-in. The temperature and pressure records increased while positioning the CDS to the retracted position. According to the tool dimensions, the T2P tip went into the formation by ~0.6 m at the latch-in position. The drill bit was lowered to 0.25 m off BOH at the end of penetration. The tool only recorded slight temperature and pressure increases due to the 0.25 m further insertion. The fluid circulation resumed 10 min after the penetration at 9 spm. Corresponding to the onset of fluid circulation, both the tip and shaft sensors recorded a slight pressure increase (<0.05 MPa). The tip and shaft pressures were generally constant during the dissipation phase. The tip had a final pressure of 11.37 MPa, and the shaft had a final pressure of 11.65 MPa. The temperature record continuously decayed to an equilibrium temperature of 5.78°C.

Upon pulling the tool out of the formation, all sensor readings were lost. At the rig floor, it was noted that the tip was bent and the thermistor and bottom porous stone were missing from the tool. We believed the tool may have been bent during penetration and then broken during the pullout when all sensor readings were lost. The pressure and temperature measurements should be viewed cautiously because of the damage incurred during the deployment.

Deployment 6: Hole U1324B, 89.3 mbsf

Table AT28 and FIGUREB13_T2P_DEPLOY6.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 6. The pressure and temperature records showed three spikes. The first spike occurred when the tool landed in the BHA, the second pulse occurred when the tool was pushed into the formation, and the third pulse occurred when circulation began while the tool was in the sediment. The shaft pressure reading continuously dissipated to its end value of 12.09 MPa. The tip pressure was not smooth and went close to or below the hydrostatic pressure after each pulse. We interpreted that there was an internal hydraulic leak at the tip. The temperature record was reasonable after the first two pulses, whereas it showed a rapid decrease after the third pulse. The last temperature reading was 5.74°C, which was even lower than the borehole fluid temperature (5.98°C) that was recorded prior to the first spike. We use the temperature data after the second spike to constrain the in situ temperature.

Deployment 7: Hole U1324B, 117.8 mbsf

Table AT29 and FIGUREB14_T2P_DEPLOY7.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 7. Similar to Deployment 6, the pressure and temperature records all showed responses to latching of the tool in the BHA, pushing into to the formation, and turning on circulation while in the formation. The internal leak at the tip pressure was not identified and repaired in Deployment 7. The shaft pressure reading had a continuous dissipation curve to its end value of 12.84 MPa after the third spike. The temperature record exhibited a type decay curve and provided an in situ temperature of 7.00°C.

Deployment 8: Hole U1324B, 136.3 mbsf

Table AT30 and FIGUREB15_T2P_DEPLOY8.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 8. The shaft pressure was not stable during this deployment, with multiple abrupt increases and decreases in pressure that were not associated with deployment events. The tip pressure and temperature records showed responses to latching of the tool in the BHA, pushing into to the formation, and backing-off the drill bit after penetration. The hydraulic leak at the tip pressure resulted in erratic dissipation curve. The temperature decay was smooth and provided an in situ temperature of 7.35°C. The tool was disassembled and reassembled after this deployment because of the poor pressure readings on both transducers.

Deployment 9: Hole U1324B, 368 mbsf

Table AT31 and FIGUREB16_T2P_DEPLOY9.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 9. This deployment recorded large pressure and temperature increases with the landing of the tool in the BHA. After a short period of decay, the tool was pulled out of the formation by pulling the wireline up. The pressure abruptly dropped to the borehole fluid pressure. The temperature increased abruptly first and then decreased to the borehole fluid temperature. The pressure and temperature had similar responses when pushing the tool into the formation. The abrupt pressure decrease was caused by backing-off the drill bit. The pressure and temperature records suggest that the tool was measuring the pressure and temperature of the borehole fluid. No in situ conditions can be ascertained from this deployment.

Deployment 10: Hole U1324B, 394.5 mbsf

The connection between the sensors and the data acquisition system had poor contact. This precluded collection of any data.

Deployment 11: Hole U1324B, 593.2 mbsf

Table AT32 and FIGUREB17_T2P_DEPLOY11.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 11. All connections were cleaned and the tool was reassembled because of the communication problem during Deployment 10. Deployment 11 was a test of the sensors and data acquisition system and did not involve pushing the probe into the sediment. The coreline depth and hook load data were not reliable during this deployment. The tip pressure showed excellent agreement with the shaft pressure. Two pressure decreases occurred in the tip pressure. These may have been caused by the tip being partly embedded in the sediment, whereas the shaft had not penetrated the formation. Overall this deployment confirmed that the electronic failure had been fixed.

Deployment 12: Hole U1324C, 50 mbsf

Table AT33 and FIGUREB18_T2P_DEPLOY12.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 12. The bit depth data had a dramatic shift and was not reliable. To explore the bit movement during the deployment, the bit depth data should be used together with Table AT33. The temperature and pressure records increased while positioning the CDS to the retracted position. When the drill bit was lowered to insert the tool, further temperature and pressure responses were recorded. Pressure and temperature records varied during the penetration process. These variations were due to variations of the sediment properties. The tip and shaft pressures decreased when the BHA was lifted; however, the magnitude of the decreases was small (<0.1 MPa). At the same time, the thermistor recorded a rapid increase in temperature. Fluid circulation resumed 8 min after the penetration at 10 spm. Corresponding to the onset of fluid circulation, both the tip and shaft pressures slightly increased. Then all sensors recorded a gradual dissipation. The tip measurement had an end value of 11.21 MPa. The shaft measurement had an end value of 11.56 MPa. Extrapolation of the pressure records will provide an estimate of the in situ pressure. The temperature decayed to an equilibrium temperature of 5.66°C.

Deployment 13: Hole U1324C, 100 mbsf

Table AT34 and FIGUREB19_T2P_DEPLOY13.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 13. All sensors had significant increases associated with pushing the tool into the sediment. The tip and shaft pressures decreased when the BHA was lifted, whereas the magnitude of the decrease was much larger at the tip. As the same time, the thermistor recorded a small increase in temperature. All sensors recorded a gradual dissipation. The tip had an end value of 11.93 MPa, and the shaft had an end value of 12.39 MPa. Extrapolation of the pressure records will provide an estimate of the in situ pressure. The temperature decayed to an equilibrium temperature of 6.65°C.

Deployment 14: Hole U1324C, 150 mbsf

Table AT35 and FIGUREB20_T2P_DEPLOY14.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 14. Similar to Deployment 13, pressure and temperature increased with insertion into the formation, followed by dissipation curves. All sensors recorded two perturbations while in the formation that could not be associated with any deployment event. After the last perturbation, the shaft pressure continued along a normal dissipation curve, whereas the tip showed a larger pressure decrease followed by a pressure increase. The tip measurement had an end value of 12.69 MPa. The shaft measurement had an end value of 13.10 MPa. The pressure records likely can be used to evaluate the in situ pressure. The temperature (7.57°C) appeared to be in equilibrium with the formation prior to pulling the tool out off BOH.

Deployment 15: Hole U1324C, 200 mbsf

Table AT36 and FIGUREB21_T2P_DEPLOY15.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 15. The temperature and pressure records increased while positioning the CDS to the retracted position. When the drill bit was lowered to insert the tool, it recorded further temperature and pressure responses. The tip and shaft pressures rapidly decreased when the BHA was backing-off the BOH. At the same time, the thermistor recorded a rapid increase in temperature. The shaft then continued along a normal dissipation curve, whereas the tip showed a pressure rebound followed by a gradual dissipation. The tip measurement had an end value of 14.09 MPa. The shaft measurement had an end value of 14.44 MPa. The pressure records can be used to evaluate the in situ pressure. The temperature decayed to an equilibrium temperature of 8.58°C.

All sensors lost communication with the data acquisition unit during retrieval of the tool from the formation. When the tool reached the rig floor, the tip was bent and the drive tube was loose. The loose drive tube most likely caused the failure to record data during the retrieval as the sensor cables were routed through the drive tube where they were connected with the data acquisition unit.

Deployment 16: Hole U1324C, 300 mbsf

Table AT37 and FIGUREB22_T2P_DEPLOY16.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 16. The temperature and tip pressure records increased while positioning the CDS to the retracted position. When the drill bit was lowered to insert the tool, it recorded further temperature and pressure responses. Pressure and temperature records varied during the penetration process. These variations were due to variations of the soil properties and penetration rate. The pressure and temperature sensors recorded continuous dissipation curves. The end temperature of 10.29°C was equilibrated with the formation. The end shaft pressure was 15.2 MPa, and the end tip pressure was 14.42 MPa. Extrapolation of the pressure records will provide an estimate of the in situ pressure.

Deployment 17: Hole U1322B, 42 mbsf

Table AT38 and FIGUREB23_T2P_DEPLOY17.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 17. When the drill bit was lowered to insert the tool, it recorded temperature and pressure responses. However, the pressure signals decreased significantly when backing-off the drill bit. The pressures were constant during the dissipation phase and were equal to the pressure recorded prior to the tool insertion. The temperature record showed a second spike when backing-off the drill bit and then decayed to a temperature that was close to the borehole fluid temperature. These observations suggest that the tool was communicating with the borehole fluid. Therefore, this deployment did not provide any constraint on in situ conditions.

Deployment 19: Hole U1322B, 134.3 mbsf

Table AT39 and FIGUREB24_T2P_DEPLOY19.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 19. The temperature and pressure records increased while positioning the CDS to the retracted position. When the drill bit was lowered to insert the tool, it recorded further temperature and pressure responses. Pressure and temperature records varied during the penetration process. These variations were due to variations of the sediment properties. The tip and shaft pressures abruptly decreased when the BHA was backing-off the BOH. At the same time, the thermistor recorded a rapid increase. After this perturbation, the tip and shaft pressure rapidly rebounded to nearly constant values. The end shaft pressure was 15.22 MPa, and the end tip pressure was 15.08 MPa. The temperature decayed to an equilibrium temperature of 7.89°C.

Deployment 20: Hole U1322B, 157.8 mbsf

Table AT40 and FIGUREB25_T2P_DEPLOY20.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 20. The temperature and pressure records increased during the first landing attempt with the bit 12 m off BOH, then the tool was pulled back up to reland it with the bit 3 m off the BOH. Fluids were circulated during landing of the tool in the BHA. When the drill bit was lowered to insert the tool, it recorded further temperature and pressure responses. The tip and shaft pressures abruptly decreased when the BHA was backing-off the BOH. At the same time, the thermistor recorded a rapid increase. After this perturbation, the tip pressure rapidly rebounded to a value and then slowly built up to an end pressure of 15.41 MPa. The shaft pressure rapidly rebounded to a nearly constant value of 15.60 MPa. The end pressures may provide a rough estimate of the in situ pressure. The temperature decayed to an equilibrium temperature of 8.47°C.

Deployment 21: Hole U1322C, 50 mbsf

A data acquisition error resulted in only 3 min of recorded data. Inspection of the data acquisition unit after recovering the probe revealed that the memory card was dislodged and thus data could not be recorded. The memory card was replaced, and the quick release button for the card was removed. This modification made it harder for the memory card to be accidentally ejected.

Deployment 22: Hole U1322C, 75 mbsf

This deployment suffered from a hydraulic leak that flooded the electronics connecting the pressure transducers and the thermistor to the data acquisition unit. The flooding shorted all circuits; therefore, no pressure and temperature data were recorded. All electrical components were cleaned and dried after the deployment.

Deployment 23: Hole U1322C, 150 mbsf

Table AT41 and FIGUREB26_T2P_DEPLOY23.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 23. TruView data are only available for the dissipation phase. Temperature and pressure signals increased with landing of the tool in the BHA and again with penetration into the formation. The tip pressure decreased when the bit was pulled up and then slowly rebounded to a final pressure of 15.29 MPa. The shaft pressure decreased when the bit was lifted and then continuously decayed to an end pressure of 15.99 MPa. The temperature decayed to an equilibrium value of 8.26°C.

Deployment 24: Hole U1322C, 200 mbsf

Table AT42 and FIGUREB27_T2P_DEPLOY24.XLS in the "APP_B" folder in "Supplementary material" present the sequence of the operations and the tool response to particular events for T2P Deployment 24. The tip pressure and temperature records increased while positioning the CDS to the retracted position. A second increase recorded by all sensors occurred when the tool was pushed into the formation. Pressure and temperature records then smoothly dissipated while the tool was in the formation. The tip decayed to a final pressure of 16.34 MPa, and the shaft dissipated to a final pressure of 17.16 MPa. Extrapolation of the pressure records will provide good estimate of the in situ pressure. The temperature decayed to an equilibrium value of 9.28°C.

Deployment 25: Hole U1322D, 40 mbsf

Table **AT43** and FIGUREB28_T2P_DEPLOY25.XLS in the "APP_B" folder in **"Supplementary material"** present the sequence of the operations and the tool response to particular events for T2P Deployment 25. The TruView data are missing for this deployment. Key deployment events are derived from the shipboard T2P Log Sheet (see the "DOWNHOLE" folder in **"Supplementary material"**). Pressure and temperature pulses were recorded when the probe was pushed into the formation but the pressure dropped rapidly when the drill bit was lifted off the BOH. The tip and shaft then increased to a nearly constant pressure of 13.78 MPa, which was equal to the fluid pressure at BOH. The temperature decreased rapidly upon pulling up of the bit and then was nearly constant and close to the temperature of the borehole fluid. The pressure and temperature records suggest that the measurement was influenced by communication with the borehole fluid. Thus this deployment did not provide any constraint on in situ conditions.

Deployment 26: Hole U1322D, 70 mbsf

Table **AT44** and FIGUREB29_T2P_DEPLOY26.XLS in the "APP_B" folder in **"Supplementary material"** present the sequence of the operations and the tool response to particular events for T2P Deployment 26. Similar to Deployment 25, the seal around the probe was weakened when the bit was lifted off the BOH. The pressure and temperature measurements were subject to influence of the borehole fluid. This deployment did not provide any constraint on in situ conditions.

Deployment 27: Hole U1322D, 100 mbsf

Table **AT45** and FIGUREB30_T2P_DEPLOY27.XLS in the "APP_B" folder in **"Supplementary material"** present the sequence of the operations and the tool response to particular events for T2P Deployment 27. The pressure and temperature records increased while positioning the CDS to the retracted position and pushing the tool into the formation. The tip and shaft pressures rapidly decreased while backing-off the bit. The tip pressure rebounded to a near-constant value of 14.69 MPa. The shaft pressure dissipated to a final value of 15.11 MPa. This dissipation curve can be extrapolated to evaluate the in situ pressure. Smooth temperature decay was measured. The final temperature of 7.11°C was equilibrated with the formation.

Deployment 28: Hole U1322D, 134 mbsf

Table **AT46** and FIGUREB31_T2P_DEPLOY28.XLS in the "APP_B" folder in **"Supplementary material"** present the sequence of the operations and the tool response to particular events for T2P Deployment 28. The pressure and temperature records increased while positioning the CDS to the retracted position and pushing the tool into the formation. The tip and shaft pressures rapidly decreased while backing-off the bit. Pressures at the shaft and tip were near-constant during the dissipation phase. The temperature increased while backing-off the bit and then rapidly decayed to a final temperature of 7.31°C. The pressure and temperature measurements were subject to influence of the borehole fluid. This deployment did not provide any constraint on in situ conditions.

All sensor data records were lost during recovery of the probe. At the rig floor, it was noted that the tip had broken and the drive tube had bent during the deployment. Damage to the probe likely occurred while pushing into the formation and then the tip was broken when pulling out of the formation.

Appendix C

Fluid pressure within the drilling pipe

To check tool performance and the pressure calibration, we made multiple 2–10 min tool stops to take the fluid pressure in the drill pipe prior to and after tool penetration. We stopped fluid circulation during tool stop to remove the effect of pump pressure on the measured pressure. Here, we present a discussion of the pressure state within the drill pipe based on the DVTPP pressure measurements.

Figure **AF7** presents the fluid pressure taken at or above the seafloor. The measured fluid pressure is generally not equal to the calculated hydrostatic pressure. The tool pressure is either close to or higher than hydrostatic pressure for deployments with no drilling mud involved. However, the tool pressure can be either significantly higher or lower than hydrostatic pressure if drilling mud was used. In addition, the range of the offset value is larger than seen during deployments in water without mud. Thus, the tool-stop technique can not effectively check the pressure calibration.

Figure **AF8** presents the fluid pressure taken at BOH prior to tool penetration. The fluid pressure at BOH is either close to or higher than the hydrostatic pressure for deployments with no drilling mud involved. The tool pressure is significantly higher than hydrostatic pressure if drilling mud was used. It shows a general trend where the pressure offset at the BOH increases with the depth of the borehole.

To understand the fluid pressure in the drill pipe, we present two ideal scenarios of the fluid conditions within the drill pipe and outside the drill pipe. The first scenario is one where no drilling mud was used and the seawater was not contaminated with drilling cuttings (Fig. **AF9A**). In this case, the fluid in the pipe is static and the pressure is equal to hydrostatic pressure everywhere. The second scenario is when drilling mud was used and the mud elevations inside and outside the pipe are at the seafloor. The fluid in the drill pipe is static and has hydrostatic pressure above the mud elevation (e.g., Stops 1 and 2 in Fig. **AF9B**). The fluid pressure below the mud elevation (e.g., Stop 3) is higher than hydrostatic pressure, follows the static pressure gradient of the drilling mud, and can be calculated using

$$P = \rho_w g H_w + \rho_m g(z - H_w),$$

where

- g = acceleration of gravity,
- ρ_w = density of seawater,
- ρ_m = density of drilling mud,
- z = the target depth, and
- H_w = depth of water at the location of the hole.

For almost all deployments, the tool pressure during tool stop reached a steady pressure within 1 min (see **"Appendix A," "Appendix B"**). This suggests that fluid in the dill pipe was static during most of the time of the tool stop. It is reasonable to assume that the fluid pressure within the drill pipe was equal to the fluid pressure inside the annulus at BOH.

Figure **AF10** presents three possible scenarios that could be encountered at tool stops. The first scenario is one in that no drilling mud was used; the elevation of fluid with cuttings inside the pipe is lower than that outside the pipe. The fluid elevation in the drill pipe must be above sea level to reach the static condition. ΔH can be calculated by

$$\Delta H = \frac{(\rho_c - \rho_w)H_1}{\rho_w}.$$

Once ΔH is determined, the fluid pressure in the drill pipe can be calculated everywhere. The offset from hydrostatic pressure is constant above the interface of seawater and the fluid with cuttings (e.g., Stops 1 and 2). Below the interface, fluid pressure follows the pressure gradient of the fluid with drilling cuttings (Fig. **AF10A**).

The second scenario is one where drilling mud was used to stabilize the borehole, and the mud elevation within the pipe is lower than that outside the pipe. The fluid elevation in the drill pipe must be above sea level to equilibrate with the fluid pressure at BOH. ΔH can be calculated by

$$\Delta H = \frac{(\rho_c - \rho_w)H_1 + (\rho_m - \rho_w)H_2}{\rho_w}.$$

The pressure within the pipe is higher than hydrostatic pressure everywhere. The offset from hydrostatic pressure is constant above the interface of seawater and the drilling mud (e.g., Stops 1 and 2). Below the interface, fluid pressure follows the pressure gradient of the drilling mud (Fig. **AF10B**).

The third scenario is one where drilling mud was used to stabilize the borehole and the mud elevation within the pipe is higher than the mud elevation outside the pipe. The fluid elevation in the drill pipe will be lower than sea level to equilibrate with the fluid pressure at BOH. ΔH can be calculated by

$$\Delta H = \frac{(\rho_w - \rho_m)H_1 + (\rho_c - \rho_m)H_2}{\rho_w}.$$

The pressure within the pipe could be either lower (e.g., Stops 1 and 2) or higher than hydrostatic pressure (e.g., Stop 3) depending on the location of the tool stop (Fig. **AF10C**).

Figure AF1. Onboard pressure calibration of transducer Z59-72. The pump pressure was run to 4000 psi from atmospheric pressure (psia) and then stepped down to atmosphere pressure.

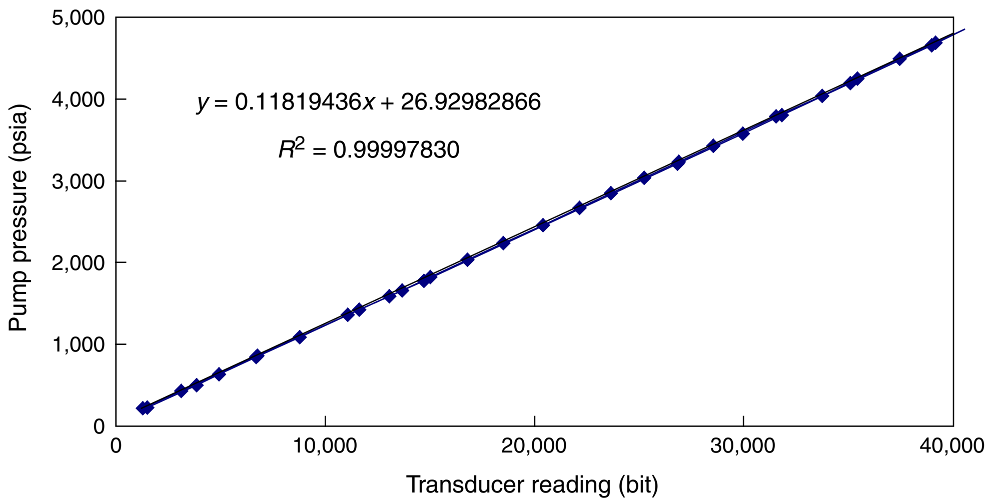

Figure AF2. Influence of temperature (*T*) on T2P pressure transducers. The slope (*S*) and intersection (*I*) of the calibration curve can change with temperature.

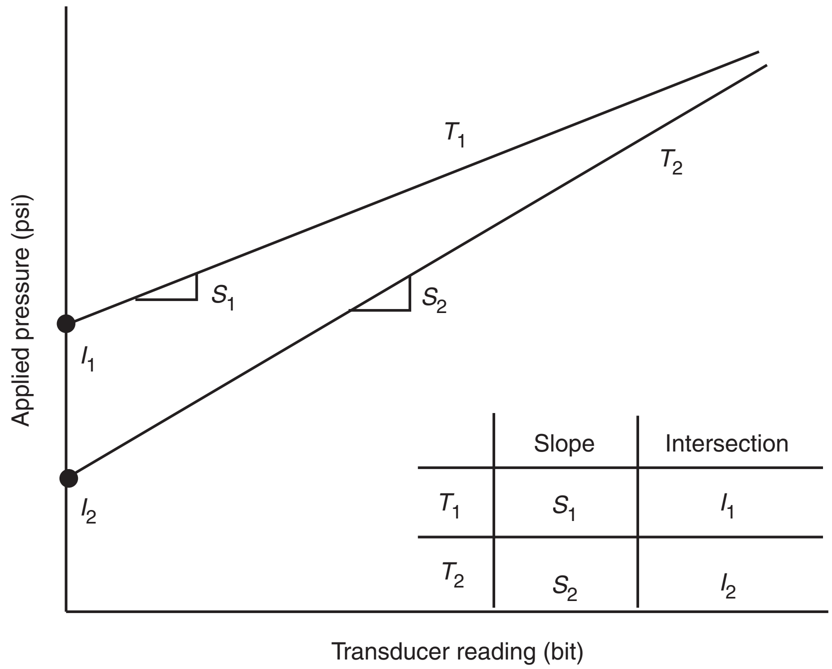

Figure AF3. Postcruise pressure calibration of transducer Z59-72. Calibration was done at 19.976°C in a temperature bath. Deadweight tester was run to 4015 psi from atmospheric pressure (psia) and then stepped down to atmosphere pressure.

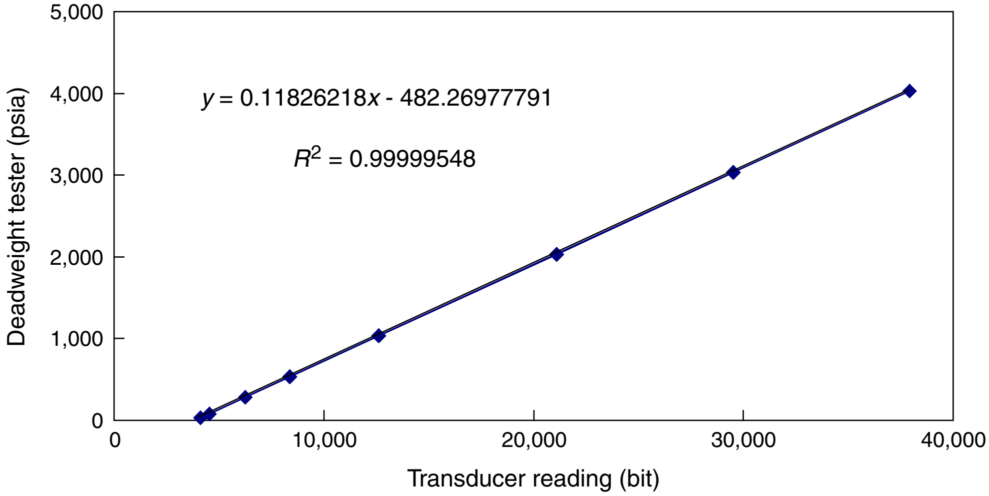

Figure AF4. Calibration coefficients of transducer S50-73 vs. temperature. **A.** Calibration curve slope vs. temperature. **B.** Intersection on *y*-axis of the calibration curve vs. temperature.

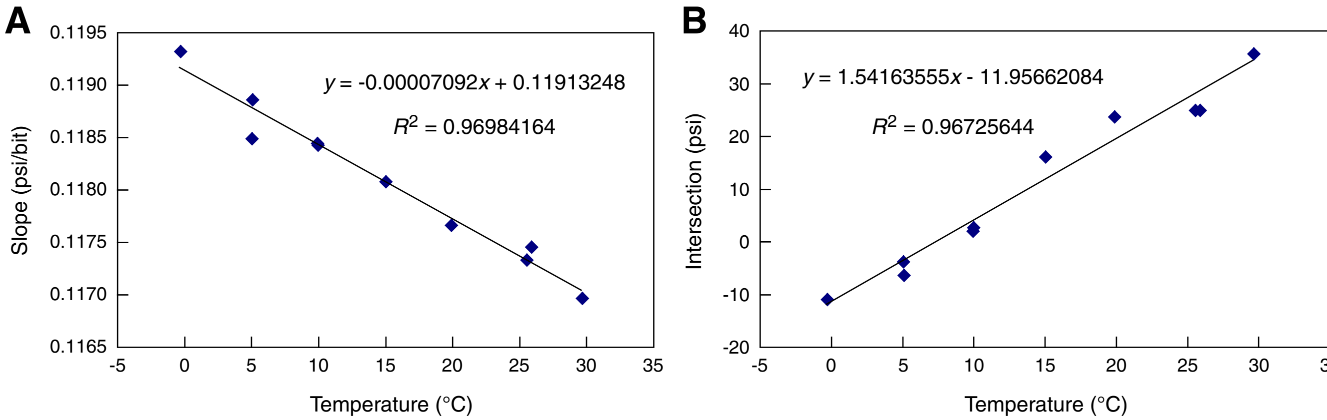

Figure AF5. Calibration coefficients of transducer Z59-72 vs. temperature. **A.** Calibration curve slope vs. temperature. **B.** Intersection on *y*-axis of the calibration curve vs. temperature.

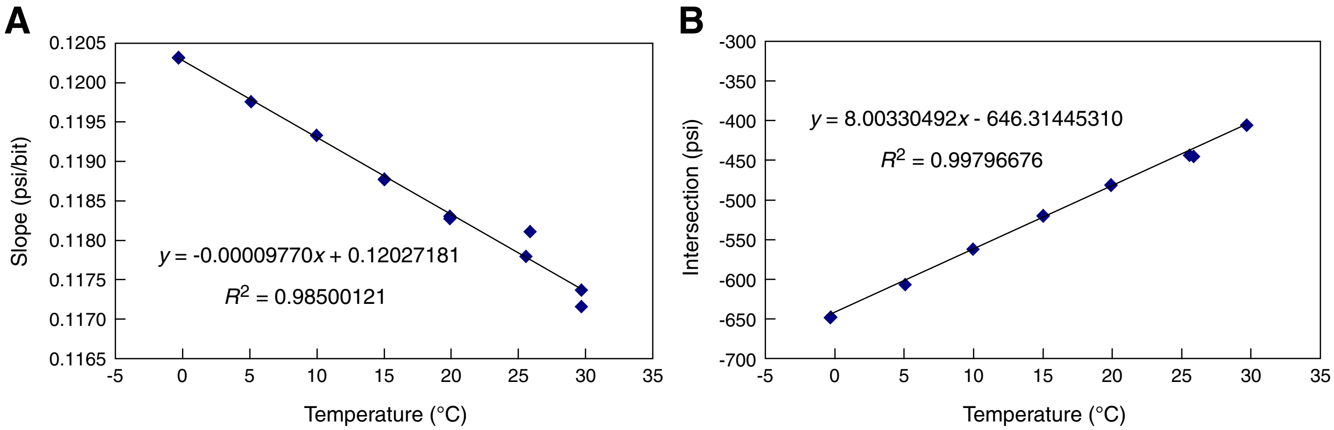

Figure AF6. Calibration coefficients of transducer S50-75 vs. temperature. **A.** Calibration curve slope vs. temperature. **B.** Intersection on *y*-axis of the calibration curve vs. temperature.

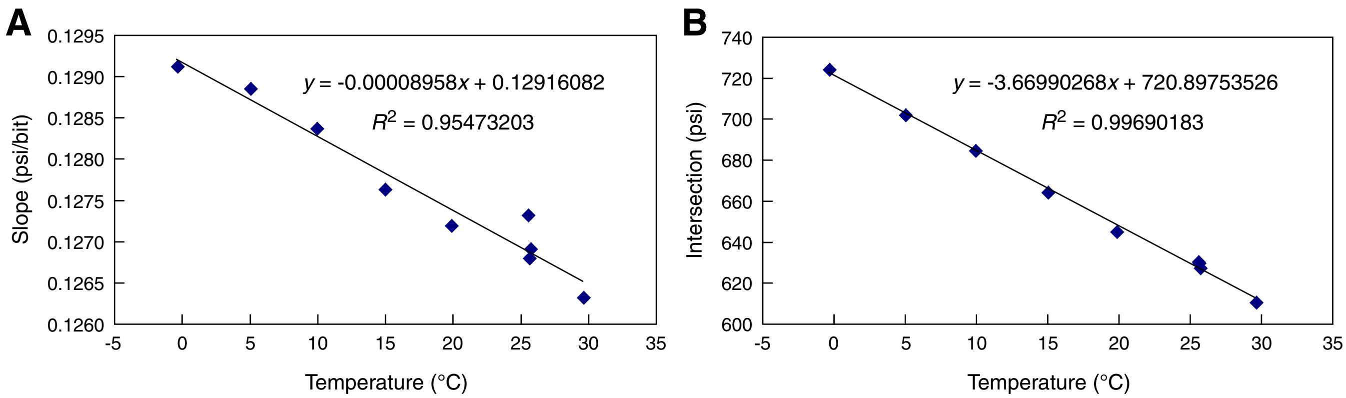

Figure AF7. Offset between tool pressure and hydrostatic pressure for tool stops at or above seafloor. Hydrostatic pressure was calculated assuming a seawater density of 1.024 g/cm³. DVTPP = Davis-Villinger Temperature-Pressure Probe.

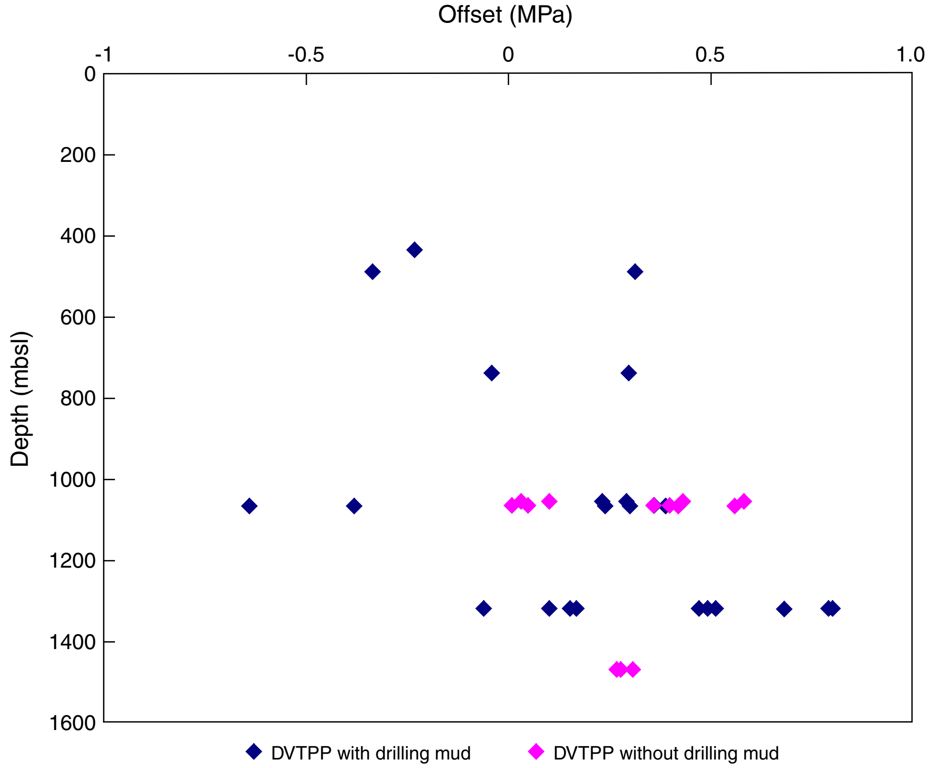

Figure AF8. Offset between tool pressure and hydrostatic pressure at the bottom of the hole. Hydrostatic pressure calculated assuming a seawater density of 1.024 g/cm^3. DVTPP = Davis-Villinger Temperature-Pressure Probe.

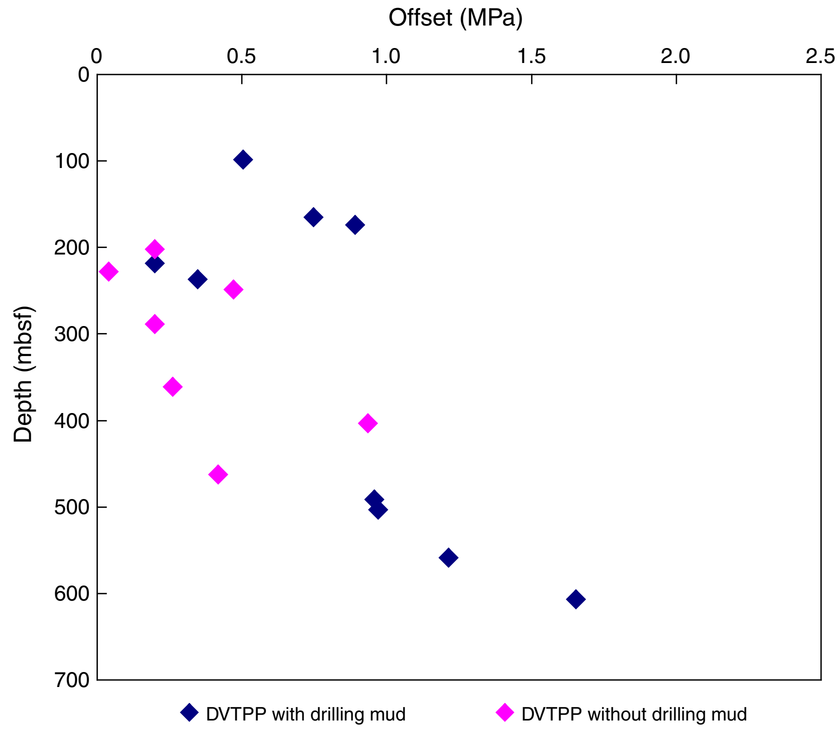

Figure AF9. Two ideal scenarios of fluid condition in drill pipe **A.** Predicted fluid pressure profile for cases in which no drilling mud was used and the seawater was not contaminated with the drilling cuttings. **B.** Predicted fluid pressure profile for cases in which drilling mud was used and the mud elevations inside and outside the pipe are at seafloor. Brown line = predicted static pressure assuming the borehole was filled with a 10.5 ppg drilling mud. ρ_w = density of seawater (1.024 g/cm³), ρ_m = density of drilling mud (1.259 g/cm³; 10.5 ppg), H_W = water depth at hole location, H_H = hole depth, H_{s1} = water depth at Stop 1.

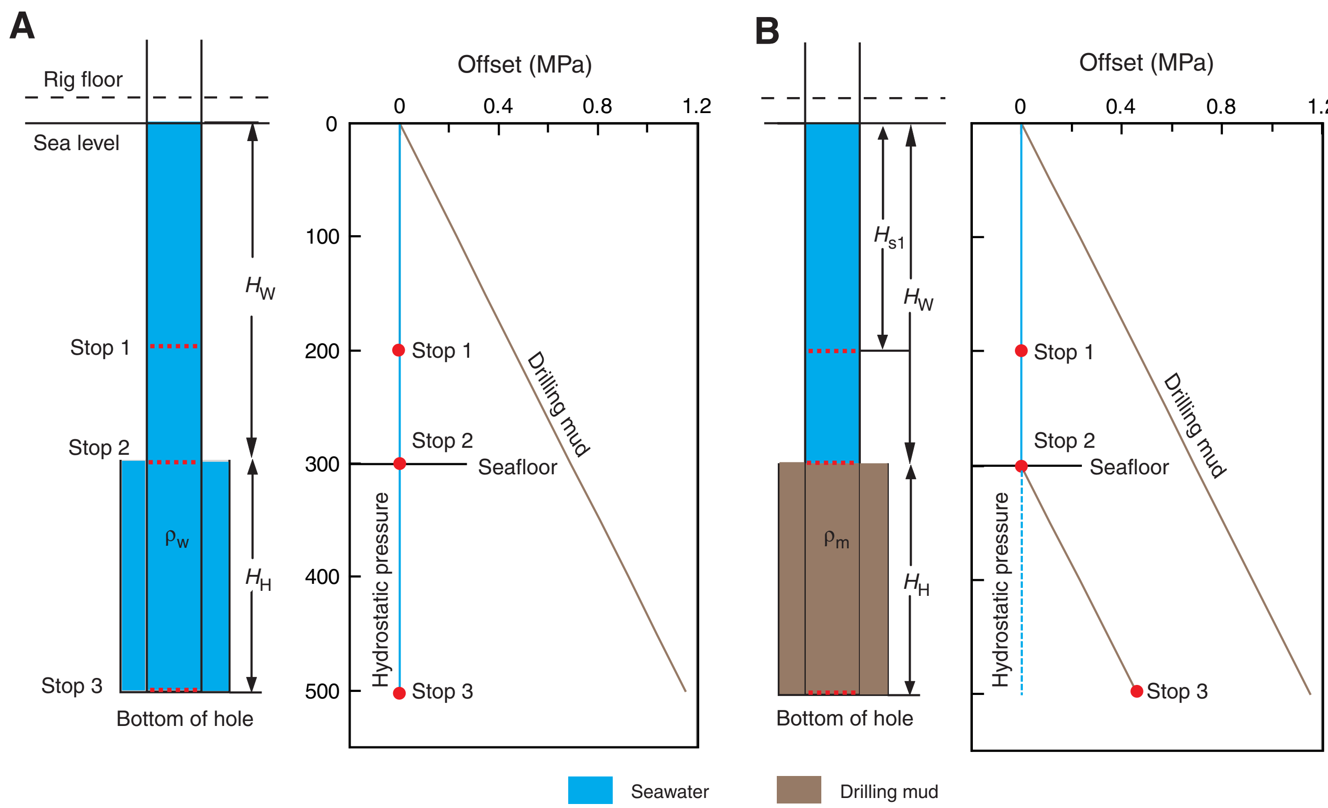

Figure AF10. Three possible scenarios that could be encountered at tool stops. The drill pipe above the rig floor was assumed to be sufficiently long, and three fluids with different density do not mix. **A.** Predicted fluid pressure profile for cases where no drilling mud was used and fluid in the borehole is contaminated with drilling cuttings. **B.** Predicted fluid pressure profile for cases where drilling mud was used to stabilize the borehole and mud elevation within the pipe is lower than the mud elevation outside the pipe. **C.** Predicted fluid pressure profile for cases where drilling mud was used to stabilize the borehole and mud elevation within the pipe is higher than the mud elevation outside the pipe. Brown line = predicted static pressure by assuming the borehole was filled with a 10.5 ppg drilling mud. ρ_w = density of seawater (1.024 g/cm^3), ρ_m = density of drilling mud (1.259 g/cm^3; 10.5 ppg), ρ_c = density of fluid with cuttings (1.139 g/cm^3; 9.5 ppg), H_W = water depth at hole location, H_H = hole depth, H_{s1} = water depth at Stop 1, ΔH = offset in hydrostatic pressure, H$_1$ = hydrostatic pressure at Stop 1, H_2 = hydrostatic pressure at Stop 2.

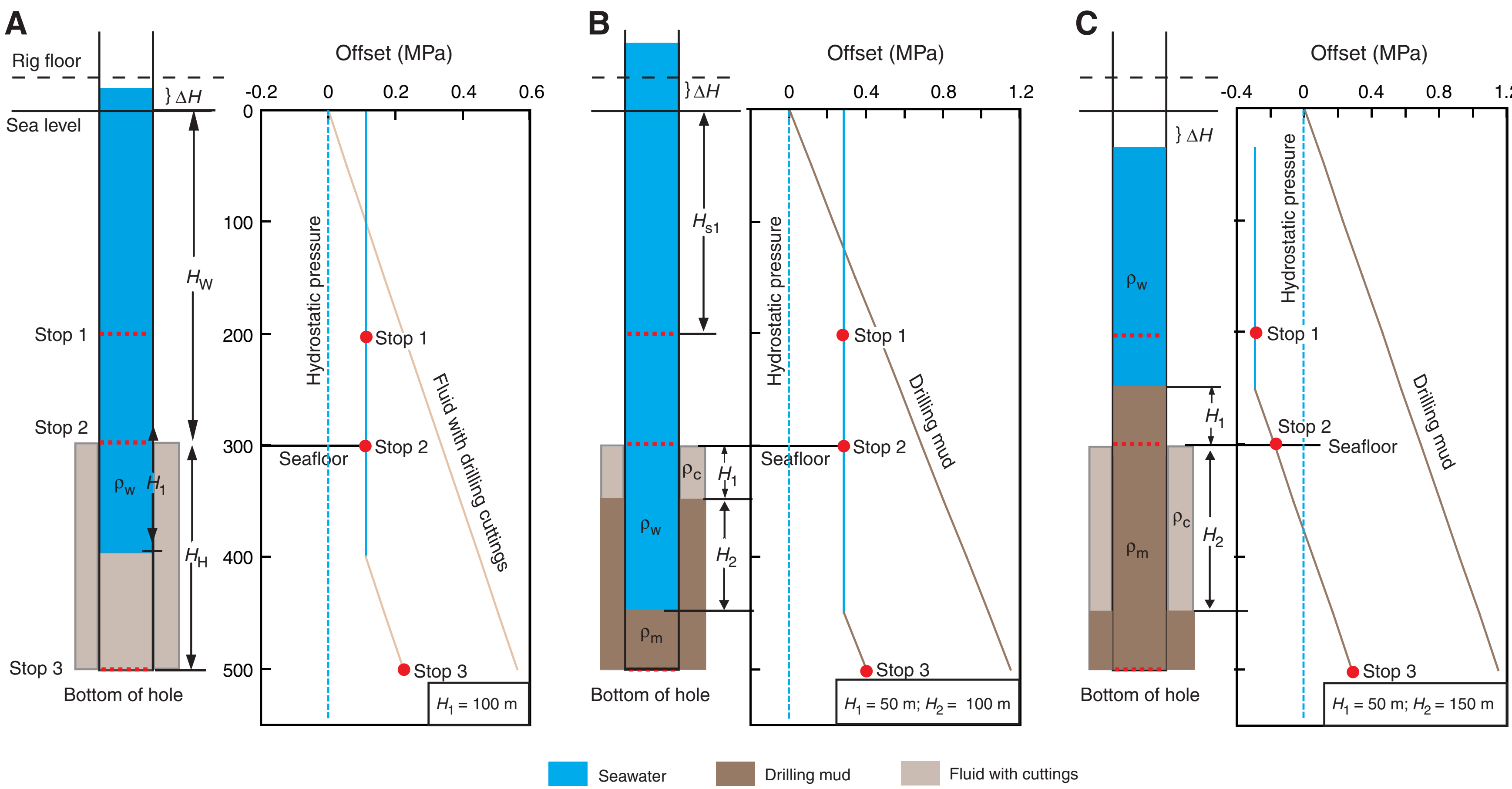

Table AT1. Temperature calibration of DVTPP. **A.** Calibration coefficients for data loggers and thermistors. Channel T1 is the logger channel used to measure the thermistor. R_t' = thermistor resistance in ohms. **B.** Actual thermistor calibration data.

Table AT1A. Calibration coefficients. (**See table notes.**)

Calibration coefficient	Logger 9367	Logger 9368
R_1	251680.977	249507.092
k_0	65564.0623	65534.6958
k_1	65550.3036	65533.6013

Calibration coefficient	Thermistor 0226-3	Thermistor 0226-2
A	4.60148156E–04	4.52826700E–04
B	2.10947147E–04	2.11217111E–04
C	6.41209309E–08	6.19876025E–08

Notes: For Channel T1 calibration, $R_t' = R_1 \times (k_1 - x)/[k_0 - (k_1 - x)]$, where $x = T_1$ counts. For thermistor calibration (ohms to Kelvin [Steinhart and Hart]), $1/t = A + B \times \mathrm{Ln}(R_t') + C \times \mathrm{Ln}(R_t')^3$, where °C = K – 273.15.

Table AT1B. Temperature vs. resistance.

Serial number	Resistance (Ω)			
	0.000°C	50.000°C	100.000°C	150.000°C
0226-2	1666200	162749	27716	6963
0226-3	1602700	157535	26907	6781

Table AT2. Pressure calibration of DVTPP, 7 June 2002. (**See table notes.**)

	PXDCR 88587	PXDCR 88579
Temperature coefficients		
U_0 (µs)	5.833194	5.878972
Y_1 (°C/µs)	–4036.649	–3969.749
Y_2 (°C/µs)	–12666.34	–11880.87
Y_3	0	0
Pressure coefficients		
C_1 (psia)	–68866.77	–66259.12
C_2 (psia/µs)	–694.2135	–2504.110
C_3 (psia/µs^2)	255224.2	223122.2
D_1	0.029732	0.030630
D_2	0	0
T_1 (psia)	30.32667	30.23938
T_2 (psia/µs)	1.025313	0.409012
T_3 (psia/µs^2)	62.84291	58.71868
T_4	0	0
T_5	0	0

Notes: For internal temperature sensor, temperature (°C) = $Y_1U + Y_2U^2 + Y_3U^3$, U_0 = temperature signal period (µs) at 25°C, U = temperature signal period – U_0 (µs). For pressure transducer, pressure (psi) = $C(1 - T_0^2/T^2)[1 - D(1 - T_0^2/T^2)]$, T = Pressure signal period (µs), U_0 = temperature signal period (µs) at 25°C, $C = C_1 + C_2U + C_3U^2$, $D = D_1 + D_2U$, $T_0 = T_1 + T_2U + T_3U^2 + T_4U^3 + T_5U^4$.

Table AT3. Event summary of DVTPP Deployment 20, Hole U1322D, 175 mbsf. (**See table notes.**)

Event number	Time (GMT)	Event description
1	1837	Start lowering DVTPP downhole
2	1859	Stop at mudline for 5 min
3	1900	Start lowering probe
4	1904	Move BHA to 7 m off BOH
5	1913	CDS lands in BHA
6	1920	Lower bit, start penetration of DVTPP into formation
7	1921	End of penetration, bit on BOH
8	1921	Raise BHA 2.4 m off BOH
9	2022	Pull probe out of formation and uphole with wireline
10	2026	Stop at mudline for 5 min
11	2031	Pull DVTPP uphole with wireline

Notes: Measurements taken 2 July 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT4. Event summary of DVTPP Deployment 1, Hole U1320A, 203.4 mbsf. (**See table notes.**)

Event number	Time (GMT)	Event description
1	0850	Start lowering DVTPP downhole
2	0901	Stop at mudline for 10 min
3	0912	Start lowering probe
4	0912	Raise BHA 11 m off BOH
5	0916	CDS lands in BHA
6	0927	Lower bit, start penetration of DVTPP into formation
7	0931	End of penetration, bit on BOH
8	0933	Raise BHA 4 m off BOH
9	1013	Pull probe out of formation and uphole with wireline

Notes: Measurements taken 9 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT5. Event summary of DVTPP Deployment 2, Hole U1320A, 289.9 mbsf. (**See table notes.**)

Event number	Time (GMT)	Event description
1	1900	Start lowering DVTPP downhole
2	1911	Stop at mudline for 5 min
3	1917	Start lowering probe
4	1917	Raise BHA 16 m off BOH
5	1922	CDS lands in BHA
6	1923	Lower bit, start penetration of DVTPP into formation
7	1926	End of penetration, bit on BOH
8	1928	Raise BHA 6 m off BOH
9	1939	Pull probe out of formation and uphole with wireline
10	1942	Stop at mudline for 5 min
11	1948	Pull DVTPP uphole with wireline

Notes: Measurements taken 9 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT6. Event summary of DVTPP Deployment 3, Hole U1324B, 229.1 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0946	Start lowering DVTPP downhole
2	1009	Stop at mudline for 2 min
3	1011	Start lowering probe
4		Raise BHA off BOH
5		CDS lands in BHA
6	1024	Lower bit, start penetration of DVTPP into formation
7	1028	End of penetration, bit on BOH
8		Raise BHA off BOH
9	1118	Pull probe out of formation and uphole with wireline
10	1230	Stop at mudline for 2 min
11	1232	Pull DVTPP uphole with wireline

Notes: Measurements taken 22 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT7. Event summary of DVTPP Deployment 4, Hole U1324B, 362.4 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0615	Start lowering DVTPP downhole
2	0636	Stop at mudline for 5 min
3	0641	Start lowering probe
4		Raise BHA off BOH
5	0657	CDS lands in BHA
6	0701	Lower bit, start penetration of DVTPP into formation
7	0704	End of penetration, bit on BOH
8		Raise BHA off BOH
9	0751	Pull probe out of formation and uphole with wireline
10	0827	Stop at mudline for 5 min
11	0832	Pull DVTPP uphole slowly with wireline

Notes: Measurements taken 23 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT8. Event summary of DVTPP Deployment 6, Hole U1324B, 464.3 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0220	Start lowering DVTPP downhole
2	0230	Stop at mudline for 5 min
3	0235	Start lowering probe
4		Raise BHA off BOH
5	0247	CDS lands in BHA
6	0253	Lower bit, start penetration of DVTPP into formation
7	0257	End of penetration, bit on BOH
8		Raise BHA off BOH
9	0331	Pull probe out of formation and uphole slowly with wireline
10	0338	Stop at mudline for 5 min
11	0343	Pull DVTPP uphole slowly with wireline

Notes: Measurements taken 24 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT9. Event summary of DVTPP Deployment 7, Hole U1324B, 493.1 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0735	Start lowering DVTPP downhole
2	0743	Stop at mudline for 5 min
3	0748	Start lowering probe
4		Raise BHA off BOH
5	0755	CDS lands in BHA
6	0757	Lower bit, start penetration of DVTPP into formation
7	0801	End of penetration, bit on BOH
8		Raise BHA off BOH
9	0832	Pull probe out of formation and uphole with wireline
10	0839	Stop at mudline for 5 min
11	0844	Pull DVTPP uphole with wireline

Notes: Measurements taken 24 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT10. Event summary of DVTPP Deployment 8, Hole U1324B, 521.9 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1846	Start lowering DVTPP downhole
2	1857	Stop at mudline for 5 min
3	1902	Start lowering probe
4	1856	Raise BHA 17 m off BOH
5	1912	CDS lands in BHA
6	1914	Lower bit, start penetration of DVTPP into formation
7	1924	End of penetration, bit on BOH
8	1930	Raise BHA 4 m off BOH
9	2005	Pull probe out of formation and uphole with wireline
10	2013	Stop at mudline for 5 min
11	2018	Pull DVTPP uphole with wireline

Notes: Measurements taken 24 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT11. Event summary of DVTPP Deployment 10, Hole U1324B, 560.4 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0720	Start lowering DVTPP downhole
2	0731	Stop at mudline for 5 min
3	0736	Start lowering probe
4	0739	Raise BHA 16 m off BOH
5	0742	CDS lands in BHA
6	0742	Lower bit, start penetration of DVTPP into formation
7	0747	End of penetration, bit on BOH
8	0748	Raise BHA 4 m off BOH
9	0819	Pull probe out of formation and uphole with wireline
10	0827	Stop at mudline for 5 min
11	0832	Pull DVTPP uphole with wireline

Notes: Measurements taken 25 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT12. Event summary of DVTPP Deployment 11, Hole U1324B, 589.2 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1402	Start lowering DVTPP downhole
2	1411	Stop at mudline for 5 min
3	1416	Start lowering probe
4	1416	Raise BHA 23 m off BOH
5	1423	CDS lands in BHA
6	1423	Lower bit, start penetration of DVTPP into formation
7	1430	End of penetration, bit on BOH
8		Raise BHA off BOH
9	1515	Pull probe out of formation and uphole with wireline
10	1522	Stop at mudline for 5 min
11	1527	Pull DVTPP uphole with wireline

Notes: Measurements taken 25 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT13. Event summary of DVTPP Deployment 12, Hole U1324B, 608.2 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	2248	Start lowering DVTPP downhole
2	2305	Stop at mudline for 5 min
3	2310	Start lowering probe
4	2257	Raise BHA 17 m off BOH
5	2318	CDS lands in BHA
6	2329	Lower bit, start penetration of DVTPP into formation
7	2334	End of the first penetration, bit is 0.2 m off BOH
8	2334	Raise BHA 4 m off BOH
9	2335	Lower bit, start further penetration
10	2335	End of penetration, bit on BOH
11	2336	Raise BHA 3 m off BOH
12	0037	Pull probe out of formation and uphole with wireline
13	0045	Stop at mudline for 5 min
14	0050	Pull DVTPP uphole with wireline

Notes: Measurements taken 25 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT14. Event summary of DVTPP Deployment 13, Hole U1324C, 250 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0700	Start lowering DVTPP downhole
2	0709	Stop at mudline for 5 min
3	0714	Start lowering probe
4	0716	Raise BHA 14.5 m off BOH
5	0717	CDS lands in BHA
6	0717	Lower bit, start penetration of DVTPP into formation
7	0722	End of first penetration, bit 0.15 m off BOH
8	0724	Raise BHA 3.5 m off BOH
9	0724	Lower bit, start further penetration
10	0725	End of penetration, bit on BOH
11	0855	Pull probe out of formation and uphole with wireline
12	0900	Stop at mudline for 5 min
13	0904	Pull DVTPP uphole with wireline

Notes: Measurements taken 27 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT15. Event summary of DVTPP Deployment 14, Hole U1324C, 405 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1752	Start lowering DVTPP downhole
2	1800	Stop at mudline for 5 min
3	1805	Start lowering probe
4	1756	Move BHA to 17 m off BOH
5	1812	CDS lands in BHA
6	1822	Lower bit, start penetration of DVTPP into formation
7	1826	End of penetration, bit on BOH
8	1830	Raise BHA 8.5 m off BOH
9	2000	Pull probe out of formation and uphole with wireline
10	2007	Stop at mudline for 5 min
11	2012	Pull DVTPP uphole with wireline

Notes: Measurements taken 27 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT16. Event summary of DVTPP Deployment 15, Hole U1324C, 505 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0030	Start lowering DVTPP downhole
2	0043	Stop at mudline for 5 min
3	0048	Start lowering probe
4	0057	CDS lands in BHA
5	0106	Lower bit, start penetration of DVTPP into formation
6	0109	End of penetration, bit on BOH
7	0112	Raise BHA 6.4 m off BOH
8	0242	Pull probe out of formation and uphole with wireline
9	0249	Stop at mudline for 5 min
10	0254	Pull DVTPP uphole with wireline

Notes: Measurements taken 28 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT17. Event summary of DVTPP Deployment 16, Hole U1322B, 166.7 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	2242	Start lowering DVTPP downhole
2	2257	Stop at mudline for 5 min
3	2302	Start lowering probe
4	2254	Raise BHA 8 m off BOH
5	2310	CDS lands in BHA, tip touched the formation
6	2320	Lower bit, start penetration of DVTPP into formation
7	2322	End of penetration, bit on BOH
8	2323	Raise BHA 3 m off BOH
9	2324	Move BHA back to BOH
10	0054	Pull probe out of formation and uphole with wireline
11	0058	Stop at mudline for 5 min
12	0103	Pull DVTPP uphole with wireline

Notes: Measurements taken 29 June 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT18. Event summary of DVTPP Deployment 17, Hole U1322C, 100 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0152	Start lowering DVTPP downhole
2	0211	Stop at mudline for 5 min
3	0216	Start lowering probe
4		Move BHA off BOH
5	0222	CDS lands in BHA
6	0233	Lower bit, start penetration of DVTPP into formation
7	0234	End of penetration, bit on BOH
8	0235	Raise BHA 4 m off BOH
9	0405	Pull probe out of formation and uphole with wireline
10	0409	Stop at mudline for 5 min
11	0414	Pull DVTPP uphole with wireline

Notes: Measurements taken 1 July 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT19. Event summary of DVTPP Deployment 18, Hole U1322C, 220 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1545	Start lowering DVTPP downhole
2	1607	Stop at mudline for 5 min
3	1612	Start lowering probe
4		Move BHA to 16 m off BOH
5	1616	CDS lands in BHA
6	1617	Lower bit, start penetration of DVTPP into formation
7	1619	End of penetration, bit on BOH
8	1619	Raise BHA 5 m off BOH
9	1721	Pull probe out of formation and uphole with wireline
10	1728	Stop at mudline for 5 min
11	1733	Pull DVTPP uphole with wireline

Notes: Measurements taken 1 July 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT20. Event summary of DVTPP Deployment 19, Hole U1322C, 238 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1901	Start lowering DVTPP downhole
2	1923	Stop at mudline for 5 min
3	1928	Start lowering probe
4	1928	Moving BHA to 11 m off BOH
5	1934	CDS lands in BHA
6	1944	Lower bit, start penetration of DVTPP into formation
7	1945	End of penetration, bit on BOH
8	1946	Raise BHA 2 m off BOH
9	1948	Lower BHA back to BOH
10	1950	Raise BHA 6 m off BOH
11	2118	Pull probe out of formation and uphole with wireline
12	2124	Stop at mudline for 5 min
13	2128	Pull DVTPP uphole with wireline

Notes: Measurements taken 1 July 2005. GMT = Greenwich Mean Time, DVTPP = Davis-Villinger Temperature-Pressure Probe, BHA = bottom-hole assembly, BOH = bottom of hole, CDS = colleted delivery system.

Table AT21. Temperature calibration of T2P. **A.** Calibration coefficients for data loggers and thermistors. **B.** Actual thermistor calibration data.

Table AT21A. Calibration coefficients. (See table notes.)

Calibration coefficient	Logger Sn 2	Logger Sn 4
R_1	1.000729	0.990307767
R_2	176.136606	–72.74909712

Calibration coefficient	Thermistor 0509-1	Thermistor 0509-2	Thermistor 0509-3	Thermistor 0509-4	Thermistor 0509-5	Thermistor 0509-6
A	4.63276461E–04	5.43051013E–04	4.75887900E–04	4.82495572E–04	4.82688206E–04	4.71824656E–04
B	2.10947147E–04	1.99981837E–04	2.08557612E–04	2.09282474E–04	2.08833095E–04	2.09263995E–04
C	6.19690000E–08	8.35910000E–08	6.34430000E–08	6.20870000E–08	6.40080000E–08	6.27480000E–08

Notes: For temperature channel calibration (counts to ohms), $R_t' = R_1 \times [5/(x/65535 \times 3.5/24900) - 24900] + R_2$, where x = counts and R_t' = thermistor resistance in ohms. For thermistor calibration (ohms to Kelvin [Steinhart and Hart]), $1/t = A + B \times \mathrm{Ln}(R_t') + C \times \mathrm{Ln}(R_t')^3$, where t (°C) = K – 273.15 and R_t' = thermistor resistance in ohms.

Table AT21B. Temperature vs. resistance.

	Resistance (Ω)			
Serial #	0.000°C	30.000°C	60.000°C	100.000°C
0509-1	1795000	406620	116210	28980
0509-2	1720000	389890	114500	27795
0509-3	1740000	394200	112590	28035
0509-4	1651000	373340	106560	26535
0509-5	1655000	375720	107480	26810
0509-6	1712000	388430	111130	27740

Table AT22. Onboard pressure calibration of T2P, June 2005. (See table note.)

Transducer number	Slope (psi/bit)	Intersection (psi)	R_2
S50-73	0.11768162	64.28686942	0.99999094
S50-74*	0.12469840	209.49786126	0.99995831
S50-74†	0.12473479	161.99347791	0.99999663
S50-75	0.13043403	221.74997847	0.99999299
Z59-72*	0.11819436	26.92982866	0.99997830
Z59-72†	0.11816986	–490.20091995	0.99997433
Y67-16	0.11944345	99.71216680	0.99999905

Note: * = pressure calibration before being flooded, † = pressure calibration after oven drying.

Table AT23. Event summary of T2P Deployment 1, Hole 1319A. (See table notes.)

Event number	Time (GMT)	Event description
1	2331	Start data logger at 1 Hz
2	0146	T2P on rig floor
3	0210	Raise T2P vertically
4	0210	Remove pressure response chamber from T2P tip
5	0210	Place shroud over T2P tip
6	0211	Place T2P in drill pipe
7	0213	Connect T2P to spacer
8	0216	Connect CDS to spacer
9	0216	CDS in extended position
10	0220	Start lowering T2P downhole
11	0232	Stop at 511 mbsl
12	0235	Start lowering probe
13	0241	Stop at 1011 mbsl
14	0244	Start lowering probe
15	0255	Stop at 1388 mbsl
16	0301	Start pulling T2P uphole
17	0316	Stop at 1010 mbsl
18	0319	Continue pulling T2P uphole
19	0323	Stop at 511 mbsl
20	0325	Continue pulling T2P uphole
21	0341	T2P on rig floor
22	0341	T2P tip in pressure response chamber
23	0346	Pressure response test
24	0358	Download data from data logger
25	0440	Remove battery from T2P

Notes: Tool test in water column, 7 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system.

Table AT24. Event summary of T2P Deployment 2, Hole U1319A, 80.5 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0607	Start data logger at 1 Hz
2	1313	T2P on rig floor
3	1315	Raise T2P vertically
4	1316	Remove pressure response chamber from T2P tip
5	1316	Place shroud over T2P tip
6	1319	Place T2P in drill pipe
7	1320	Connect T2P to spacer
8	1323	Connect CDS to spacer
9	1325	CDS in extended position
10	1326	Start lowering T2P downhole, pumps on
11	1335	Stop at 511 mbsl, pumps off
12	1337	Start lowering probe, pumps on
13	1344	Stop at 1012 mbsl, pumps off
14	1346	Start lowering probe, pumps on
15	1352	Stop at 1431 mbsl, pumps off
16	1355	Start lowering probe
17	1358	Pass T2P through LFV
18	1405	CDS lands in BHA
19	1408	Start penetration of T2P into sediment
20	1415	End of T2P penetration
21	1427	Pumps on at 10 spm
22	1447	Start pulling T2P uphole
23	1448	Stop pulling at 1509 mbsl
24	1449	Pull/release winch to free CDS from BHA
25	1452	Start pulling T2P uphole
26	1509	Stop at 511 mbsl, pumps off
27	1511	Start pulling T2P uphole
28	1520	Detach CDS from wireline
29	1527	Detach CDS from spacer
30	1530	Detach spacer from T2P
31	1530	T2P on rig floor
32	1531	T2P tip in pressure response chamber
33	1539	T2P in workroom
34	1549	Remove battery from T2P
35	1604	Connect T2P to DC power
36	1605	Download data from data logger

Notes: Measurements taken 7 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, LFV = lockable float valve, spm = strokes per minute, BHA = bottom-hole assembly, DC = direct current.

Table AT25. Event summary of T2P Deployment 3, Hole U1320A, 126.3 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	2308	T2P on rig floor
3	2314	Remove pressure response chamber from T2P tip
4	2314	Place shroud over T2P tip
5	2315	Connect T2P to spacer
6	2317	Connect CDS to spacer
7	2322	Connect CDS to wireline
8	2323	Start lowering T2P downhole, pumps on
9	2330	Stop at 511 mbsl, pumps off
10	2333	Start lowering probe, pumps on
11	2340	Stop at 1011 mbsl, pumps off
12	2343	Start lowering probe, pumps on
13	2344	Pump at 13 spm
14	2350	Stop at 1490 mbsl, pumps off
15	2353	Start lowering probe, pumps on at 13 spm
16	2357	Pumps off
17	0000	CDS lands in BHA
18	0000	Raise BHA to 2 m off BOH
19	0002	Start penetration of T2P into sediment, 2m advance of BHA
20	0003	End of T2P penetration
21	0004	Raise BHA 3m off BOH
22	0007	Pump at 10 spm
23	0055	Pull T2P uphole slowly 10 m
24	0059	10 m pull completed
25	0059	Pull T2P uphole, pump at 10 spm
26	0105	Stop at 511 mbsl, pumps off
27	0109	Pull T2P uphole, pumps on
28	0113	Detach CDS from wireline
29	0116	Detach CDS from spacer
30	0118	Detach spacer from T2P
31	0118	T2P on rig floor
32	0118	T2P tip in pressure response chamber
33	0126	T2P in workroom
34	0146	Remove battery from T2P
35	0146	Connect T2P to DC power
		Download data from data logger

Notes: Measurements taken 8–9 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, spm = strokes per minute, BHA = bottom-hole assembly, BOH = bottom of hole, DC = direct current.

Table AT26. Event summary of T2P Deployment 4, Hole U1320A, 213.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	1124	T2P on rig floor
3	1129	Remove pressure response chamber from T2P tip
4	1129	Place shroud over T2P tip
5	1131	T2P in drill pipe
6	1132	Connect T2P to spacer
7	1134	Connect CDS to spacer
8	1137	Connect CDS to wireline
9	1139	Start lowering T2P downhole, pumps on
10	1144	Stop at 511 mbsl, pumps off
11	1146	Start lowering probe, pumps on
12	1152	Stop at 1011 mbsl, pumps off
13	1154	Start lowering probe, pumps on
14	1200	Stop at 1471 mbsl, pumps off
15	1203	Position drill bit 0.5–0.75 m off BOH
16	1212	CDS lands in BHA, probe in formation
17	1212	Raise BHA 2.5 m
18	1217	Pump at 10 spm
19	1236	Pull T2P uphole to disengage CDS
20	1237	Pull T2P uphole
21	1251	T2P tip at 372 mbsl
22	1254	Lower T2P to 511 mbsl, pumps off
23	1256	Pull T2P uphole
24	1305	Lower CDS to retracted position
25	1308	Detach CDS from spacer
26	1309	Detach T2P from spacer
27	1309	T2P tip in pressure response chamber
28	1316	T2P in workroom
29		Remove battery from T2P
30		Connect T2P to DC power
31		Download data from data logger

Notes: Measurements taken 9 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BOH = bottom of hole, BHA = bottom-hole assembly, spm = strokes per minute, DC = direct current.

Table AT27. Event summary of T2P Deployment 5, Hole U1324B, 51.3 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	1140	T2P on rig floor
3	1147	Remove pressure response chamber from T2P tip
4	1147	Place shroud over T2P tip
5	1148	Connect T2P to spacer
6	1150	Connect CDS to spacer
7	1155	Start lowering T2P downhole, pumps on
8	1204	Stop at 515 mbsl, pumps off
9	1208	Start lowering probe, pumps on
10	1212	Stop at 768 mbsl, pumps off
11	1214	Start lowering probe, pumps on
12	1219	Stop at 1066 mbsl, pumps off
13	1222	Start lowering probe, pumps on at 18 spm
14	1223	Bit is 0.5 m off BOH
15	1224	Start lowering probe to land in BHA
16	1225	CDS lands in BHA, pumps off
17	1225	Raise BHA to 2 m off BOH
18	1226	Start penetration of T2P into sediment, 2 m advance of BHA
19	1227	End of T2P penetration, bit 0.25 m off BOH
20	1227	Raise BHA 2 m off BOH
21	1232	Pump at 11 spm
22	1257	Pull T2P uphole slowly with wireline
23	1258	CDS clear of BHA
24	1300	Stop at 1067 mbsl, pumps off
25	1304	Pull T2P uphole slowly with wireline
26	1309	Stop at 767 mbsl, pumps off
27	1311	Pull T2P uphole slowly with wireline
28	1315	Stop at 516 mbsl, pumps off
29	1317	Pull T2P uphole slowly with wireline
30	1325	Disconnect wireline from CDS
31	1325	Extend CDS
32	1328	Disconnect CDS from spacer
33	1328	Disconnect spacer from CDS
34	1330	Disconnect T2P from spacer
35	1333	T2P out of pipe
36		Download data from data logger

Notes: Measurements taken 21 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, spm = strokes per minute, BOH = bottom of hole, BHA = bottom-hole assembly.

Table AT28. Event summary of T2P Deployment 6, Hole U1324B, 89.3 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1417	Start data logger at 1 Hz
2	1615	T2P on rig floor
3	1647	Start lowering T2P downhole, pumps on
4	1656	Stop at 511 mbsl, pumps off
5	1657	Start lowering probe, pumps on
6	1703	Stop at 761 mbsl, pumps off
7	1704	Start lowering probe, pumps on
8	1710	Stop at 1058 mbsl, pumps off
9	1716	Start lowering probe
10	1718	Stop at 1135 mbsl, pumps off
11	1720	Start lowering probe to land in BHA
12	1722	CDS lands in BHA, pumps off
13	1731	Start penetration of T2P into sediment
14	1733	End of T2P penetration, bit 1 m off BOH
15	1736	Raise BHA 2 m off BOH
16	1742	Pump at 11 spm
17	1808	Pull T2P uphole slowly with wireline
18	1811	CDS clear of BHA
19	1813	Stop at 1058 mbsl, pumps off
20	1815	Pull T2P uphole slowly with wireline
21	1818	Stop at 760 mbsl, pumps off
22	1820	Pull T2P uphole slowly with wireline
23	1823	Stop at 511 mbsl, pumps off
24	1825	Pull T2P uphole slowly with wireline
25	1831	Disconnect wireline from CDS
26	1832	Retract CDS
27	1835	Disconnect CDS from spacer
28	1837	Disconnect spacer from CDS
29	1838	T2P out of pipe
30	1850	Download data from data logger

Notes: Measurements taken 21 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, BHA = bottom-hole assembly, CDS = colleted delivery system, BOH = bottom of hole, spm = strokes per minute.

Table AT29. Event summary of T2P Deployment 7, Hole U1324B, 117.8 mbsf. (**See table notes.**)

Event number	Time (GMT)	Event description
1	2018	Start data logger at 1 Hz
2	2056	T2P on rig floor
3	2107	Start lowering T2P downhole, pumps on
4	2115	Stop at 511 mbsl, pumps off
5	2117	Start lowering probe, pumps on
6	2120	Stop at 761 mbsl, pumps off
7	2122	Start lowering probe, pumps on
8	2126	Stop at 1058 mbsl, pumps off
9	2130	Start lowering probe
10	2133	Stop at 1164 mbsl, pumps off
11	2140	Start lowering probe to land in BHA
12	2144	CDS lands in BHA, pumps off
13	2147	Start penetration of T2P into sediment
14	2148	End of T2P penetration, bit 1 m off BOH
15	2152	Raise BHA 2 m off BOH
16	2158	Pump at 14 spm
17	2228	Pull T2P uphole slowly with wireline
18	2233	CDS clear of BHA
19	2234	Stop at 1058 mbsl, pumps off
20	2236	Pull T2P uphole slowly with wireline
21	2240	Stop at 760 mbsl, pumps off
22	2242	Pull T2P uphole slowly with wireline
23	2246	Stop at 511 mbsl, pumps off
24	2248	Pull T2P uphole slowly with wireline
25	2255	Disconnect wireline from CDS
26	2256	Retract CDS
27	2258	Disconnect CDS from spacer
28	2259	Disconnect spacer from CDS
29	2301	T2P out of pipe
30	2308	Download data from data logger

Notes: Measurements taken 21 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, BHA = bottom-hole assembly, CDS = colleted delivery system, BOH = bottom of hole, spm = strokes per minute.

Table AT30. Event summary of T2P Deployment 8, Hole U1324B, 136.3 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0028	Start data logger at 1 Hz
2	0145	T2P on rig floor
3	0158	Start lowering T2P downhole, pumps on
4	0208	Stop at 511 mbsl, pumps off
5	0210	Start lowering probe, pumps on
6	0214	Stop at 761 mbsl, pumps off
7	0217	Start lowering probe, pumps on
8	0221	Stop at 1058 mbsl, pumps off
9	0223	Start lowering probe
10	0227	Stop at 1151 mbsl, pumps off
11	0232	Start lowering probe
12	0234	Stop at 1181 mbsl, pumps off
13	0238	Start lowering probe
14	0243	CDS lands in BHA, pumps off
15	0243	Start penetration of T2P into sediment
16	0244	End of T2P penetration, bit at BOH
17	0245	Raise BHA 1.5 m off BOH
18	0316	Pull T2P uphole slowly with wireline
19	0318	CDS clear of BHA
20	0320	Stop at 1058 mbsl, pumps off
21	0323	Pull T2P uphole slowly with wireline
22	0327	Stop at 761 mbsl, pumps off
23	0330	Pull T2P uphole slowly with wireline
24	0333	Stop at 511 mbsl, pumps off
25	0336	Pull T2P uphole slowly with wireline
26	0342	Disconnect wireline from CDS
27	0345	Disconnect CDS from spacer
28	0346	Disconnect spacer from CDS
29	0347	T2P out of pipe
30	0411	Download data from data logger

Notes: Measurements taken 22 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT31. Event summary of T2P Deployment 9, Hole U1324B, 368.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1328	Start data logger at 1 Hz
2	1457	T2P on rig floor
3	1511	Start lowering T2P downhole, pumps on
4	1528	Stop at 1058 mbsl, pumps off
5	1533	Start lowering probe
6	1545	Stop at 1432 mbsl, pumps off
7	1549	Start lowering probe
8	1553	CDS lands in BHA, pumps off
9	1554	Start penetration of T2P into sediment
10	1558	End of T2P penetration, bit at BOH
11	1559	Raise BHA 2 m off BOH
12	1640	Pull T2P uphole slowly with wireline
13	1648	Stop at 1058 mbsl, pumps off
14	1651	Pull T2P uphole slowly with wireline
15	1701	Disconnect wireline from CDS
16	1704	Disconnect CDS from spacer
17	1706	Disconnect spacer from CDS
18	1708	T2P out of pipe
19	1730	Download data from data logger

Notes: Measurements taken 23 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT32. Event summary of T2P Deployment 11, Hole U1324B, 593.2 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1802	Start data logger at 1 Hz
2	1818	T2P on rig floor
3	1831	Start lowering T2P downhole, pumps on
4	1842	Stop at 1068 mbsl, pumps off
5	1845	Start lowering probe
6	1850	Stop at 1510 mbsl, pumps off
7	1856	Start lowering probe
8	1858	CDS lands in BHA, pumps off
9	1914	Pull T2P uphole slowly with wireline
10	1925	Stop at 1067 mbsl, pumps off
11	1928	Pull T2P uphole slowly with wireline
12	1934	Disconnect wireline from CDS
13	1938	Disconnect CDS from spacer
14	1940	Disconnect spacer from CDS
15	1946	T2P out of pipe
16	2010	Download data from data logger

Notes: Measurements taken 25 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly.

Table AT33. Event summary of T2P Deployment 12, Hole U1324C, 50.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	1044	T2P on rig floor
3	1052	Start lowering T2P downhole, pumps on
4	1109	Stop at 491 mbsl, pumps off
5	1111	Start lowering probe
6	1114	Stop at 741 mbsl, pumps off
7	1119	Stop at 1057 mbsl, pumps off
8	1122	Stop at 1095 mbsl, pumps off
9	1128	Start lowering probe
10	1129	CDS lands in BHA, pumps off
11	1132	Start penetration of T2P into sediment
12	1140	End of T2P penetration, bit on BOH
13	1140	Raise BHA 4.5m off BOH
14	1241	Pull T2P uphole slowly with wireline
15	1244	Stop at 1057 mbsl, pumps off
16	1248	Pull T2P uphole slowly with wireline
17	1254	Stop at 741 mbsl, pumps off
18	1256	Pull T2P uphole slowly with wireline
19	1300	Stop at 491 mbsl, pumps off
20	1302	Pull T2P uphole slowly with wireline
21		Download data from data logger

Notes: Measurements taken 26 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT34. Event summary of T2P Deployment 13, Hole U1324C, 100.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1442	Start data logger at 1 Hz
2	1618	T2P on rig floor
3	1628	Start lowering T2P downhole, pumps on
4	1644	Stop at 741 mbsl, pumps off
5	1646	Start lowering probe
6	1652	Stop at 1057 mbsl, pumps off
7	1654	Start lowering probe
8	1703	CDS lands in BHA, pumps off
9	1704	Start penetration of T2P into sediment
10	1705	End of T2P penetration, bit 1 m off BOH
11	1706	Raise BHA 2 m off BOH
12	1808	Pull T2P uphole slowly with wireline
13	1811	Stop at 1057 mbsl, pumps off
14	1813	Pull T2P uphole slowly with wireline
15	1817	Stop at 741 mbsl, pumps off
16	1819	Pull T2P uphole slowly with wireline
17	1822	Stop at 491 mbsl, pumps off
18	1824	Pull T2P uphole slowly with wireline
19	1830	Disconnect wireline from CDS
20	1834	Disconnect CDS from spacer
21	1836	Disconnect spacer from CDS
22	1836	T2P out of pipe
23		Download data from data logger

Notes: Measurements taken 26 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT35. Event summary of T2P Deployment 14, Hole U1324C, 150.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	2128	Stop at 491 mbsl, pumps off
3	2130	Start lowering T2P
4	2135	Stop at 741 mbsl, pumps off
5	2137	Start lowering T2P
6	2143	Stop at 1057 mbsl, pumps off
7	2145	Start lowering T2P
8	2149	Stop at 1195 mbsl, pumps off
9	2152	Start lowering T2P
10	2155	CDS lands in BHA, pumps off
11	2156	Start penetration of T2P into sediment
12	2157	End of T2P penetration, bit on BOH
13	2157	Raise BHA 2.5 m off BOH
14	2302	Pull T2P uphole slowly with wireline
15	2309	Stop at 1057 mbsl, pumps off
16	2314	Pull T2P uphole slowly with wireline
17	2318	Stop at 741 mbsl, pumps off
18	2321	Pull T2P uphole slowly with wireline
19	2324	Stop at 491 mbsl, pumps off
20	2326	Pull T2P uphole slowly with wireline
21		Download data from data logger

Notes: Measurements taken 26 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT36. Event summary of T2P Deployment 15, Hole U1324C, 200.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	0049	Start data logger at 1 Hz
2	0156	T2P on rig floor
3	0209	Start lowering T2P downhole, pumps on
4	0217	Stop at 491 mbsl, pumps off
5	0219	Start lowering probe
6	0224	Stop at 741 mbsl, pumps off
7	0226	Start lowering probe
8	0232	Stop at 1057 mbsl, pumps off
9	0235	Start lowering probe
10	0240	Stop at 1245 mbsl, pumps off
11	0243	Start lowering probe
12	0247	CDS lands in BHA, pumps off
13	0248	Start penetration of T2P into sediment
14	0249	End of T2P penetration, bit 1 m off BOH
15	0252	Raise BHA 4.5 m off BOH
16	0353	Pull T2P uphole slowly with wireline
17	0356	Stop at 1057 mbsl, pumps off
18	0359	Pull T2P uphole slowly with wireline
19	0402	Stop at 741 mbsl, pumps off
20	0405	Pull T2P uphole slowly with wireline
21	0407	Stop at 491 mbsl, pumps off
22	0410	Pull T2P uphole slowly with wireline
23	0415	Disconnect wireline from CDS
24	0417	Disconnect CDS from spacer
25	0419	Disconnect spacer from CDS
26	0421	T2P out of pipe
27		Download data from data logger

Notes: Measurements taken 27 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT37. Event summary of T2P Deployment 16, Hole U1324C, 300.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	1118	Start lowering T2P downhole, pumps on
3	1137	Stop at 491 mbsl, pumps off
4	1139	Start lowering probe
5	1143	Stop at 741 mbsl, pumps off
6	1145	Start lowering probe
7	1149	Stop at 1057 mbsl, pumps off
8	1152	Start lowering probe
9	1157	Stop at 1345 mbsl, pumps off
10	1159	Start lowering probe
11	1205	Start penetration of T2P into sediment
12	1217	End of T2P penetration, bit on BOH
13	1222	Raise BHA 4m off BOH
14	1347	Pull T2P uphole slowly with wireline
15	1354	Stop at 1057 mbsl, pumps off
16	1357	Pull T2P uphole slowly with wireline
17	1402	Stop at 741 mbsl, pumps off
18	1404	Pull T2P uphole slowly with wireline
19	1409	Stop at 491 mbsl, pumps off
20	1411	Pull T2P uphole slowly with wireline
21		Download data from data logger

Notes: Measurements taken 27 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, BOH = bottom of hole, BHA = bottom-hole assembly.

Table AT38. Event summary of T2P Deployment 17, Hole U1322B, 42.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1839	Start data logger at 1 Hz
2	2010	T2P on rig floor
3	2022	Start lowering T2P downhole, pumps on
4	2029	Stop at 491 mbsl, pumps off
5	2031	Start lowering probe
6	2035	Stop at 741 mbsl, pumps off
7	2037	Start lowering probe
8	2043	Stop at 1321 mbsl, pumps off
9	2046	Start lowering probe
10	2048	Stop at 1351 mbsl, pumps off
11	2050	Start lowering probe
12	2057	CDS lands in BHA, pumps off
13	2057	Start penetration of T2P into sediment
14	2100	End of T2P penetration, bit on BOH
15	2100	Raise BHA 4.0 m off BOH
16	2207	Pull T2P uphole slowly with wireline
17	2210	Stop at 1321 mbsl, pumps off
18	2213	Pull T2P uphole slowly with wireline
19	2219	Stop at 741 mbsl, pumps off
20	2221	Pull T2P uphole slowly with wireline
21	2226	Stop at 491 mbsl, pumps off
22	2228	Pull T2P uphole slowly with wireline
23	2232	Disconnect wireline from CDS
24	2235	Disconnect CDS from spacer
25	2237	Disconnect spacer from CDS
26	2238	T2P out of pipe
27		Download data from data logger

Notes: Measurements taken 28 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT39. Event summary of T2P Deployment 19, Hole U1322B, 134.3 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	1230	Start lowering T2P downhole, pumps on
3	1236	Stop at 491 mbsl, pumps off
4	1238	Start lowering probe
5	1244	Stop at 741 mbsl, pumps off
6	1246	Start lowering probe
7	1303	Stop at 1321 mbsl, pumps off
8	1307	Start lowering probe
9	1334	Stop at 1443 mbsl, pumps off
10	1336	Start lowering probe
11	1341	CDS lands in BHA, pumps off
12	1352	Start penetration of T2P into sediment
13	1354	End of T2P penetration, bit on BOH
14	1354	Raise BHA 4.0 m off BOH
15	1425	Pull T2P uphole slowly with wireline
16	1429	Stop at 1321 mbsl, pumps off
17	1431	Pull T2P uphole slowly with wireline
18	1440	Stop at 741 mbsl, pumps off
19	1441	Pull T2P uphole slowly with wireline
20	1446	Stop at 491 mbsl, pumps off
21	1447	Pull T2P uphole slowly with wireline
22		Download data from data logger

Notes: Measurements taken 29 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT40. Event summary of T2P Deployment 20, Hole U1322B, 157.8 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	1815	T2P on rig floor
3	1838	Start lowering T2P downhole, pumps on
4	1846	Stop at 491 mbsl, pumps off
5	1849	Start lowering probe
6	1854	Stop at 741 mbsl, pumps off
7	1857	Start lowering probe
8	1905	Stop at 1321 mbsl, pumps off
9	1908	Start lowering probe
10	1913	Stop at 1467 mbsl, pumps off
11	1919	Start lowering probe
12	1936	CDS lands in BHA, pumps off
13	1936	Start penetration of T2P into sediment
14	1937	End of T2P penetration, bit on BOH
15	1937	Raise BHA 4.0 m off BOH
16	2043	Pull T2P uphole slowly with wireline
17	2110	Disconnect wireline from CDS
18	2113	Disconnect CDS from spacer
19	2114	Disconnect spacer from CDS
20	2215	T2P out of pipe
21		Download data from data logger

Notes: Measurements taken 29 June 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT41. Event summary of T2P Deployment 23, Hole U1322C, 150.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	0651	T2P on rig floor
3	0701	Start lowering T2P downhole, pumps on
4	0709	Stop at 491 mbsl, pumps off
5	0712	Start lowering probe
6	0717	Stop at 741 mbsl, pumps off
7	0719	Start lowering probe
8	0729	Stop at 1321 mbsl, pumps off
9	0743	Start lowering probe
10	0752	Stop at 1459 mbsl, pumps off
11	0754	Start lowering probe
12	0758	CDS lands in BHA, pumps off
13	0758	Start penetration of T2P into sediment
14	0802	End of T2P penetration, bit 1 m off BOH
15	0803	Raise BHA 4.0 m off BOH
16	0905	Pull T2P uphole slowly with wireline
17	0912	Stop at 1321 mbsl, pumps off
18	0914	Pull T2P uphole slowly with wireline
19	0924	Stop at 741 mbsl, pumps off
20	0926	Pull T2P uphole slowly with wireline
21	0932	Stop at 491 mbsl, pumps off
22	0934	Pull T2P uphole slowly with wireline
23		Download data from data logger

Notes: Measurements taken 1 July 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT42. Event summary of T2P Deployment 24, Hole U1322C, 200.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1	1201	Stop at 491 mbsl for 2 min
2	1208	Stop at 741 mbsl for 2.5 min
3	1222	Stop at 1321 mbsl for 3 min
4	1226	Stop at 1367 mbsl for 7 min
5	1239	Stop at 1509 mbsl, pumps off
6	1212	Start lowering probe
7	1248	CDS lands in BHA
8	1249	Lowering BHA, start penetration
9	1251	End of T2P penetration, bit 1 m off BOH
10	1251	Raise BHA 5 m off BOH
11	1351	Pull T2P uphole slowly with wireline
12	1357	Stop at 1321 mbsl for 2.5 min, pumps off
13	1409	Stop at 741 mbsl for 2 min, pumps off
14	1414	Stop at 491 mbsl for 3 min, pumps off
15	1416	Pull T2P uphole slowly with wireline

Notes: Measurements taken 1 July 2005. GMT = Greenwich Mean Time, CDS = colleted delivery system, BHA = bottom-hole assembly, T2P = temperature/dual pressure probe, BOH = bottom of hole.

Table AT43. Event summary of T2P Deployment 25, Hole U1322D, 40.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	0206	Start lowering T2P downhole, pumps on
3	0214	Stop at 491 mbsl, pumps off
4	0221	Stop at 741 mbsl, pumps off
5	0232	Stop at 1321 mbsl, pumps off
6	0238	Stop at 1349 mbsl, pumps off
7	0240	Start lowering probe
8	0245	CDS lands in BHA, pumps off
9	0246	Start penetration of T2P into sediment
10	0246	End of T2P penetration, bit 0.8 m off BOH
11	0246	Raise BHA 4.0 m off BOH
12	0349	Pull T2P uphole slowly with wireline
13	0352	Stop at 1321 mbsl, pumps off
14	0355	Pull T2P uphole slowly with wireline
15	0402	Stop at 741 mbsl, pumps off
16	0404	Pull T2P uphole slowly with wireline
17	0408	Stop at 491 mbsl, pumps off
18	0410	Pull T2P uphole slowly with wireline
19		Download data from data logger

Notes: Measurements taken 2 July 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT44. Event summary of T2P Deployment 26, Hole U1322D, 70.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	0632	T2P on rig floor
3	0656	Stop at 741 mbsl, pumps off
4	0707	Stop at 1321 mbsl, pumps off
5	0718	Stop at 1386 mbsl, pumps off
6	0720	Start lowering probe
7	0724	CDS lands in BHA, pumps off
8	0726	Start penetration of T2P into sediment
9	0727	End of T2P penetration, bit 0.8 m off BOH
10	0727	Raise BHA 4.0 m off BOH
11	0814	Pull T2P uphole slowly with wireline
12	0816	Stop at 1321 mbsl, pumps off
13	0826	Stop at 741 mbsl, pumps off
14	0832	Stop at 491 mbsl, pumps off
15		Download data from data logger

Notes: Measurements taken 2 July 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT45. Event summary of T2P Deployment 27, Hole U1322D, 100.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	1104	Stop at 491 mbsl, pumps off
3	1115	Stop at 741 mbsl, pumps off
4	1115	Stop at 1321 mbsl, pumps off
5	1124	Stop at 1409 mbsl, pumps off
6	1126	Start lowering T2P
7	1129	CDS lands in BHA, pumps off
8	1129	Start penetration of T2P into sediment
9	1130	End of T2P penetration, bit 0.8 m off BOH
10	1130	Raise BHA 4.0m off BOH
11	1216	Pull T2P uphole slowly with wireline
12	1219	Stop at 1321 mbsl, pumps off
13	1228	Stop at 741 mbsl, pumps off
14	1235	Stop at 491 mbsl, pumps off
15		Download data from data logger

Notes: Measurements taken 2 July 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe, CDS = colleted delivery system, BHA = bottom-hole assembly, BOH = bottom of hole.

Table AT46. Event summary of T2P Deployment 28, Hole U1322D, 134.0 mbsf. (See table notes.)

Event number	Time (GMT)	Event description
1		Start data logger at 1 Hz
2	1452	T2P on rig floor
3	1510	Stop at 491 mbsl, pumps off
4	1512	Start lowering probe
5	1515	Stop at 741 mbsl, pumps off
6	1516	Start lowering probe
7		Download data from data logger

Notes: Measurements taken 2 July 2005. GMT = Greenwich Mean Time, T2P = temperature/dual pressure probe.