# Data report: carbon stable isotope ratios of dissolved inorganic carbon in interstitial waters from IODP Expedition 303 Sites U1305, U1306, and U1307 (Eirik Drift)<sup>1</sup>

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## Abstract

In this data report, we present carbon stable isotope ( $\delta^{13}$ C) analyses of dissolved inorganic carbon (DIC) in interstitial water samples from Integrated Ocean Drilling Program Expedition 303 Sites U1305, U1306, and U1307 on the Eirik Drift in the Labrador Sea. A total of 84 interstitial water samples extracted on board were analyzed postcruise in this study. The low- to intermediate-resolution (from ~3 to 30 m interval) data allow us to identify downhole trends in  $\delta^{13}C_{DIC}$ . Our results show a downhole decreasing trend in  $\delta^{13}C_{DIC}$  in the upper ~50–80 meters below seafloor (mbsf) at the three sites studied. The most depleted  $\delta^{13}C_{DIC}$  values occur at 51.4, 85.8, and 79.2 mbsf at Sites U1305, U1306, and U1307, respectively. Below the depths of  $\delta^{13}C_{DIC}$  minima,  $\delta^{13}C_{DIC}$  values generally increase toward the bottom of the cored interval.

## Introduction

Carbon stable isotopic composition ( $\delta^{13}$ C) of dissolved inorganic carbon (DIC) in interstitial waters, as well as concentrations of other pore fluid chemical species, have been widely used to infer rates of subseafloor metabolic activities and carbonate diagenesis (Claypool et al., 2006; D'Hondt et al., 2004). Shipboard analyses of interstitial water chemistry and headspace gas at the Eirik Drift sites exhibit downhole sulfate and methane concentration profiles that indicate the presence of the sulfate/methane interface (see the "**Expedition 303 summary**" chapter). To further explore chemical signatures of subseafloor metabolisms and early diagenesis, we measured  $\delta^{13}$ C of DIC in interstitial waters from the Eirik Drift Sites U1305, U1306, and U1307 (Fig. **F1**). This report provides results of our shore-based analysis of interstitial waters from the three sites.

## Methods and materials

Samples for interstitial waters were extracted from either (1) 5 cm long whole-round sediment sections that were cut and capped immediately after core retrieval on deck or (2) small plug sediment samples of  $\sim 10$  cm<sup>3</sup> taken with a syringe from the ends of cut sections, also immediately after core retrieval. In the shipboard laboratory, whole-round sediment samples were removed

<sup>1</sup>Ennyu, A., and Malone, M.J., 2009. Data report: carbon stable isotope ratios of dissolved inorganic carbon in interstitial waters from IODP Expedition 303 Sites U1305, U1306, and U1307 (Eirik Drift). *In* Channell, J.E.T., Kanamatsu, T., Sato, T., Stein, R., Alvarez Zarikian, C.A., Malone, M.J., and the Expedition 303/306 Scientists, *Proc. IODP*, 303/ 306: College Station, TX (Integrated Ocean Drilling Program Management International, Inc.). doi:10.2204/iodp.proc.303306.207.2009 <sup>2</sup>Itochu Oil Exploration Co., Ltd., 2-5-1 Kita-Aoyama, Minato-ku, Tokyo 107-0061, Japan. **aennyu@usa.net** 

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from the core liner and the outside surfaces of the samples were carefully scraped off with spatulas to minimize potential contamination with drill fluids. Plug sediment samples were expelled from the syringe directly into squeezers. Fluids were extracted from sediments in Manheim titanium squeezers at ambient temperature with a Carver hydraulic press (Manheim and Sayles, 1974). Interstitial water samples discharged from the squeezer were passed through 0.45 µm polyethersulfone membrane filters and collected in plastic syringes. Aliquots for shorebased inorganic carbon isotope analysis were poisoned with saturated mercuric chloride solution and stored in 2 cm<sup>3</sup> glass vials sealed with butyl rubber septa and plastic screw caps. The glass vials were kept refrigerated until they were processed for isotopic analysis at a shore-based laboratory.

Interstitial water samples were analyzed for  $\delta^{13}$ C content of DIC at Oregon State University using the method described in Torres et al. (2005). In summary, this method loads ~0.15–0.7 mL of sample into a Thermo Fisher GasBench-II headspace sampler, which is online with Thermo Fisher Delta V Plus isotope ratio mass spectrometer. Replicate measurements during these analyses indicate precision to be better than ±0.15‰ (1 $\sigma$ ).

## Results

Results of carbon stable isotope analyses of interstitial waters from Sites U1305, U1306, and U1307 are shown in Figure F2 and are reported in Table T1. Our results indicate a downhole decreasing trend in  $\delta^{13}C_{DIC}$  in the upper ~50–80 meters below seafloor (mbsf) at the three sites studied. The most depleted  $\delta^{13}C_{DIC}$  value of approximately –34.1‰ is recorded at 79.15 mbsf at Site U1307. At Sites U1305 and U1306, the  $\delta^{13}C_{DIC}$  minima occur at 51.4 and 85.8 mbsf, respectively. Below the depth of  $\delta^{13}C_{DIC}$  minima, the  $\delta^{13}C_{DIC}$  values generally increase to approximately –3‰ toward the bottom of the cored interval.

Also presented in Figure F2 are dissolved sulfate  $(SO_4^{2-})$  and headspace methane  $(C_1)$  concentration profiles from shipboard measurements (see the "Site U1305," "Site U1306," and "Site U1307" chapters). The depth at which the most depleted  $\delta^{13}C_{\text{DIC}}$  value is recorded at each site typically coincides with the sulfate/methane interface inferred from the shipboard SO<sub>4</sub><sup>2-</sup> and C<sub>1</sub> profiles (Fig. F2).

### Acknowledgments

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**Figure F1.** Map showing locations of sites used in this study that were drilled during Expedition 303. Red circles = sites investigated for interstitial water carbon stable isotopes in this report. Bathymetric contours are in meters below sea level. This map was generated using Generic Mapping Tools (Wessel and Smith, 1998).





**Figure F2.** Carbon stable isotope ( $\delta^{13}$ C) records of dissolved inorganic carbon (DIC) from Sites U1305, U1306, and U1307. Also plotted are sulfate and methane concentration profiles measured on board during Expedition 303 (see the "**Site U1305**," "**Site U1306**," and "**Site U1307**" chapters). Light khaki bars = sulfate/methane interfaces inferred from the downhole chemical compositions at each site. The  $\delta^{13}$ C data are reported in Table **T1**. VPDB = Vienna Peedee belemnite standard.





**Table T1.** Carbon stable isotopes of pore water dissolved inorganic carbon, Sites U1305, U1306, and U1307. (See table notes.)

Core, section,	Depth	$\delta^{13}C$
interval (cm)	(mbsf)	(‰ VPDB)
303-U1305A-		
1H-1, 145–150	1.45	-10.99
1H-3, 145–150	4.45	-7.11
1H-5, 145–150	7.45	-12.58
2H-1, 145–150	10.35	-13.21
2H-3, 145–150	13.35	-14.22
2H-5, 145–150	16.35	-14.30
3H-1, 145–150	19.85	-16.77
3H-3, 145–150	22.85	-14.88
4H-1, 145–150	29.35	-20.45
4H-3, 145–150	32.35	-19.95
4H-5, 145–150	35.35	-22.44
5H-1, 145–150	38.85	-22.95
5H-3, 145–150	41.85	-24.82
5H-5, 145–150	44.85	-24.52
6H-1, 145–150	48.35	-26.23
6H-3, 145–150	51.35	-27.56
6H-5, 145–150	54.35	-26.72
7H-1, 145–150	57.85	-24.85
7H-5, 145–150	63.85	-21.40
8H-1, 145–150	67.35	-19.83
9H-1, 145–150	76.85	-17.40
10H-1, 145–150	86.35	-14.84
11H-1, 145–150	95.85	-13.21
12H-1, 145–150	105.35	-10.48
13H-1, 145–150	114.85	-9.47
16H-1, 145–150	143.35	-5.59
19H-1, 145–150	171.85	-3.58
22H-1, 145–150	200.35	-2.85
25H-1, 145–150	228.85	-4.19
28H-1, 145–150	257.35	-4.17
303-U1306A-		
1H-1, 145–150	1.45	-5.32
1H-3, 145–150	4.45	-7.10
1H-5, 145–150	7.45	-10.16
2H-1, 145–150	9.75	-11.59
2H-3, 145–150	12.75	-11.62
2H-5, 145–150	15.75	-12.27
3H-1, 145–150	19.25	-12.74
3H-3, 95–100	22.25	-13.09
4H-1, 145–150	28.75	-14.75
4H-3, 145–150	31.75	-14.03
4H-5, 145–150	34.75	-14.42
5H-1, 145–150	38.25	-15.53
5H-3, 145–150	41.25	-15.56

Core, section, interval (cm)         Depth (mbsf) $\delta^{13}C$ (% VPDB)           5H-6, 145-150         44.92         -16.20           6H-1, 145-150         47.75         -17.66           6H-3, 145-150         50.75         -16.96           6H-5, 145-150         53.75         -18.06           7H-1, 145-150         57.25         -19.02           8H-1, 145-150         76.25         -21.72           10H-1, 145-150         85.75         -22.44           11H-1, 145-150         114.25         -17.33           17H-1, 145-150         114.25         -17.33           17H-1, 145-150         144.25         -13.06           20H-1, 145-150         127.74         -9.64           23H-1, 145-150         127.74         -9.64           23H-1, 145-150         144.25         -13.06           20H-1, 145-150         145         -3.39           1H-1, 145-150         145         -3.39           1H-1, 145-150         286.75         -3.79           303-U1307A-         1142         -1.142           1H-1, 145-150         1.45         -5.40           1H-5, 145-150         1.45         -5.40           1H-5, 145-150         13.95			
interval (cm)         (mbsf)         (‰ VPDB)           SH-6, 145-150         44.92         -16.20           6H-1, 145-150         47.75         -17.66           6H-3, 145-150         50.75         -16.96           6H-5, 145-150         53.75         -18.06           7H-1, 145-150         57.25         -19.02           8H-1, 145-150         56.75         -21.72           10H-1, 145-150         76.25         -21.72           10H-1, 145-150         95.25         -19.18           13H-1, 145-150         144.25         -17.33           17H-1, 145-150         172.74         -9.64           23H-1, 145-150         172.74         -9.64           23H-1, 145-150         129.75         -5.38           26H-1, 145-150         268.75         -3.79           303-U1307A-         1H-1, 145-150         1.45         -3.39           1H-3, 145-150         1.45         -5.40         1H-5, 145-150         1.45         -5.40           1H-5, 145-150         1.45         -5.40         1H-5, 145-150         1.45         -17.27           2H-5, 145-150         16.95         -11.39         3H-1, 145-150         2.45         -17.02           2H-5, 145-150	Core, section,	Depth	δ <sup>13</sup> C
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	interval (cm)	(mbsf)	(‰ VPDB)
6H-1, $145-150$ $47.75$ $-17.66$ $6H-3$ , $145-150$ $50.75$ $-16.96$ $6H-5$ , $145-150$ $53.75$ $-18.06$ $7H-1$ , $145-150$ $57.25$ $-19.02$ $8H-1$ , $145-150$ $76.25$ $-21.72$ $10H-1$ , $145-150$ $85.75$ $-22.44$ $11H-1$ , $145-150$ $114.25$ $-17.33$ $17H-1$ , $145-150$ $114.25$ $-17.33$ $17H-1$ , $145-150$ $114.25$ $-17.33$ $17H-1$ , $145-150$ $114.25$ $-13.06$ $20H-1$ , $145-150$ $122.75$ $-5.38$ $20H-1$ , $145-150$ $229.75$ $-5.38$ $29H-1$ , $145-150$ $229.75$ $-5.38$ $29H-1$ , $145-150$ $286.75$ $-3.79$ $303-U1307A H-1$ , $145-150$ $1.45$ $1H-1$ , $145-150$ $1.45$ $-3.39$ $1H-3$ , $145-150$ $1.45$ $-3.39$ $1H-3$ , $145-150$ $1.45$ $-14.17$ $3H-3$ , $145-150$ $10.95$ $-910$ $2H-3$ , $145-150$ $16.95$ $-11.39$ $3H-1$ , $145-150$ $20.45$ $-17.02$ $4H-1$ , $145-150$ $29.95$ $-18.47$ $4H-3$ , $145-150$ $32.95$ $-17.27$ $4H-5$ , $145-150$ $35.95$ $-21.79$ $5H-1$ , $145-150$ $35.95$ $-21.79$ $5H-1$ , $145-150$ $35.95$ $-21.79$ $5H-1$ , $145-150$ $35.95$ $-27.56$ $7H-3$ , $145-150$ $39.45$ $-22.45$ $5H-5$ , $145-150$ $59.95$ $-27.13$ $7H-5$ , $145-150$ $59.95$ $-27.1$	5H-6, 145–150	44.92	-16.20
6H-3 $145-150$ $50.75$ $-16.96$ $6H-5$ $145-150$ $53.75$ $-18.06$ $7H-1$ $145-150$ $57.25$ $-19.02$ $8H-1$ $145-150$ $66.75$ $-18.23$ $9H-1$ $145-150$ $65.75$ $-22.44$ $11H-1$ $145-150$ $95.25$ $-19.18$ $13H-1$ $145-150$ $114.25$ $-17.33$ $17H-1$ $145-150$ $114.25$ $-17.33$ $17H-1$ $145-150$ $114.25$ $-13.06$ $20H-1$ $145-150$ $114.25$ $-13.06$ $20H-1$ $145-150$ $114.25$ $-6.38$ $26H-1$ $145-150$ $212.5$ $-6.38$ $26H-1$ $145-150$ $229.75$ $-5.38$ $29H-1$ $145-150$ $286.75$ $-3.79$ $303-U1307A 1H-1$ $145-150$ $1.45$ $1H-5$ $145-150$ $1.45$ $-5.40$ $1H-5$ $145-150$ $1.45$ $-5.40$ $1H-5$ $145-150$ $1.45$ $-5.40$ $1H-5$ $145-150$ $1.45$ $-7.14$ $2H-1$ $145-150$ $10.95$ $-910$ $2H-3$ $145-150$ $10.95$ $-11.39$ $3H-1$ $145-150$ $20.45$ $-17.02$ $4H-1$ $145-150$ $29.95$ $-18.47$ $4H-3$ $145-150$ $32.95$ $-17.27$ $4H-5$ $145-150$ $32.95$ $-27.55$ $5H-5$ $145-150$ $39.45$ $-22.45$ $5H-5$ $145-150$ $39.45$ $-22.45$ <t< td=""><td>6H-1, 145–150</td><td>47.75</td><td>-17.66</td></t<>	6H-1, 145–150	47.75	-17.66
6H-5, 145-150       53.75       -18.06         7H-1, 145-150       57.25       -19.02         8H-1, 145-150       66.75       -18.23         9H-1, 145-150       76.25       -21.72         10H-1, 145-150       85.75       -22.44         11H-1, 145-150       95.25       -19.18         13H-1, 145-150       114.25       -13.06         20H-1, 145-150       142.5       -13.06         20H-1, 145-150       172.74       -9.64         23H-1, 145-150       172.74       -9.64         23H-1, 145-150       172.74       -9.64         23H-1, 145-150       125       -6.38         26H-1, 145-150       125       -6.38         26H-1, 145-150       229.75       -5.38         29H-1, 145-150       1.45       -3.39         1H-3, 145-150       1.45       -3.39         1H-3, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -13.9         3H-1, 145-150       1.45       -13.9         3H-1, 145-150       2.45       -11.39         3H-1, 145-150       2.45       -17.02         4H-1, 145-150	6H-3, 145–150	50.75	-16.96
7H-1, 145-150       57.25       -19.02         8H-1, 145-150       57.25       -19.02         8H-1, 145-150       66.75       -18.23         9H-1, 145-150       76.25       -21.72         10H-1, 145-150       85.75       -22.44         11H-1, 145-150       114.25       -17.33         17H-1, 145-150       114.25       -17.33         17H-1, 145-150       114.25       -17.33         17H-1, 145-150       172.74       -9.64         23H-1, 145-150       172.74       -9.64         23H-1, 145-150       201.25       -6.38         26H-1, 145-150       202.75       -5.38         29H-1, 145-150       286.75       -3.79         303-U1307A-       1H-1, 145-150       1.45       -3.39         1H-3, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -7.14         2H-1, 145-150       1.95       -10.32         2H-5, 145-150       1.695       -11.39         3H-1, 145-150       2.45       -17.02         4H-1, 145-150       2.945       -14.17         3H-3, 145-150       2.945       -17.27         4H-5, 145-150       32.95       -17.27	6H-5, 145–150	53.75	-18.06
8H-1, 145-150       66.75       -18.23         9H-1, 145-150       76.25       -21.72         10H-1, 145-150       85.75       -22.44         11H-1, 145-150       114.25       -17.33         17H-1, 145-150       114.25       -17.33         17H-1, 145-150       114.25       -13.06         20H-1, 145-150       172.74       -9.64         23H-1, 145-150       201.25       -6.38         26H-1, 145-150       202.5       -5.38         29H-1, 145-150       286.75       -3.79         303-U1307A-       1H-1, 145-150       1.45       -3.39         1H-3, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -7.14         2H-1, 145-150       1.95       -9.10         2H-3, 145-150       1.95       -9.10         2H-3, 145-150       1.95       -9.10         2H-3, 145-150       1.95       -9.10         2H-3, 145-150       1.95       -10.32         2H-3, 145-150       2.45       -11.39         3H-1, 145-150       2.45       -17.02         4H-1, 145-150       2.9.5       -17.27         4H-3, 145-150       3.9.5       -21.79	7H-1, 145–150	57.25	-19.02
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	8H-1 145-150	66 75	_18 23
10H-1, 145-150       85.75       -22.44         11H-1, 145-150       85.75       -19.18         13H-1, 145-150       114.25       -17.33         17H-1, 145-150       144.25       -13.06         20H-1, 145-150       172.74       -9.64         23H-1, 145-150       201.25       -6.38         26H-1, 145-150       209.75       -5.38         29H-1, 145-150       258.25       -4.02         32H-1, 145-150       286.75       -3.79         303-U1307A-       1H-1, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -5.40         1H-5, 145-150       1.695       -9.10         2H-3, 145-150       1.695       -11.39         3H-1, 145-150       2.45       -17.02         2H-5, 145-150       2.45       -17.02         2H-5, 145-150       2.45       -17.02         4H-1, 145-150       2.995       -18.47         4H-3, 145-150       3.945       -22.45         SH-5, 145-150       35.95       -21.79         SH-1, 145-150       39.45       -22.45         SH-5, 145-150       39.45       -22.45	9H-1 145-150	76.25	-21 72
11H-1, 145-150       95.25       -19.18         13H-1, 145-150       114.25       -17.33         17H-1, 145-150       144.25       -13.06         20H-1, 145-150       172.74       -9.64         23H-1, 145-150       201.25       -6.38         26H-1, 145-150       229.75       -5.38         29H-1, 145-150       286.75       -3.79         303-U1307A-       1H-1, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -7.14         2H-1, 145-150       1.695       -910         2H-3, 145-150       10.95       -910         2H-3, 145-150       16.95       -11.39         3H+1, 145-150       20.45       -17.02         2H-5, 145-150       26.45       -17.02         4H-1, 145-150       29.95       -18.47         4H-3, 145-150       29.95       -18.47         4H-3, 145-150       39.45       -22.45         5H-5, 145-150       35.95       -21.79         5H-1, 145-150       39.45       -22.45         5H-5, 145-150       39.45       -22.45	10H-1 145-150	85 75	_27.72
13H-1, 145-150       114.25       -17.33         17H-1, 145-150       114.25       -13.06         20H-1, 145-150       172.74       -9.64         23H-1, 145-150       201.25       -6.38         26H-1, 145-150       229.75       -5.38         29H-1, 145-150       286.75       -3.79         303-U1307A-       1H-1, 145-150       1.45       -3.39         1H-3, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -5.40         1H-5, 145-150       1.45       -7.14         2H-1, 145-150       1.45       -9.10         2H-3, 145-150       1.95       -9.10         2H-3, 145-150       13.95       -10.32         2H-5, 145-150       16.95       -11.39         3H-1, 145-150       20.45       -14.17         3H-3, 145-150       20.45       -17.02         4H-1, 145-150       29.95       -18.47         4H-3, 145-150       29.95       -18.47         4H-3, 145-150       39.45       -22.45         5H-5, 145-150       39.45       -22.45         5H-5, 145-150       45.42       -15.81         6H-1, 145-150       39.95       -27.55	11H-1 145-150	95 25	_19.18
17H-1, 145-150       144.25       -13.06         20H-1, 145-150       172.74       -9.64         23H-1, 145-150       172.74       -9.64         23H-1, 145-150       172.74       -9.64         23H-1, 145-150       229.75       -5.38         29H-1, 145-150       229.75       -5.38         29H-1, 145-150       286.75       -3.79         303-U1307A-       1H-1, 145-150       1.45       -3.39         1H-3, 145-150       1.45       -5.40         1H-5, 145-150       7.45       -7.14         2H-1, 145-150       1.45       -9.10         2H-3, 145-150       1.95       -10.32         2H-5, 145-150       16.95       -11.39         3H-1, 145-150       20.45       -14.17         3H-3, 145-150       23.45       -13.14         3H-5, 145-150       26.45       -17.02         4H-1, 145-150       29.95       -18.47         4H-3, 145-150       32.95       -17.27         4H-5, 145-150       35.95       -21.79         SH-5, 145-150       35.95       -21.79         SH-5, 145-150       45.42       -15.81         6H-1, 145-150       39.95       -27.55 <t< td=""><td>13H_1 145_150</td><td>114 25</td><td>_17.33</td></t<>	13H_1 145_150	114 25	_17.33
20H-1, 145-150       172.74       -9.64         23H-1, 145-150       201.25       -6.38         26H-1, 145-150       201.25       -6.38         26H-1, 145-150       229.75       -5.38         29H-1, 145-150       258.25       -4.02         32H-1, 145-150       286.75       -3.79         303-U1307A-       1H-1, 145-150       1.45       -3.39         1H-3, 145-150       1.45       -3.39         1H-3, 145-150       1.45       -5.40         1H-5, 145-150       7.45       -7.14         2H-1, 145-150       10.95       -9.10         2H-3, 145-150       16.95       -11.39         3H-1, 145-150       20.45       -14.17         3H-3, 145-150       26.45       -17.02         4H-1, 145-150       29.95       -18.47         4H-3, 145-150       32.95       -17.27         4H-5, 145-150       35.95       -21.79         SH-1, 145-150       35.95       -21.79         SH-1, 145-150       35.95       -27.55         7H-1, 145-150       35.95       -27.55         7H-1, 145-150       58.95       -27.13         7H-5, 145-150       59.95       -29.19	17H-1 145-150	144 25	-13.06
23H-1, 145-150201.25-6.3823H-1, 145-150201.25-6.3826H-1, 145-150229.75-5.3829H-1, 145-150258.25-4.0232H-1, 145-150286.75-3.79303-U1307A-1H-1, 145-1501.451H-3, 145-1504.45-5.401H-5, 145-1507.45-7.142H-1, 145-15010.95-9.102H-3, 145-15010.95-10.322H-5, 145-15016.95-11.393H-1, 145-15020.45-14.173H-3, 145-15026.45-17.024H-1, 145-15029.95-18.474H-3, 145-15032.95-17.274H-5, 145-15035.95-21.795H-1, 145-15039.45-22.455H-5, 145-15056.95-27.557H-1, 145-15059.95-29.198H-1, 145-15059.95-29.198H-1, 145-15059.95-29.198H-1, 145-15059.95-29.198H-1, 145-15079.15-34.091H-1, 145-150107.65-23.4316H-3, 145-150130.15ND19H-1, 145-150130.15ND19H-1, 145-150130.15ND	20H-1 145 150	172 74	9.64
26H-1, 145-150         2075         -5.38           26H-1, 145-150         229.75         -5.38           29H-1, 145-150         258.25         -4.02           32H-1, 145-150         286.75         -3.79           303-U1307A-         1H-1, 145-150         1.45         -3.39           1H-3, 145-150         1.45         -5.40           1H-5, 145-150         1.45         -5.40           1H-5, 145-150         1.45         -7.14           2H-1, 145-150         10.95         -9.10           2H-3, 145-150         13.95         -10.32           2H-5, 145-150         16.95         -11.39           3H-1, 145-150         20.45         -14.17           3H-3, 145-150         23.45         -13.14           3H-5, 145-150         26.45         -17.02           4H-1, 145-150         29.95         -18.47           4H-3, 145-150         32.95         -17.27           4H-5, 145-150         35.95         -21.79           5H-1, 145-150         39.45         -22.45           5H-5, 145-150         48.95         -27.55           7H-1, 145-150         59.95         -29.19           8H-1, 145-150         59.95         -29.19<	23H-1 145 150	201 25	6 38
29H-1, 145-150         252.7.5         -4.02           29H-1, 145-150         258.25         -4.02           303-U1307A-         1H-1, 145-150         1.45         -3.79           303-U1307A-         1H-1, 145-150         1.45         -3.39           1H-3, 145-150         1.45         -5.40           1H-5, 145-150         7.45         -7.14           2H-1, 145-150         10.95         -9.10           2H-3, 145-150         13.95         -10.32           2H-5, 145-150         16.95         -11.39           3H-1, 145-150         20.45         -17.02           2H-3, 145-150         26.45         -17.02           4H-1, 145-150         29.95         -18.47           4H-3, 145-150         32.95         -17.27           4H-5, 145-150         35.95         -21.79           5H-1, 145-150         39.45         -22.45           5H-5, 145-150         39.45         -22.45           5H-5, 145-150         39.95         -27.56           7H-3, 145-150         59.95         -29.19           8H-1, 145-150         59.95         -29.19           8H-1, 145-150         79.15         -34.09           1H+1, 145-150	26H-1 145 150	201.25	-0.30
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	20H-1 145-150	258 25	-3.50
303-U1307A-           1H-1, 145-150         1.45           1H-3, 145-150         1.45           1H-5, 145-150         1.45           1H-5, 145-150         7.45           2H-5, 145-150         10.95           2H-5, 145-150         10.95           2H-5, 145-150         10.95           3H-1, 145-150         20.45           3H-1, 145-150         20.95           3H-1, 145-150         29.95           4H-3, 145-150         32.95           95         -11.27           4H-3, 145-150         39.45           22.45         5H-5, 145-150           5H-5, 145-150         39.45           22.45         5H-5, 145-150           5H-5, 145-150         59.95           29.19         5H-1, 145-150           8H-1, 145-150         59.95           7H-3, 145-150         59.95           99.65         -26.63           13H-1, 145-150         99.65           94.5         -26.63           13H-1, 145-150	32H-1 145 150	230.23	3 70
303-U1307A-           1H-1, 145-150         1.45         -3.39           1H-3, 145-150         4.45         -5.40           1H-5, 145-150         7.45         -7.14           2H-1, 145-150         10.95         -9.10           2H-3, 145-150         13.95         -10.32           2H-5, 145-150         16.95         -11.39           3H-1, 145-150         20.45         -14.17           3H-3, 145-150         26.45         -17.02           4H-1, 145-150         29.95         -18.47           4H-3, 145-150         32.95         -17.27           4H-5, 145-150         39.45         -22.45           5H-5, 145-150         45.42         -15.81           6H-1, 145-150         39.45         -27.55           7H-1, 145-150         59.95         -29.19           8H-1, 145-150         79.15         -34.09           1H+1, 145-150         79.65         -26.63           13H-1, 145-150         107.65 <td>5211-1, 145-150</td> <td>200.75</td> <td>-5.77</td>	5211-1, 145-150	200.75	-5.77
1H-1, 145-150       1.45       -3.39         1H-3, 145-150       4.45       -5.40         1H-5, 145-150       7.45       -7.14         2H-1, 145-150       10.95       -9.10         2H-3, 145-150       13.95       -10.32         2H-5, 145-150       13.95       -11.39         3H-1, 145-150       20.45       -14.17         3H-3, 145-150       23.45       -13.14         3H-5, 145-150       26.45       -17.02         4H-1, 145-150       29.95       -18.47         4H-3, 145-150       32.95       -17.27         4H-5, 145-150       35.95       -21.79         5H-1, 145-150       35.95       -22.45         5H-5, 145-150       45.42       -15.81         6H-1, 145-150       48.95       -27.55         7H-1, 145-150       59.95       -29.19         8H-1, 145-150       59.95       -29.19         8H-1, 145-150       59.95       -29.19         8H-1, 145-150       63.45       -30.35         10H-1, 145-150       79.15       -34.09         11H-1, 145-150       107.65       -23.43         16H-3, 145-150       107.65       -23.43         16H-3, 145-150<	303-U1307A-		
1H-3, 145–150       4.45       -5.40         1H-5, 145–150       7.45       -7.14         2H-1, 145–150       10.95       -9.10         2H-3, 145–150       13.95       -10.32         2H-5, 145–150       16.95       -11.39         3H-1, 145–150       20.45       -14.17         3H-3, 145–150       26.45       -17.02         4H-1, 145–150       29.95       -18.47         4H-3, 145–150       32.95       -17.27         4H-5, 145–150       35.95       -21.79         5H-5, 145–150       35.95       -22.45         5H-5, 145–150       45.42       -15.81         6H-1, 145–150       48.95       -27.55         7H-1, 145–150       59.95       -29.19         8H-1, 145–150       59.95       -29.19         8H-1, 145–150       59.95       -29.19         8H-1, 145–150       58.65       -31.39         10H-1, 145–150       88.65       -31.94         12H-2, 145–150       107.65       -23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       130.15       ND	1H-1, 145–150	1.45	-3.39
1H-5, 145-150       7.45       -7.14         2H-1, 145-150       10.95       -9.10         2H-3, 145-150       13.95       -10.32         2H-5, 145-150       16.95       -11.39         3H-1, 145-150       20.45       -14.17         3H-3, 145-150       23.45       -13.14         3H-5, 145-150       26.45       -17.02         4H-1, 145-150       29.95       -18.47         4H-3, 145-150       32.95       -17.27         4H-5, 145-150       35.95       -21.79         5H-5, 145-150       35.95       -22.45         5H-5, 145-150       45.42       -15.81         6H-1, 145-150       59.95       -27.55         7H-1, 145-150       59.95       -27.13         7H-5, 145-150       59.95       -29.19         8H-1, 145-150       59.95       -29.19         8H-1, 145-150       63.45       -30.35         10H-1, 145-150       79.15       -34.09         11H-1, 145-150       107.65       -23.43         16H-3, 145-150       107.65       -23.43         16H-3, 145-150       130.15       ND         19H-1, 145-150       130.15       ND	1H-3, 145–150	4.45	-5.40
2H-1, 145-150       10.95       -9.10         2H-3, 145-150       13.95       -10.32         2H-5, 145-150       13.95       -11.39         3H-1, 145-150       20.45       -14.17         3H-3, 145-150       23.45       -13.14         3H-5, 145-150       26.45       -17.02         4H-1, 145-150       29.95       -18.47         4H-3, 145-150       32.95       -17.27         4H-5, 145-150       39.45       -22.45         5H-5, 145-150       39.45       -21.79         5H-1, 145-150       39.45       -22.45         5H-5, 145-150       48.95       -27.55         7H-1, 145-150       53.95       -27.13         7H-5, 145-150       59.95       -29.19         8H-1, 145-150       59.95       -29.19         8H-1, 145-150       79.15       -34.09         1H+1, 145-150       79.65       -26.63         13H-1, 145-150       107.65       -23.43         16H-3, 145-150       130.15       ND         19H-1, 145-150       130.15       ND	1H-5, 145–150	7.45	-7.14
2H-3, 145-150       13.95       -10.32         2H-5, 145-150       16.95       -11.39         3H-1, 145-150       20.45       -14.17         3H-3, 145-150       23.45       -13.14         3H-5, 145-150       26.45       -17.02         4H-1, 145-150       29.95       -18.47         4H-3, 145-150       32.95       -17.27         4H-5, 145-150       35.95       -21.79         5H-1, 145-150       39.45       -22.45         5H-5, 145-150       45.42       -15.81         6H-1, 145-150       59.95       -27.56         7H-3, 145-150       59.95       -29.19         8H-1, 145-150       59.95       -29.19         8H-1, 145-150       59.95       -29.19         8H-1, 145-150       59.95       -29.19         8H-1, 145-150       79.15       -34.09         1H-1, 145-150       79.15       -34.09         1H-1, 145-150       107.65       -23.43         16H-3, 145-150       107.65       -23.43         16H-3, 145-150       130.15       ND         19H-1, 145-150       154.55       -9.75	2H-1, 145–150	10.95	-9.10
2H-5, 145–150       16.95       -11.39         3H-1, 145–150       20.45       -14.17         3H-3, 145–150       23.45       -13.14         3H-5, 145–150       26.45       -17.02         4H-1, 145–150       26.45       -17.02         4H-1, 145–150       29.95       -18.47         4H-3, 145–150       32.95       -17.27         4H-5, 145–150       35.95       -21.79         5H-1, 145–150       39.45       -22.45         5H-5, 145–150       45.42       -15.81         6H-1, 145–150       58.95       -27.55         7H-1, 145–150       59.95       -29.19         8H-1, 145–150       59.95       -29.19         8H-1, 145–150       63.45       -30.35         10H-1, 145–150       79.15       -34.09         11H-1, 145–150       99.65       -26.63         13H-1, 145–150       107.65       -23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       130.15       ND	2H-3, 145–150	13.95	-10.32
3H-1, 145-150       20.45       -14.17         3H-3, 145-150       23.45       -13.14         3H-5, 145-150       26.45       -17.02         4H-1, 145-150       29.95       -18.47         4H-3, 145-150       32.95       -17.27         4H-5, 145-150       35.95       -21.79         5H-1, 145-150       39.45       -22.45         5H-1, 145-150       48.95       -27.55         7H-1, 145-150       58.95       -27.13         7H-5, 145-150       59.95       -29.19         8H-1, 145-150       59.95       -29.19         8H-1, 145-150       63.45       -30.35         10H-1, 145-150       79.15       -34.09         11H-1, 145-150       107.65       -23.43         16H-3, 145-150       107.65       -23.43         16H-3, 145-150       130.15       ND         19H-1, 145-150       154.55       -9.75	2H-5, 145–150	16.95	-11.39
3H-3, 145–150       23.45       -13.14         3H-5, 145–150       26.45       -17.02         4H-1, 145–150       29.95       -18.47         4H-3, 145–150       32.95       -17.27         4H-5, 145–150       35.95       -21.79         5H-1, 145–150       39.45       -22.45         5H-5, 145–150       45.42       -15.81         6H-1, 145–150       53.95       -27.55         7H-1, 145–150       56.95       -27.13         7H-5, 145–150       59.95       -29.19         8H-1, 145–150       59.95       -29.19         8H-1, 145–150       63.45       -30.35         10H-1, 145–150       79.15       -34.09         11H-1, 145–150       107.65       -23.43         16H-3, 145–150       107.65       -23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       154.55       -9.75	3H-1, 145–150	20.45	-14.17
3H-5, 145–150       26.45       -17.02         4H-1, 145–150       29.95       -18.47         4H-3, 145–150       32.95       -17.27         4H-5, 145–150       35.95       -21.79         5H-1, 145–150       39.45       -22.45         5H-5, 145–150       45.42       -15.81         6H-1, 145–150       48.95       -27.55         7H-1, 145–150       53.95       -29.19         8H-1, 145–150       56.95       -27.13         7H-5, 145–150       63.45       -30.35         10H-1, 145–150       63.45       -30.35         10H-1, 145–150       88.65       -31.94         12H-2, 145–150       107.65       -23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       154.55       -9.75	3H-3, 145–150	23.45	-13.14
4H-1, 145–150       29.95       -18.47         4H-3, 145–150       32.95       -17.27         4H-5, 145–150       35.95       -21.79         5H-5, 145–150       35.95       -22.45         5H-5, 145–150       45.42       -15.81         6H-1, 145–150       48.95       -27.55         7H-1, 145–150       58.95       -27.13         7H-5, 145–150       59.95       -29.19         8H-1, 145–150       63.45       -30.35         10H-1, 145–150       79.15       -34.09         11H-1, 145–150       99.65       -26.63         13H-1, 145–150       107.65       -23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       154.55       -9.75	3H-5, 145–150	26.45	-17.02
4H-3, 145–150       32.95       -17.27         4H-5, 145–150       35.95       -21.79         5H-1, 145–150       39.45       -22.45         5H-5, 145–150       48.95       -27.55         7H-1, 145–150       58.95       -27.55         7H-1, 145–150       58.95       -27.56         7H-3, 145–150       56.95       -27.13         7H-5, 145–150       59.95       -29.19         8H-1, 145–150       63.45       -30.35         10H-1, 145–150       79.15       -34.09         11H-1, 145–150       99.65       -26.63         13H-1, 145–150       107.65       -23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       154.55       -9.75	4H-1, 145–150	29.95	-18.47
4H-5, 145–150         35.95         -21.79           5H-1, 145–150         39.45         -22.45           5H-5, 145–150         45.42         -15.81           6H-1, 145–150         48.95         -27.55           7H-1, 145–150         53.95         -27.56           7H-3, 145–150         56.95         -27.13           7H-5, 145–150         59.95         -29.19           8H-1, 145–150         63.45         -30.35           10H-1, 145–150         79.15         -34.09           11H-1, 145–150         99.65         -26.63           13H-1, 145–150         107.65         -23.43           16H-3, 145–150         130.15         ND           19H-1, 145–150         130.15         ND	4H-3, 145–150	32.95	-17.27
SH-1, 145–150       39.45       -22.45         SH-5, 145–150       45.42       -15.81         6H-1, 145–150       48.95       -27.55         7H-1, 145–150       53.95       -27.56         7H-3, 145–150       56.95       -27.13         7H-5, 145–150       59.95       -29.19         8H-1, 145–150       63.45       -30.35         10H-1, 145–150       79.15       -34.09         11H-1, 145–150       88.65       -31.94         12H-2, 145–150       99.65       -26.63         13H-1, 145–150       107.65       -23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       154.55       -9.75	4H-5, 145–150	35.95	-21.79
5H-5, 145–150       45.42       –15.81         6H-1, 145–150       48.95       –27.55         7H-1, 145–150       53.95       –27.13         7H-3, 145–150       59.95       –29.19         8H-1, 145–150       63.45       –30.35         10H-1, 145–150       79.15       –34.09         11H-1, 145–150       88.65       –31.94         12H-2, 145–150       99.65       –26.63         13H-1, 145–150       107.65       –23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       154.55       –9.75	5H-1, 145–150	39.45	-22.45
6H-1, 145–150         48.95         -27.55           7H-1, 145–150         53.95         -27.56           7H-3, 145–150         56.95         -27.13           7H-5, 145–150         59.95         -29.19           8H-1, 145–150         63.45         -30.35           10H-1, 145–150         79.15         -34.09           11H-1, 145–150         88.65         -31.94           12H-2, 145–150         99.65         -26.63           13H-1, 145–150         107.65         -23.43           16H-3, 145–150         130.15         ND           19H-1, 145–150         154.55         -9.75	5H-5, 145–150	45.42	-15.81
7H-1, 145–150       53.95       -27.56         7H-3, 145–150       56.95       -27.13         7H-5, 145–150       59.95       -29.19         8H-1, 145–150       63.45       -30.35         10H-1, 145–150       79.15       -34.09         11H-1, 145–150       99.65       -26.63         13H-1, 145–150       107.65       -23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       154.55       -9.75	6H-1, 145–150	48.95	-27.55
7H-3, 145–150       56.95       -27.13         7H-5, 145–150       59.95       -29.19         8H-1, 145–150       63.45       -30.35         10H-1, 145–150       79.15       -34.09         11H-1, 145–150       88.65       -31.94         12H-2, 145–150       107.65       -22.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       154.55       -9.75	7H-1, 145–150	53.95	-27.56
7H-5, 145–150       59.95       -29.19         8H-1, 145–150       63.45       -30.35         10H-1, 145–150       79.15       -34.09         11H-1, 145–150       89.65       -31.94         12H-2, 145–150       107.65       -23.43         16H-3, 145–150       130.15       ND         19H-1, 145–150       154.55       -9.75	7H-3, 145–150	56.95	-27.13
8H-1, 145–150         63.45         -30.35           10H-1, 145–150         79.15         -34.09           11H-1, 145–150         88.65         -31.94           12H-2, 145–150         99.65         -26.63           13H-1, 145–150         107.65         -23.43           16H-3, 145–150         130.15         ND           19H-1, 145–150         154.55         -9.75	7H-5, 145–150	59.95	-29.19
10H-1, 145–150         79.15         -34.09           11H-1, 145–150         88.65         -31.94           12H-2, 145–150         99.65         -26.63           13H-1, 145–150         107.65         -23.43           16H-3, 145–150         130.15         ND           19H-1, 145–150         154.55         -9.75	8H-1, 145–150	63.45	-30.35
11H-1, 145–150         88.65         -31.94           12H-2, 145–150         99.65         -26.63           13H-1, 145–150         107.65         -23.43           16H-3, 145–150         130.15         ND           19H-1, 145–150         154.55         -9.75	10H-1, 145–150	79.15	-34.09
12H-2, 145–150         99.65         -26.63           13H-1, 145–150         107.65         -23.43           16H-3, 145–150         130.15         ND           19H-1, 145–150         154.55         -9.75	11H-1, 145–150	88.65	-31.94
13H-1, 145–150         107.65         -23.43           16H-3, 145–150         130.15         ND           19H-1, 145–150         154.55         -9.75	12H-2, 145–150	99.65	-26.63
16H-3, 145–150 130.15 ND 19H-1, 145–150 154.55 –9.75	13H-1, 145–150	107.65	-23.43
19H-1, 145–150 154.55 –9.75	16H-3, 145–150	130.15	ND
	19H-1, 145–150	154.55	-9.75

Notes: VPDB = Vienna Peedee belemnite. ND = not determined.

