Supplementary Material

S1 Calibration of GeoB18116-2 Dry Bulk Density (DBD) from CT scan data and pycnometer density measurements

CT analysis can be utilized reliably for sediment core density analyses (*sensu* Orsi *et al.*, 1994; Gerland and Villinger, 1995) with the advantage of much higher resolution, non-invasive sampling and substantial reduction of lab work. This is based on a general link between the density of an object and the attenuation of x-rays by the object (Orsi and Anderson, 1999; Duchesne *et al.*, 2009).

Upon comparing the Pycnometer-based classical density measurements of GeoB18116-2 with the 5 cm-average values from the CT on "Mean x-ray attenuation of matrix sediment [HU]", a high correlation was found (R^2 = 0.89; p-val. = < 0.0001, Spearman's test; normally distributed according to Shapiro-wilk test; no heteroscedasticity, Breusch-Pagan test p = 0.45). This regression-based validation method illustrates how CT data can be used as a proxy for DBD. Therefore, we here use our lab-measured pycnometer-based density samples throughout the record to calibrate the density profile of the entire core (see Orsi and Anderson, 1999). Assuming a linear regression equation of Y = 868 * X + 205, with DBD as independent variable, we calculated density X from CT mean x-ray attenuation Y (see Fig. 1).

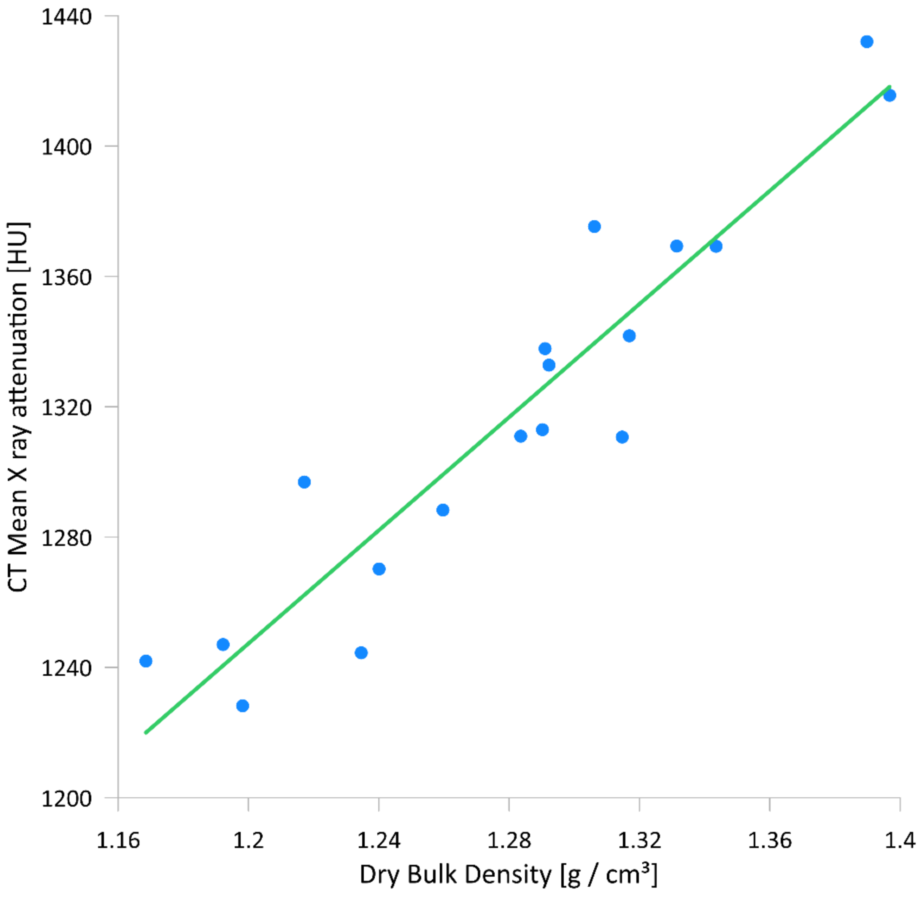

Fig. S1: Cross-Plot with linear regression fit, plotting Dry Bulk Density (measured with pycnometer) agains mean X ray attenuation (CT derived high-resolution data). Regression function Y = 868 * X + 205.

S2 Raw Data of TIC/TOC and Density Measurements

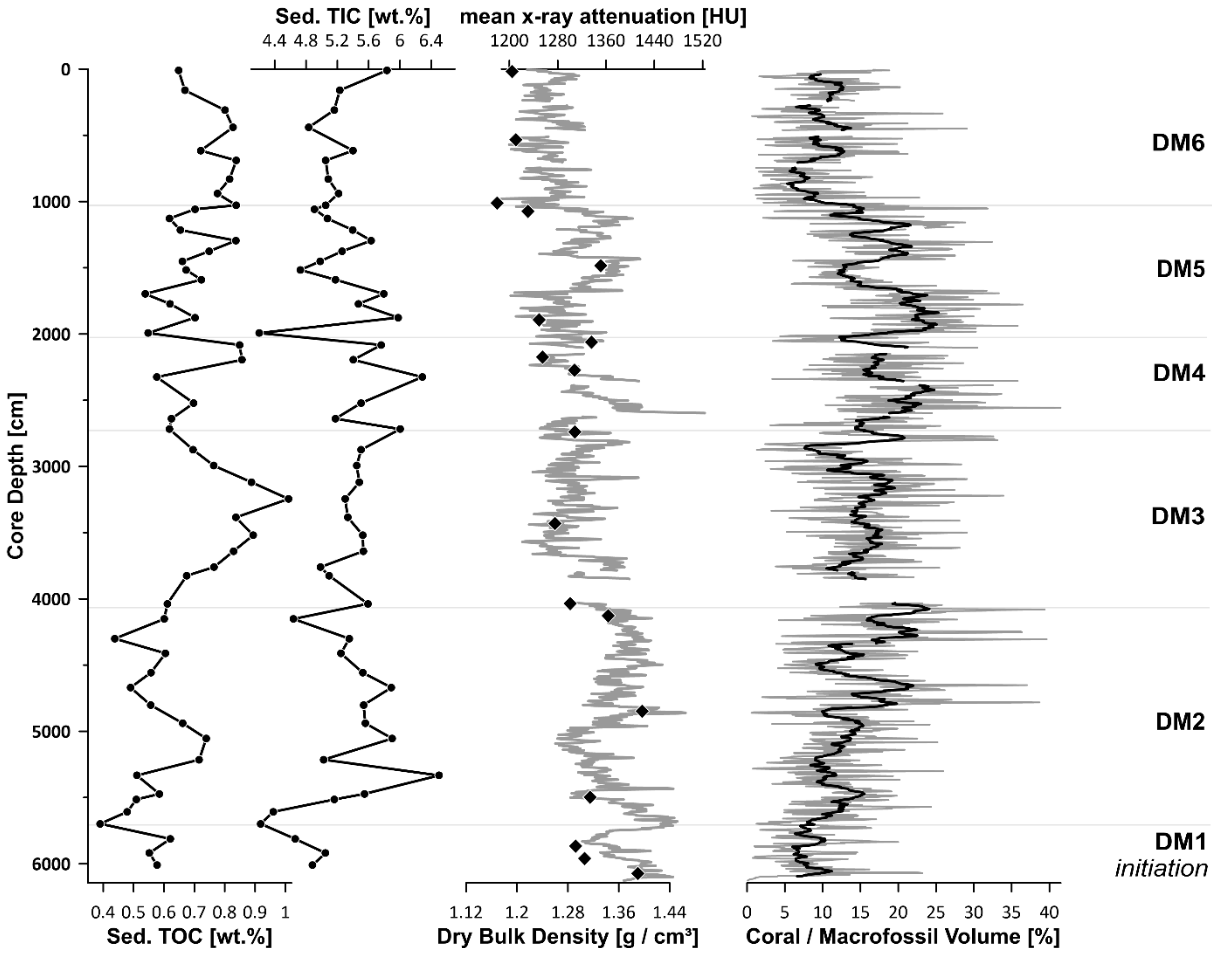

Fig. S2: Raw data summary from Dragon Mound (GeoB18116-2) measurements, based on new core depth model (CSF-B). TIC/TOC values (n = 53) are given in wt.% and refer to the sediment fraction of the record. Dry Bulk Density refers to black dashed line / points. Correlation between CT data and measured density data is clearly visible. Coral volume shows full 5 cm average (grey) and smoothened line (30 cm average) in black. CT / DBD data gaps are due to the recovery < 100 % in some MeBo barrel sections.

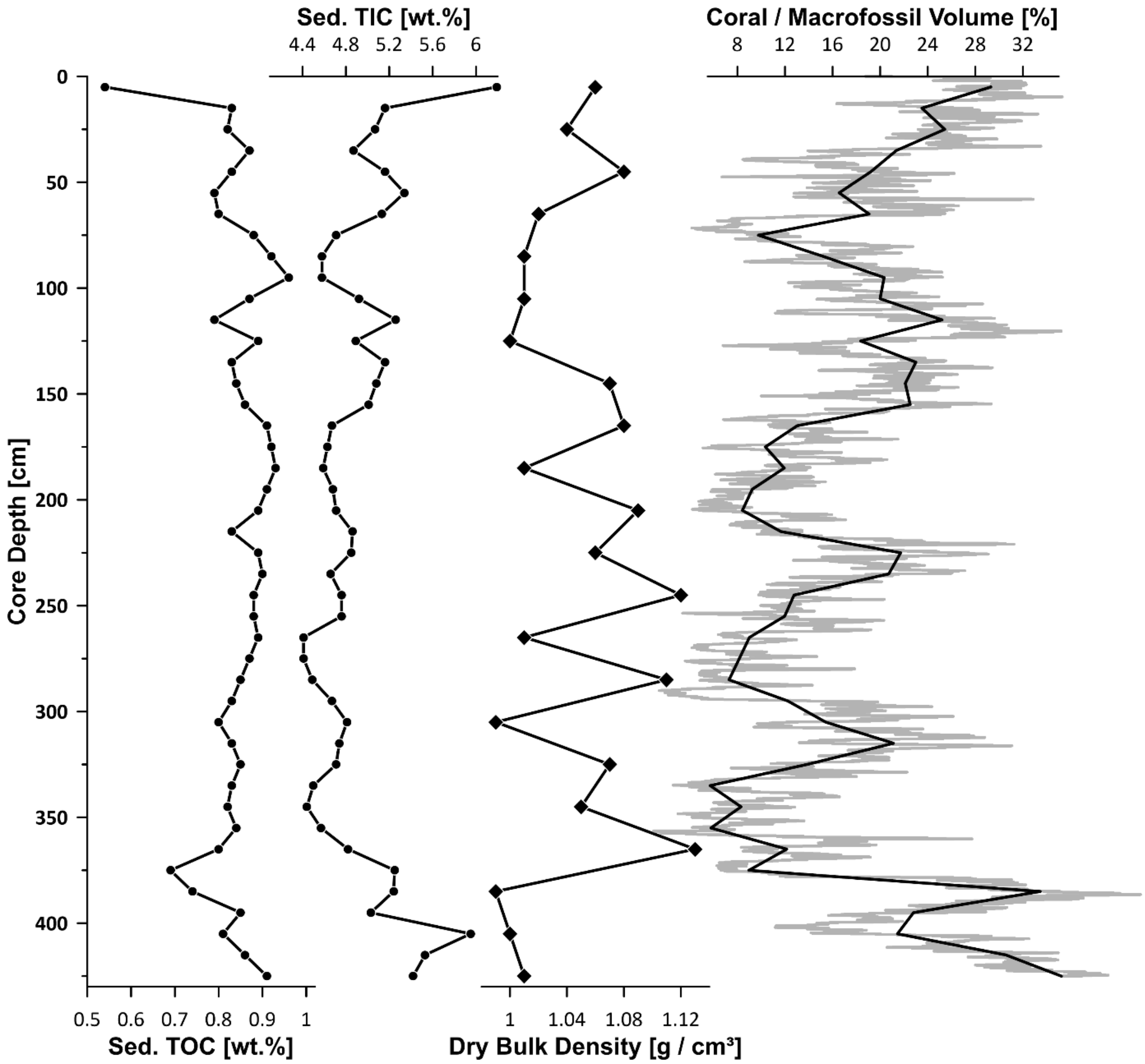

Fig. S3: Raw data summary from BRI (GeoB13729-1) measurements, based on published data. TIC/TOC values (n = 44; obtained by Wang et al., 2021) are given in wt.% and refer to the sediment fraction of the record. Dry Bulk Density (n = 22) is based on pycnometer measurements by Wang et al. (2021). CT coral content data (vol.%) are based on Titschack et al. (2016). Dark line shows smoothened 10 cm average, grey line represents the raw CT resolution.

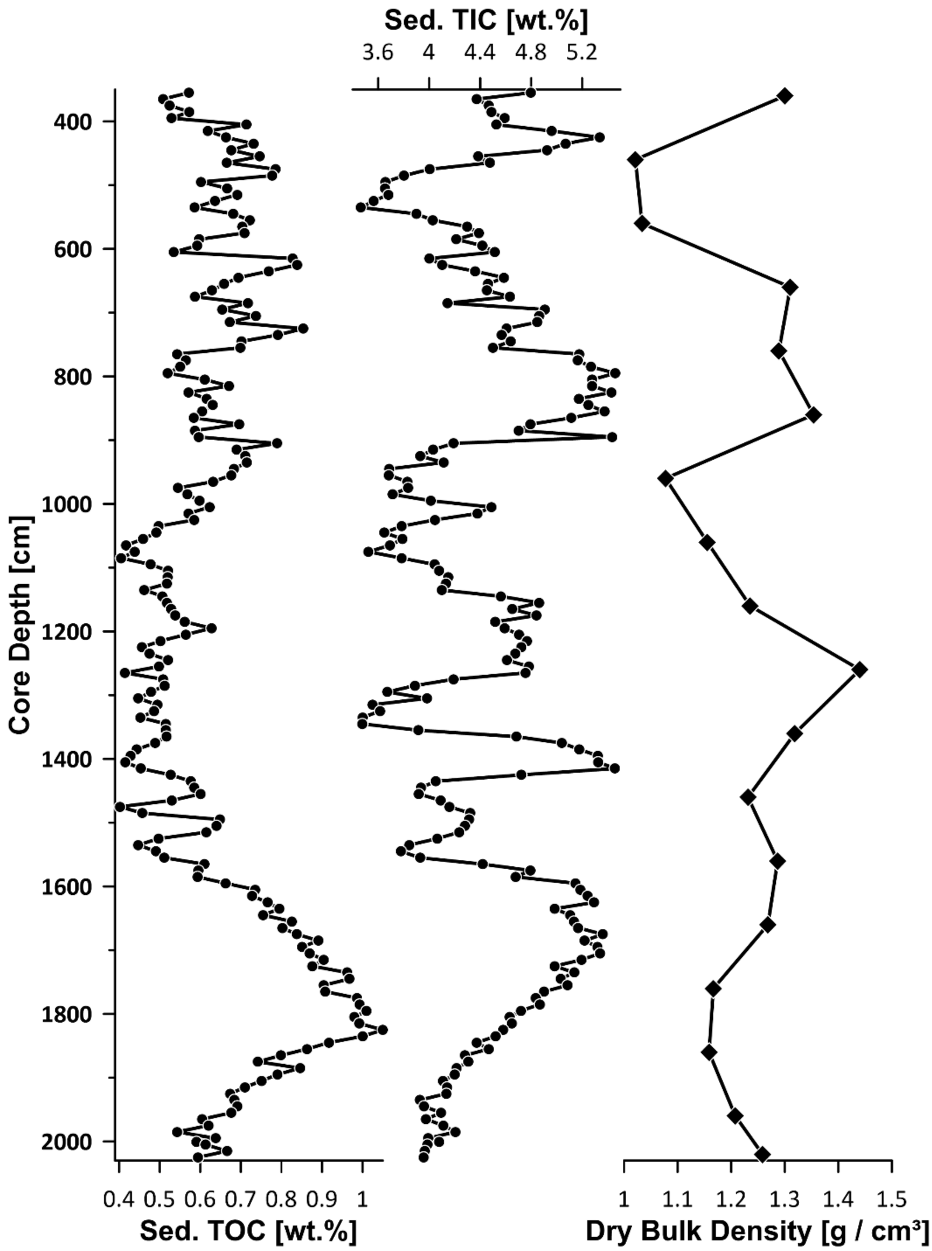

Fig. S4: Raw data summary from Off-Mound core MD13-3457 measurements. TIC/TOC values (n = 169) are given in wt.%. Dry Bulk Density is based on pycnometer measurements (n = 21), all conducted for this study.

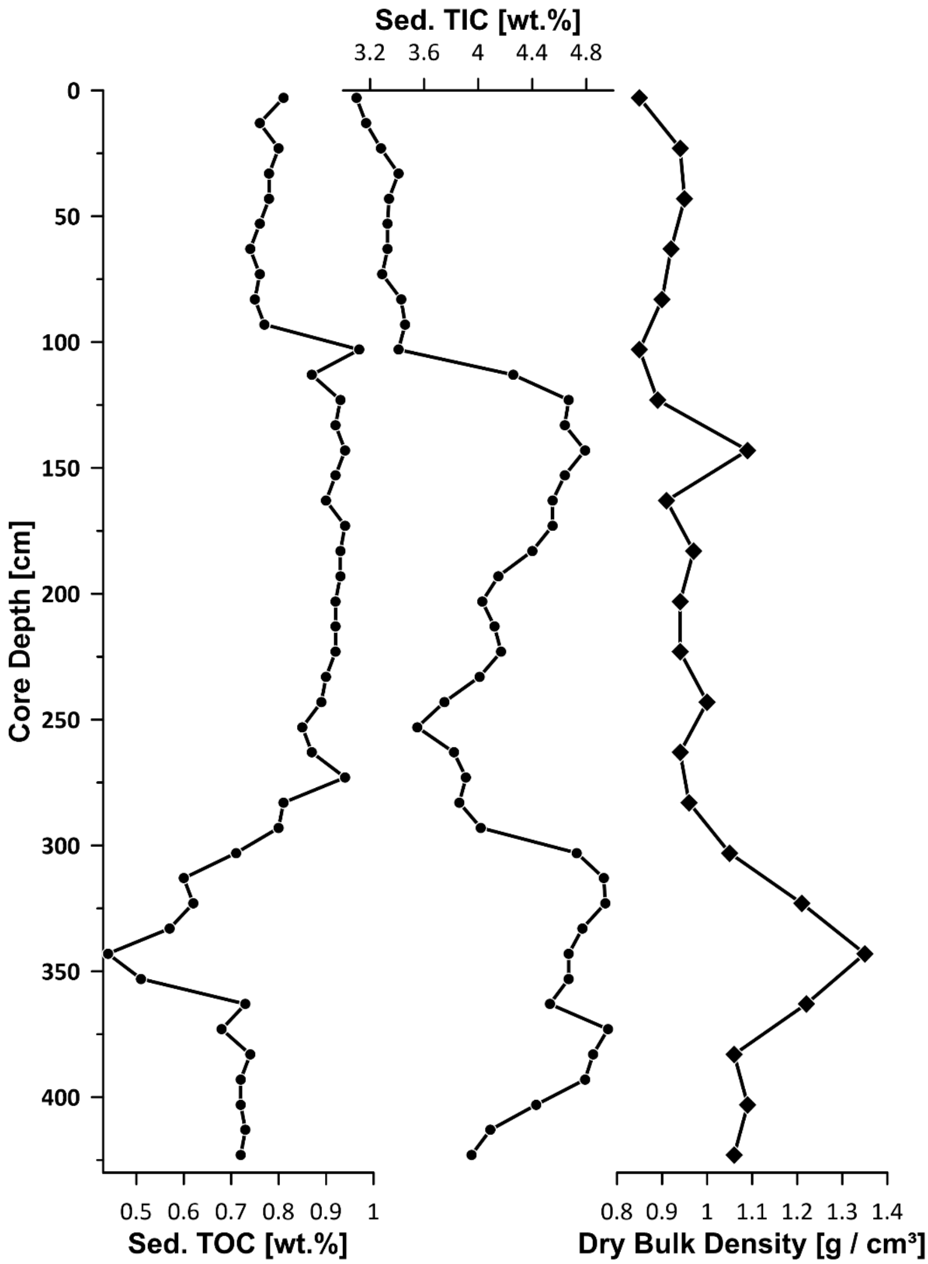

Fig. S5: Raw data summary from Off-Mound core GeoB13731-1 measurements. TIC/TOC values (n = 43) are given in wt.% and were measured by Wang et al. (2021). Dry Bulk Density is based on pycnometer measurements (n = 22) from Wang et al. (2021), too.

S3 Sedimentation Rates, off mound cores

Undatable was used as a novel approach to create age models from marine fossils. However, a linear interpolation between the calibrated AMS ^{14}C ages was favoured over the 1 cm resolution sedimentation rates given in Undatable (based on Gaussian uncertainty sampling).

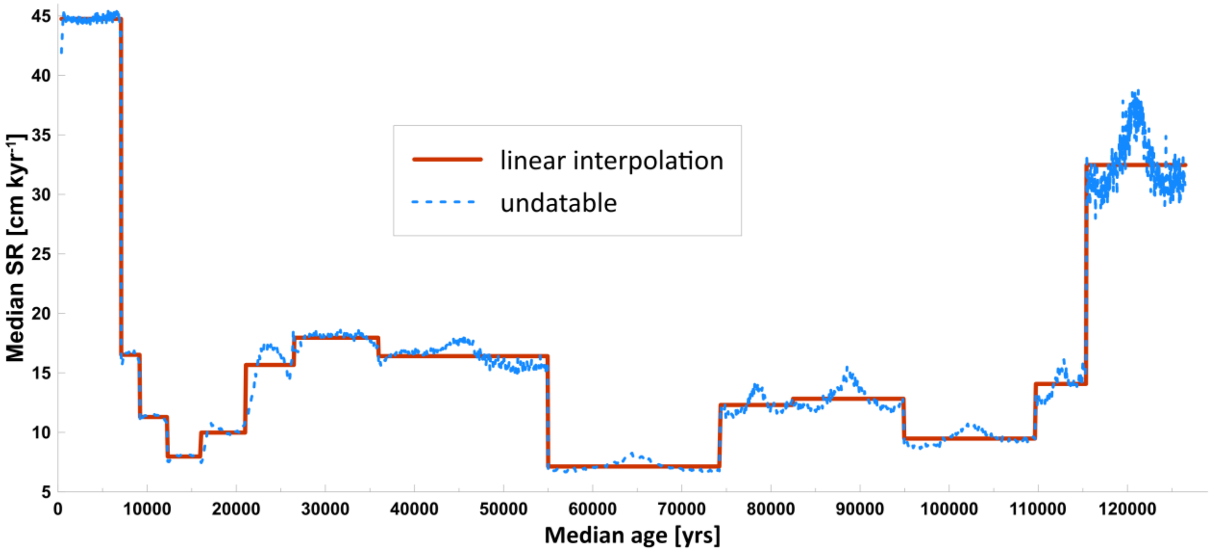

Fig. S6: Median AR (aggradation rate) of off-mound core MD13-3457 across time. Blue dotted line represents the initial age model from Undatable, while the red line represents the linear interpolation between the ages / tie points used in the study.

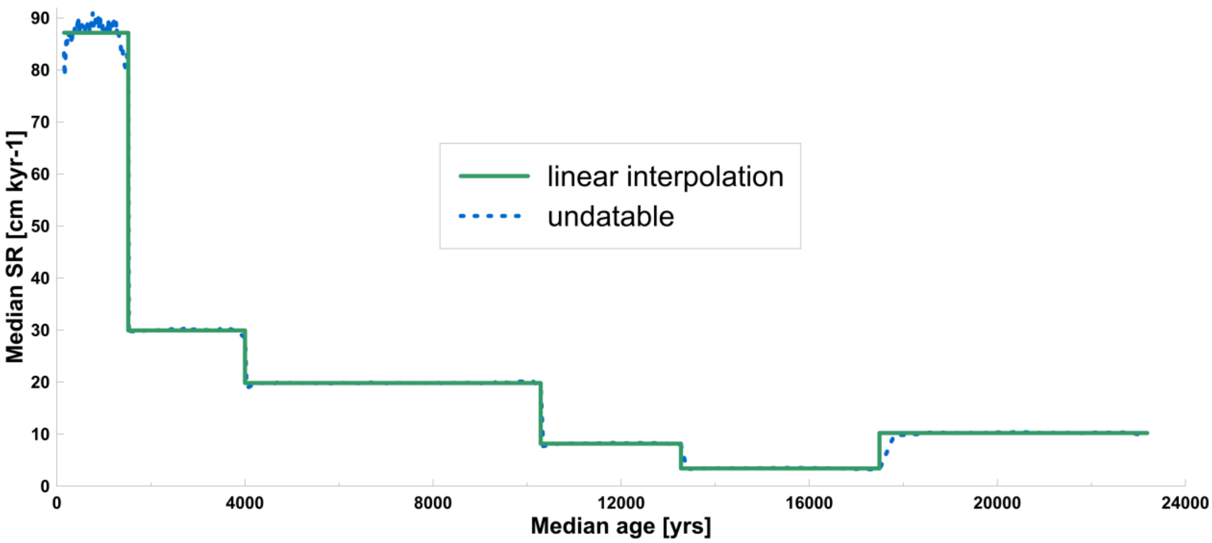

Fig. S7: Median AR (aggradation rate) of off-mound core GeoB13731-1 across time. Blue dotted line represents the initial age model from Undatable, while the green line represents the linear interpolation between the ages used in the study.

S4 AMS ^{14}C ages and tie points obtained for MD13-3457

Table S1: All ages used for this study from MD13-3457. Sample 1-8 are based on AMS 14C dating, the others are tie points based on the d18O data from MD13-3457 and the global LR04 stack by Lisiecki and Raymo (2005).

Sample ID	Depth [m]	Raw Age [kyr BP]	Age error [kyr BP]	Dating Method	Reserv. Age [kyr BP]	Reserv. Error [kyr BP]	Calibration	Calib. Age [kyr BP]
1	0.03	0.75	0.03	^{14}C marine fossil	0.422	0.050	IntCal20	0.391
2	3.03	6.69	0.05	^{14}C marine fossil	0.483	0.051	IntCal20	7.095
3	3.38	8.59	0.05	^{14}C marine fossil	0.349	0.057	IntCal20	9.214
4	3.73	10.54	0.06	^{14}C marine fossil	0.108	0.052	IntCal20	12.314
5	4.03	13.47	0.08	^{14}C marine fossil	0.117	0.188	IntCal20	16.077
6	4.53	22.51	0.15	^{14}C marine fossil	0.157	0.268	IntCal20	21.087
7	5.38	22.37	0.40	^{14}C marine fossil	0.190	0.263	IntCal20	26.513
8	7.08	31.80	0.50	^{14}C marine fossil	0.178	0.219	IntCal20	35.982
s1	10.2	55.00	4.00	tie point	n/a	n/a	n/a	55.000
s2	11.58	75.00	4.00	tie point	n/a	n/a	n/a	74.351
s3	12.58	82.50	4.00	tie point	n/a	n/a	n/a	82.479
s4	14.18	95.00	4.00	tie point	n/a	n/a	n/a	94.955
s5	15.58	112.00	4.00	tie point	n/a	n/a	n/a	109.726
s6	16.38	115.50	4.00	tie point	n/a	n/a	n/a	115.412
s7	19.98	126.50	4.00	tie point	n/a	n/a	n/a	126.499

S5 δ^{18}O ‰ curve MD13-3457 and corresponding tie points for age model construction

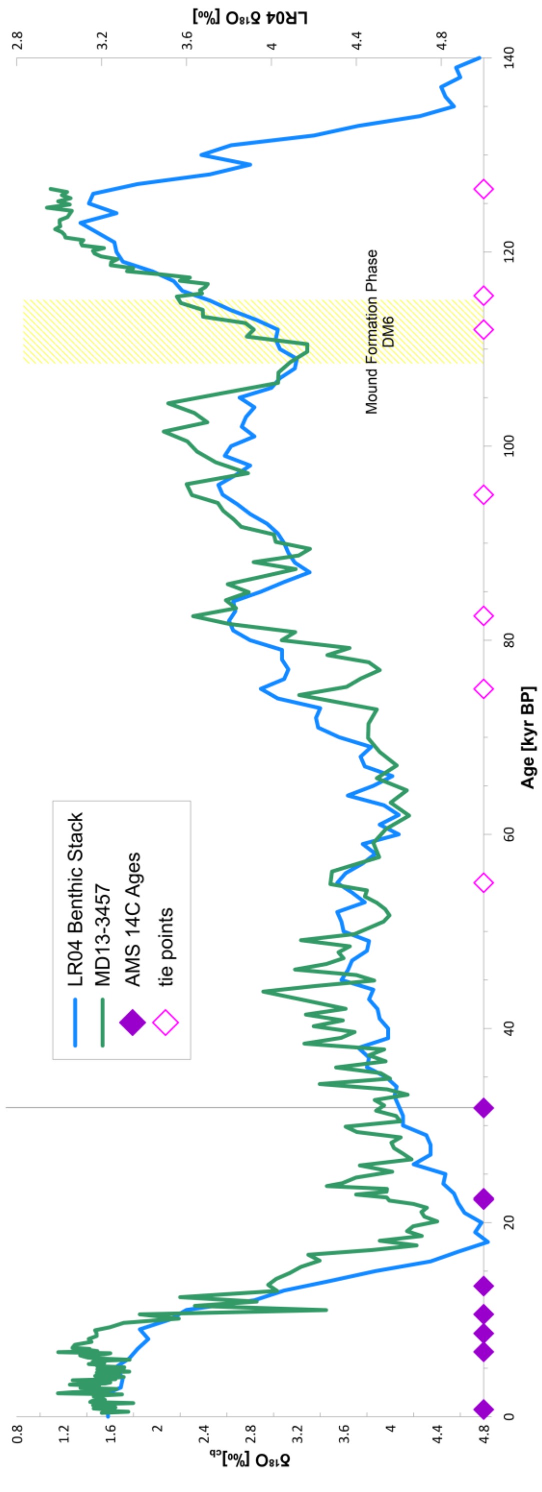

Fig. S8: Visual alignment of LR04 benthic stack and the δ^{18}O ‰ curve based on Stable oxygen isotopes (δ^{18}O) obtained from the benthic foraminifera *Cibicidoides mundulus*. Dated ages and tie points are indicated. Yellow box indicated the period of mound formation during MIS5d on Dragon Mound (DM6).

S6 carbon accumulation rates off-mound during BRI_{final} and DM6

Table S2: Values from both off-mound records GeoB13731-1 and MD13-3457 identified as corresponding to the mound formation phases of BRI_{final} (9 – 12 kyr BP; MIS1) and DM6 (~108 – 115 kyr BP; MIS5). Ages and sedimentation rates (SR) based on age models above. DBD for Dry Bulk Density. TOC/TIC values given in content weight-%. C(in)org Acc stands for (in)organic carbon accumulation. Note that mean values presented in the manuscript are based on weighted sedimentation rate means.

Core	Depth [cm]	Age [kyr BP]	TOC [%]	TIC [%]	DBD [g/cm³]	SR [cm kyr-1]	C_{org} Acc [g cm-2 ky-1]	C_{inorg} Acc [g cm-2 ky-1]	Total Carbon Acc [g cm-2 ky-1]
GeoB13731-1	293	8.58	0.80	4.02	1.01	19.8	0.16	0.80	0.96
GeoB13731-1	303	9.09	0.71	4.73	1.05	19.8	0.15	0.98	1.13
GeoB13731-1	313	9.59	0.60	4.93	1.13	19.8	0.13	1.10	1.24
GeoB13731-1	323	10.09	0.62	4.94	1.21	19.8	0.15	1.19	1.33
GeoB13731-1	333	10.97	0.57	4.77	1.28	8.2	0.06	0.50	0.56
GeoB13731-1	343	12.18	0.44	4.67	1.35	8.2	0.05	0.52	0.56
MD13-3457	1545	108.34	0.49	3.78	1.28	9.5	0.06	0.46	0.52
MD13-3457	1555	109.41	0.51	3.93	1.28	9.5	0.06	0.48	0.54
MD13-3457	1565	110.27	0.61	4.42	1.29	14.1	0.11	0.80	0.91
MD13-3457	1575	111.05	0.60	4.80	1.26	14.1	0.11	0.85	0.95
MD13-3457	1585	111.80	0.59	4.68	1.23	14.1	0.10	0.81	0.91
MD13-3457	1595	112.48	0.66	5.15	1.20	14.1	0.11	0.87	0.98
MD13-3457	1605	113.13	0.74	5.19	1.17	14.1	0.12	0.86	0.98
MD13-3457	1615	113.83	0.73	5.24	1.15	14.1	0.12	0.85	0.96
MD13-3457	1625	114.54	0.77	5.29	1.12	14.1	0.12	0.83	0.95
MD13-3457	1635	115.21	0.80	4.99	1.09	14.1	0.12	0.77	0.89

S7 CT scans of Dragon Mound (GeoB18116-2)

The following section provides all obtained CT data in this study, referring to the 60 m long CT scan of Dragon Mound, consisting of 26 barrels. Each figure shows, from left to right, CT orthoslice, 3D macrofossil reconstruction, a mean grain size distribution plot as well as a clast orientation plot, several graphs representing coral content (vol. %), the mean x-ray attenuation in Hounsfield Units [HU], and its standard deviation, all along the corresponding core depth. To avoid distortion of the CT images, the following figures show the core depth based on CSF-A.

GeoB18116-2 *P1*

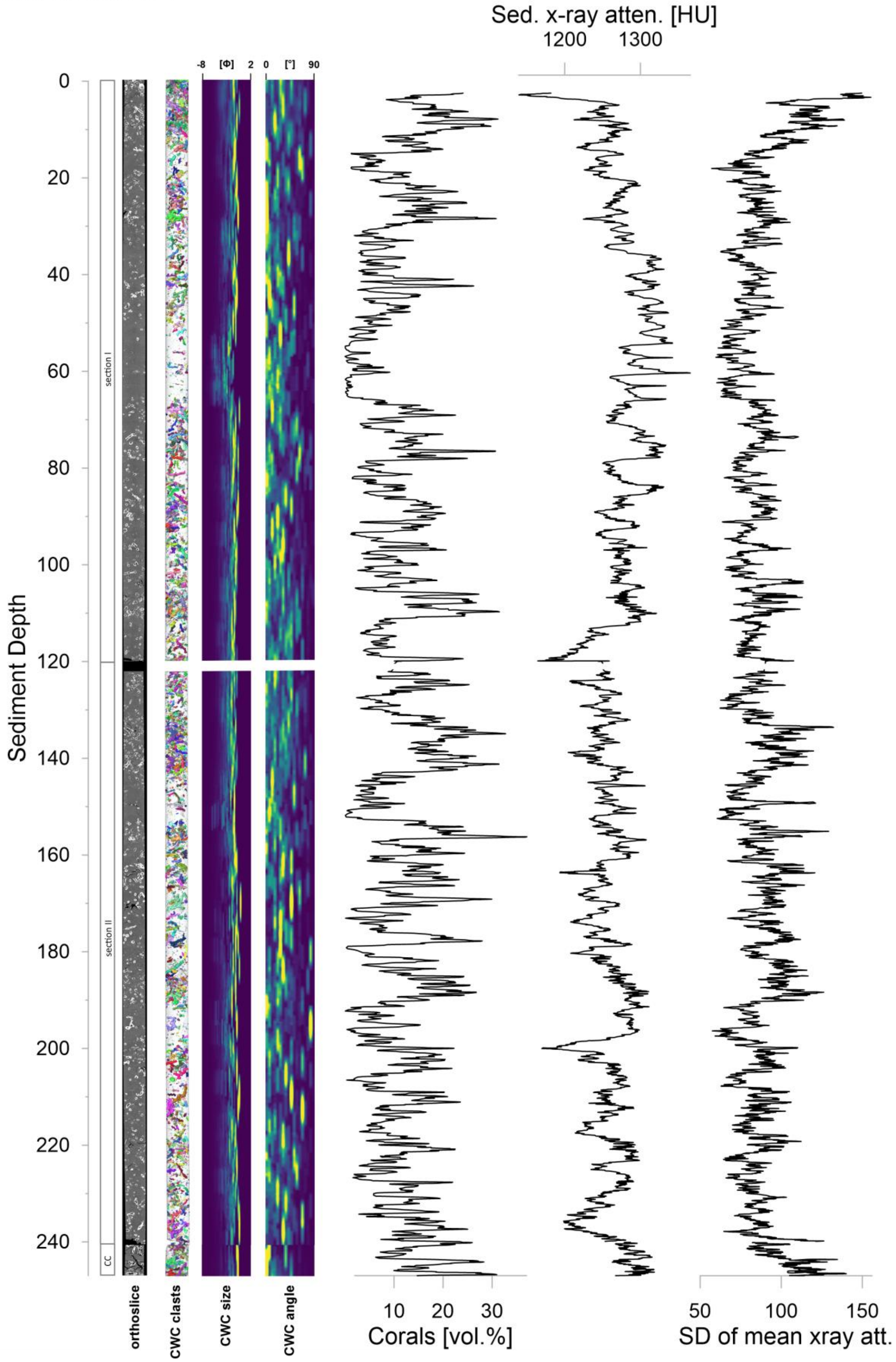

Fig. S9: CT-derived core data for GeoB18116-2 Barrel P1, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P2*

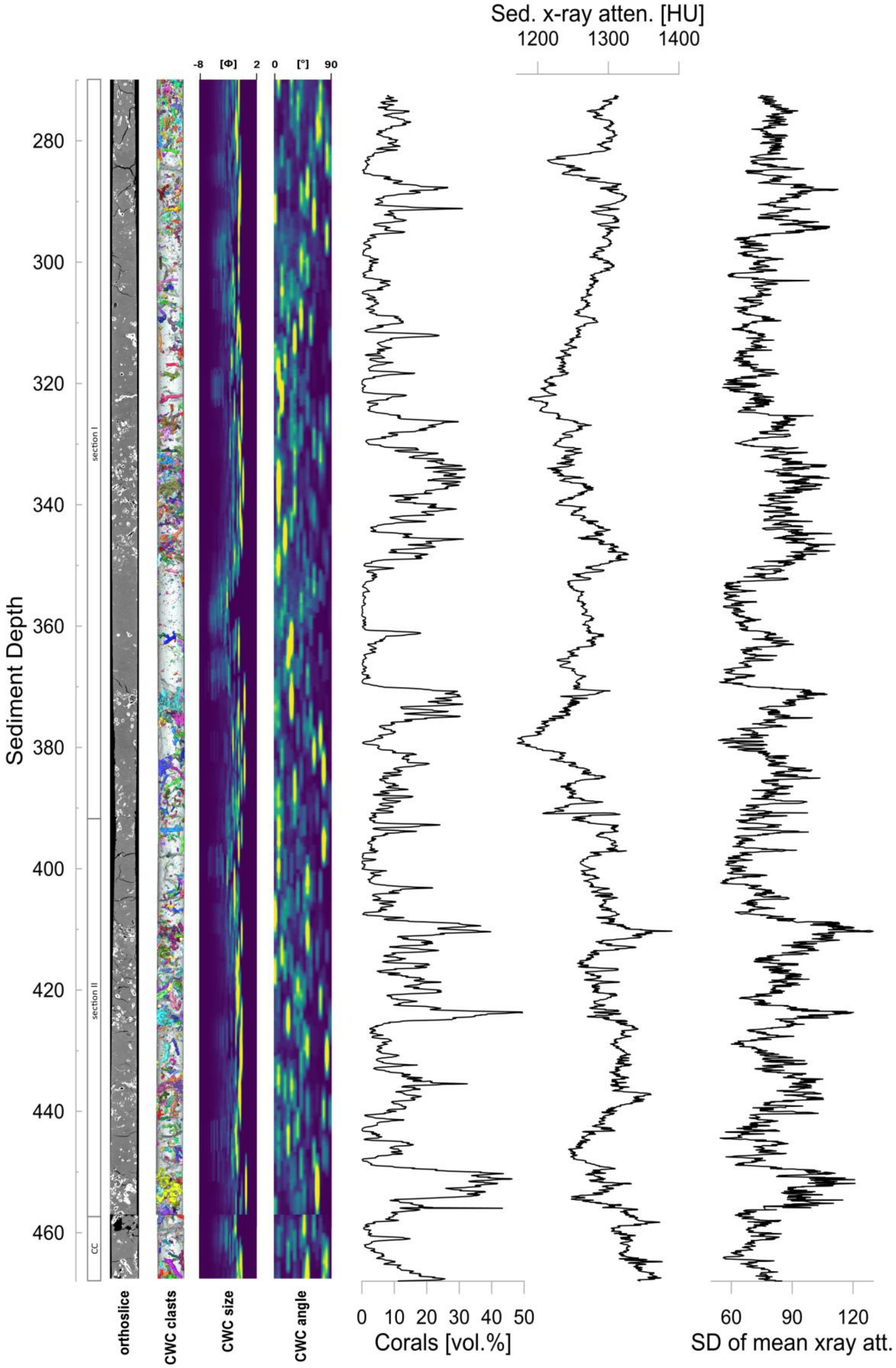

Fig. S10: CT-derived core data for GeoB18116-2 Barrel P2, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P3*

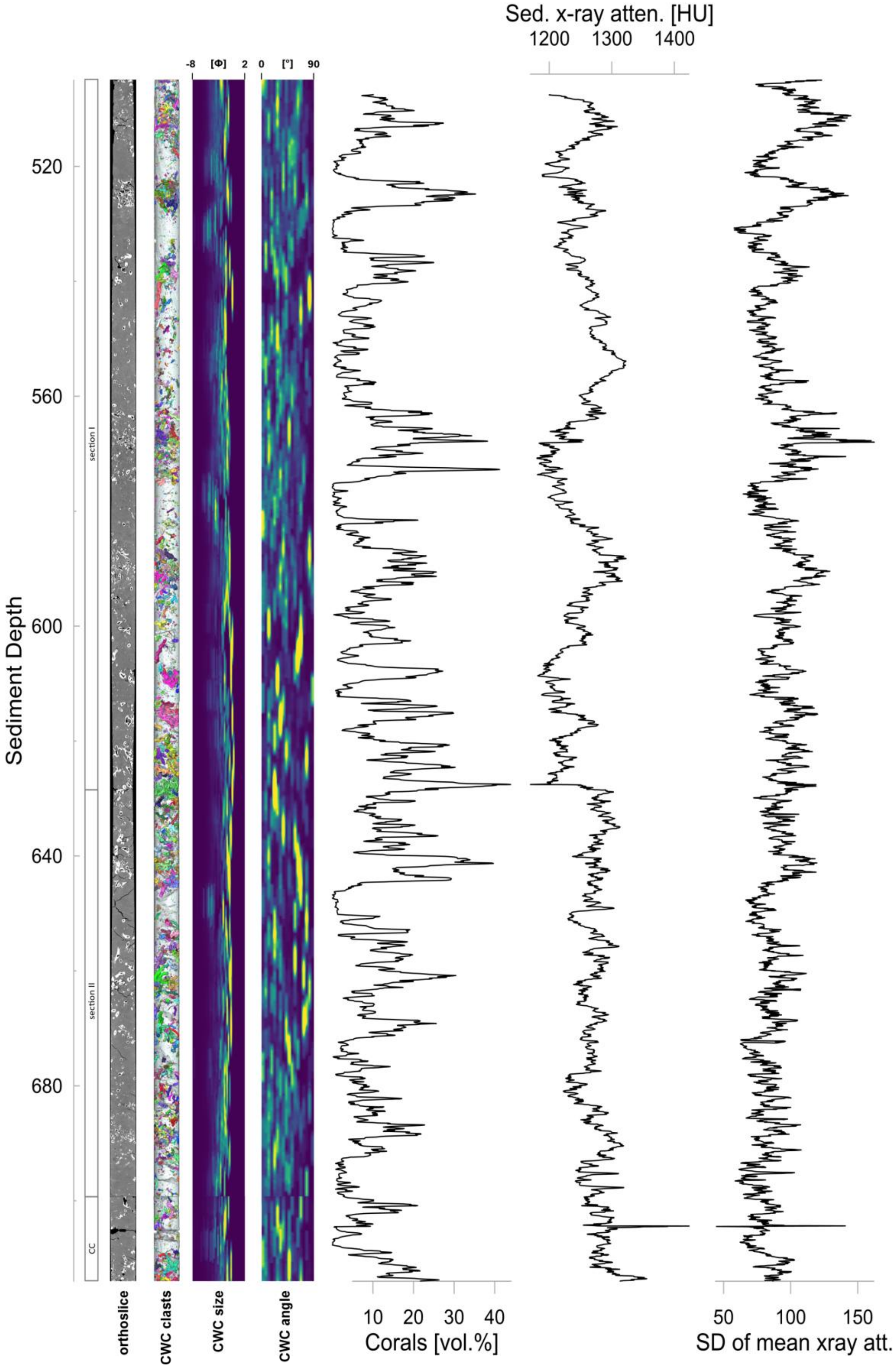

Fig. S11: CT-derived core data for GeoB18116-2 Barrel P3, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P4*

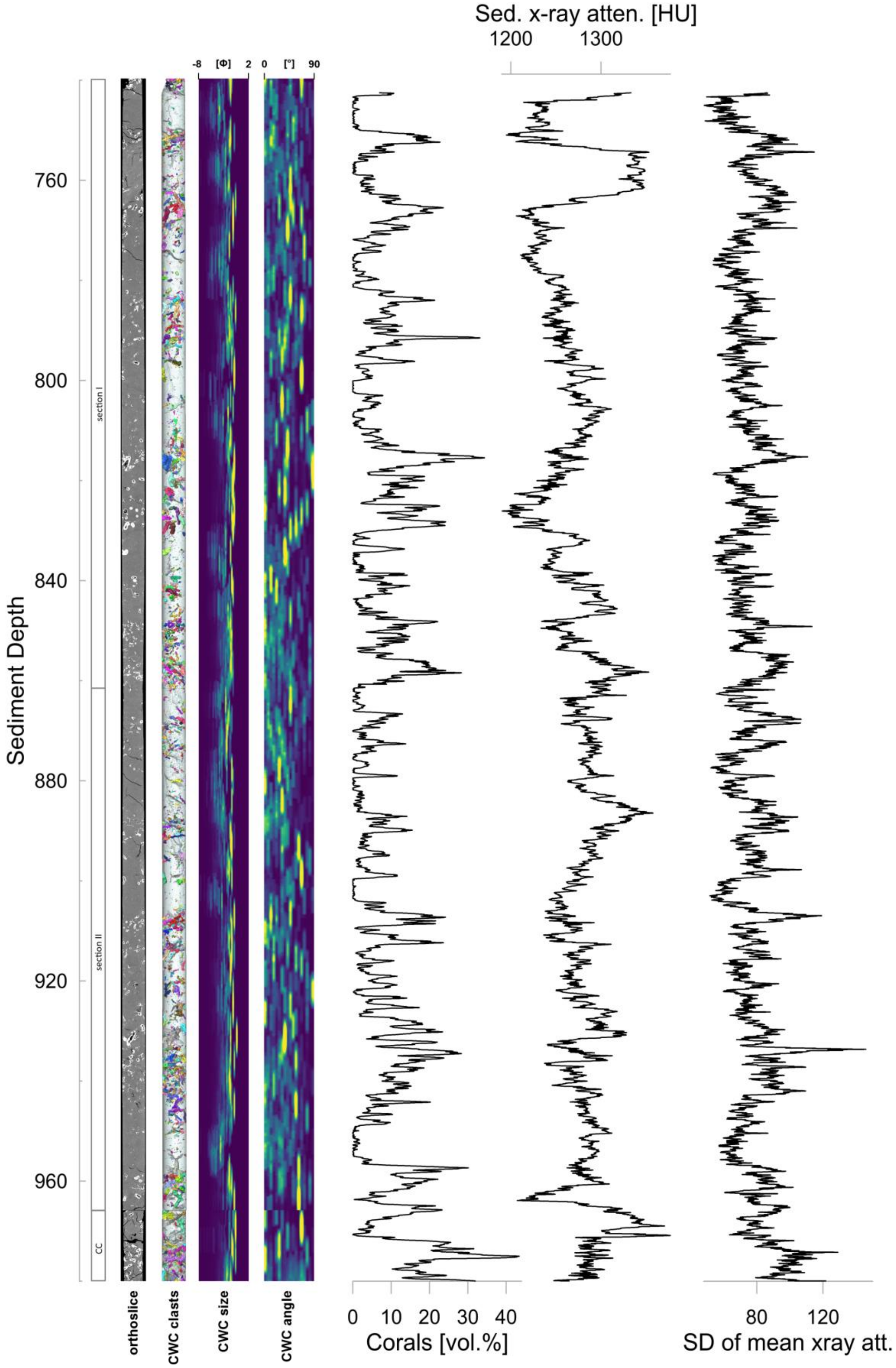

Fig. S12: CT-derived core data for GeoB18116-2 Barrel P4, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P5*

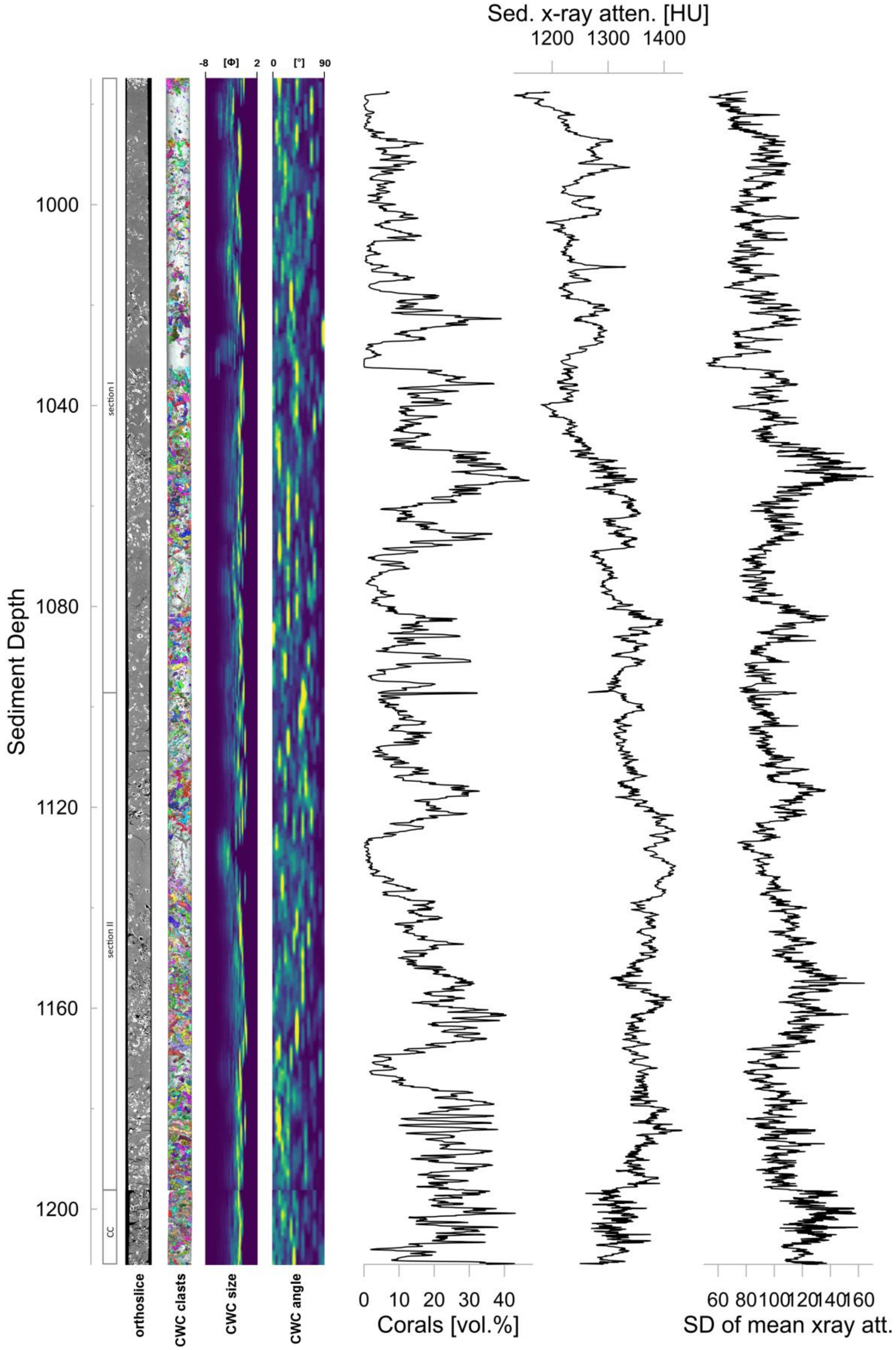

Fig. S13: CT-derived core data for GeoB18116-2 Barrel P5, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

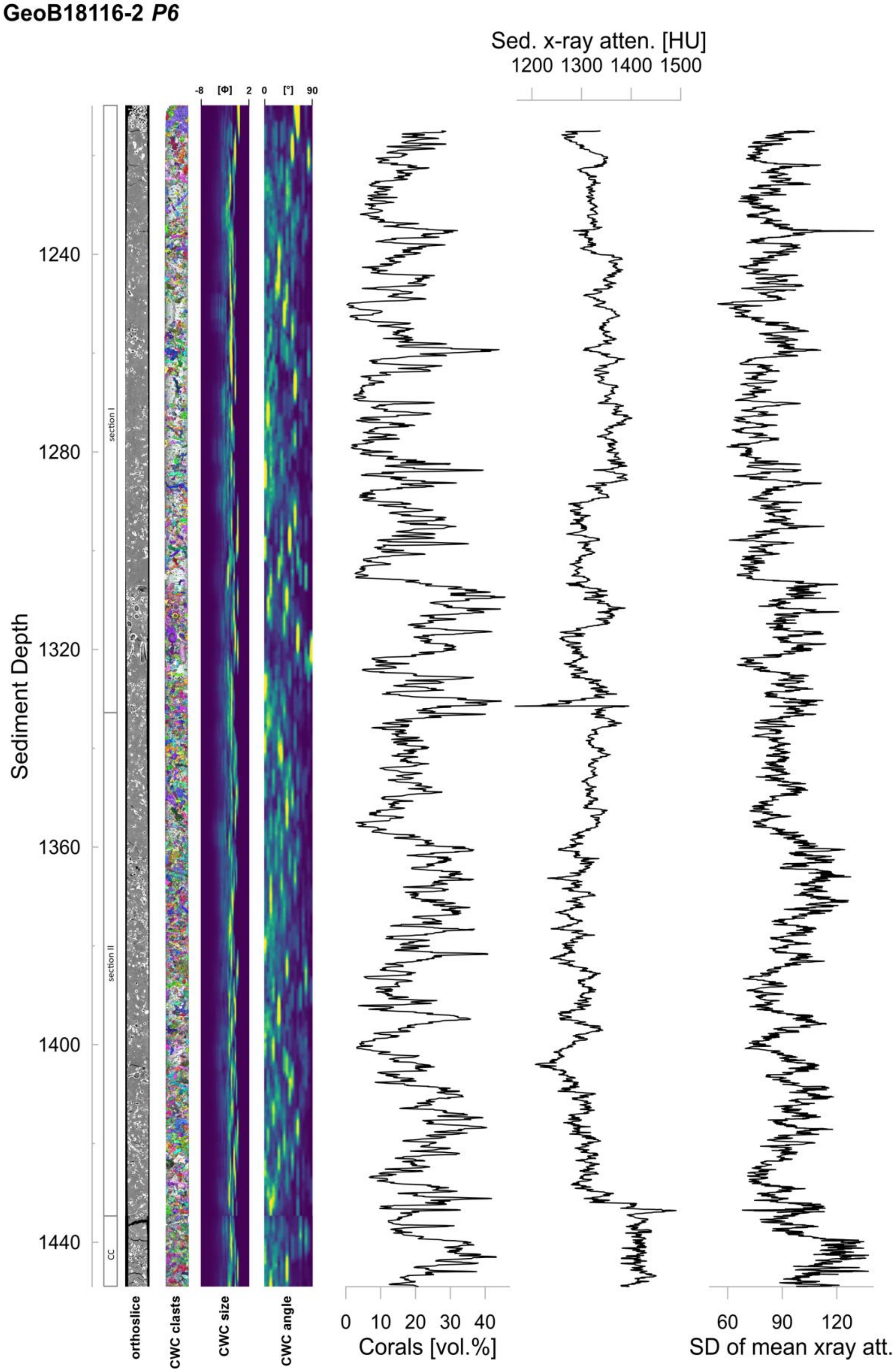

Fig. S14: CT-derived core data for GeoB18116-2 Barrel P6, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

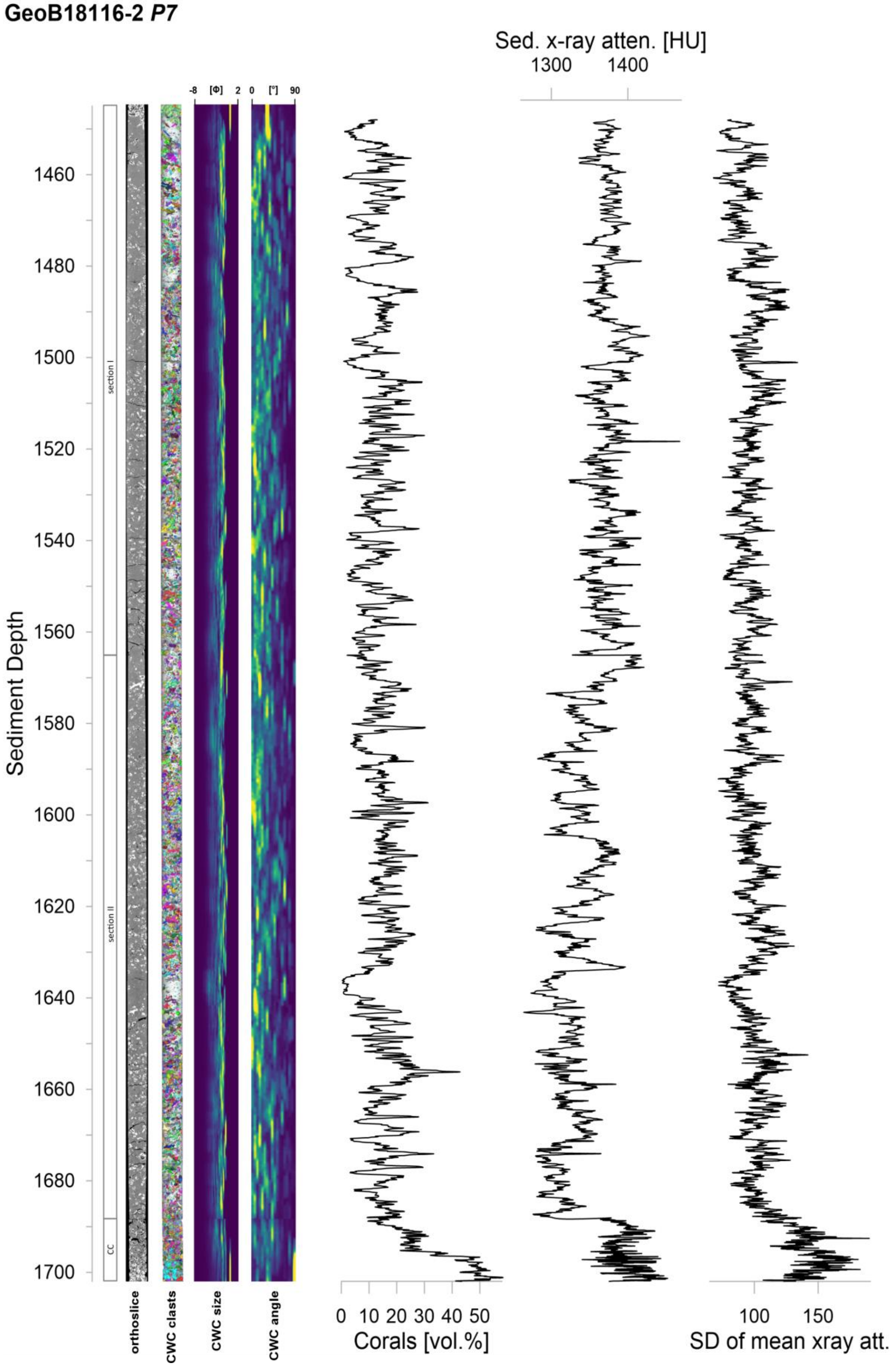

Fig. S15: CT-derived core data for GeoB18116-2 Barrel P7, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P8*

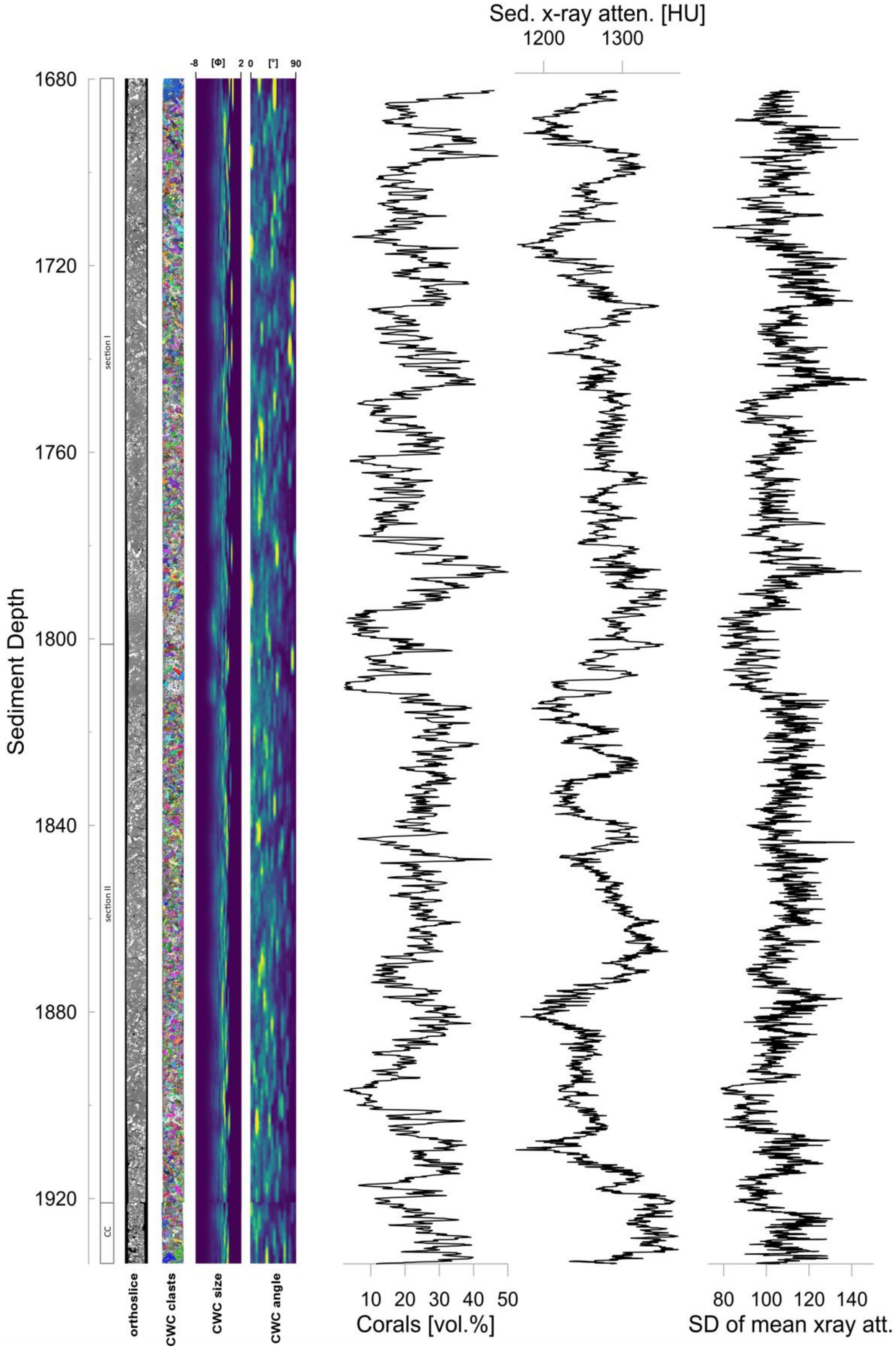

Fig. S16: CT-derived core data for GeoB18116-2 Barrel P8, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

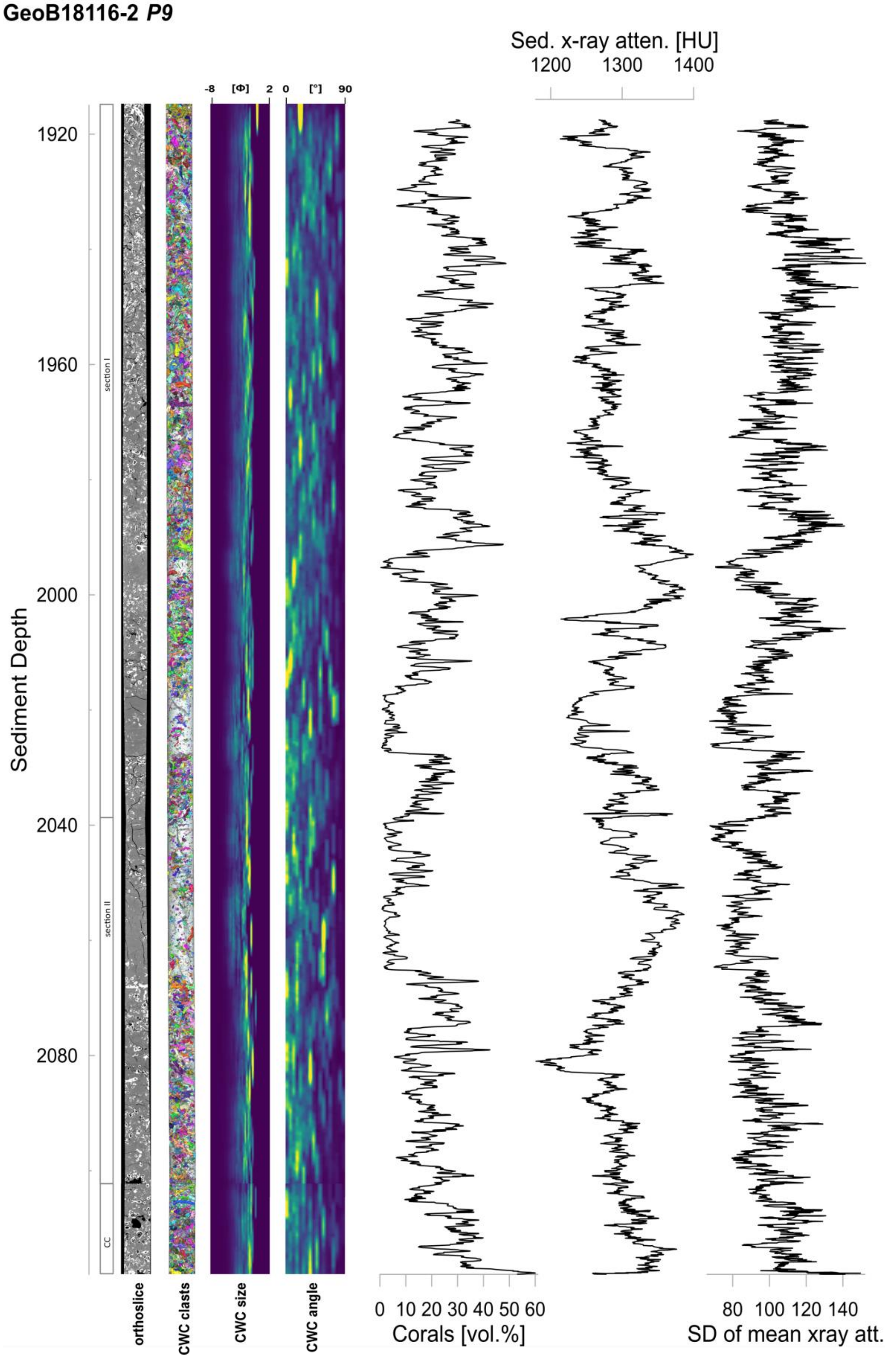

Fig. 17: CT-derived core data for GeoB18116-2 Barrel P9, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

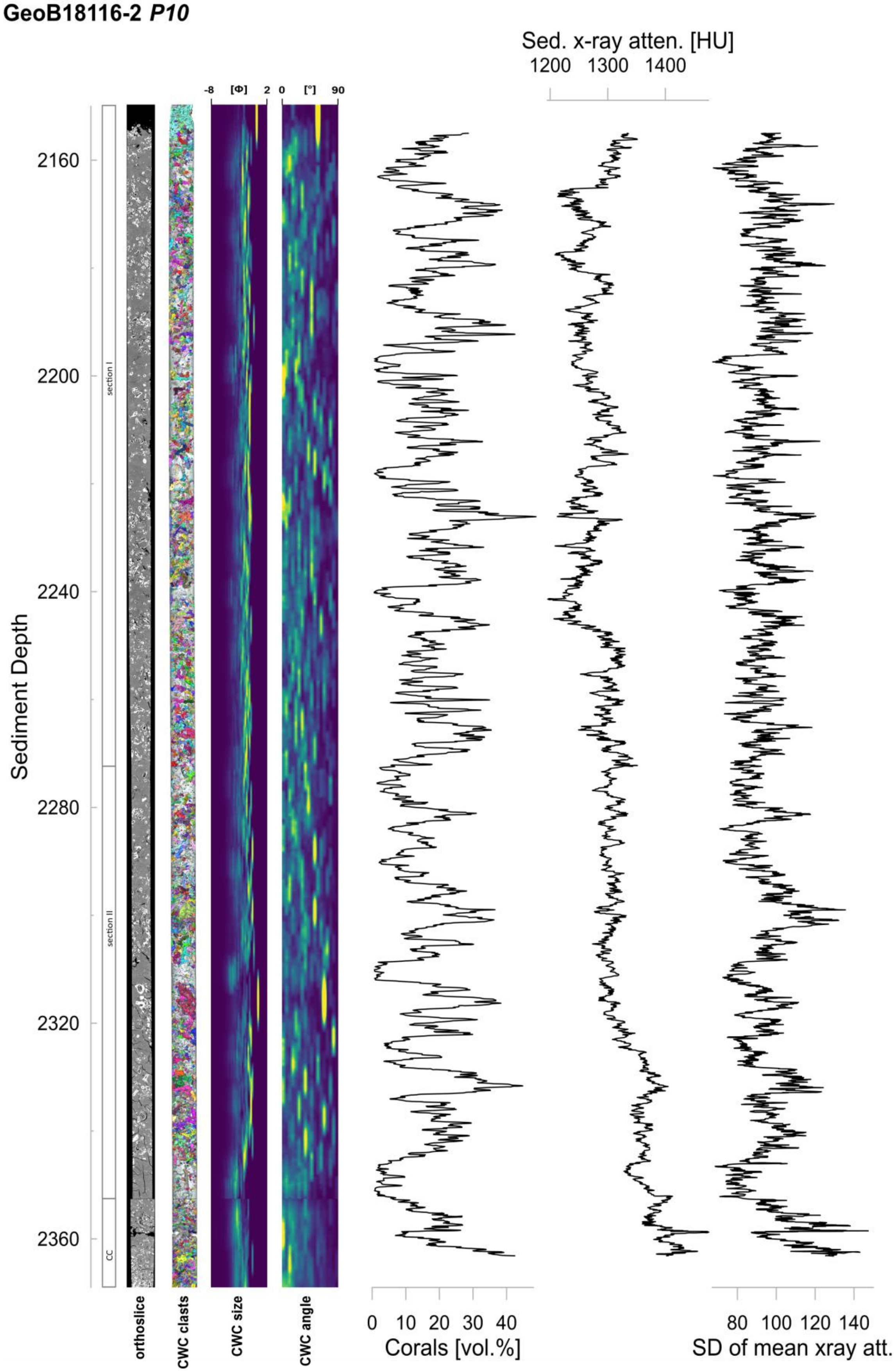

Fig. S18: CT-derived core data for GeoB18116-2 Barrel P10, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P11*

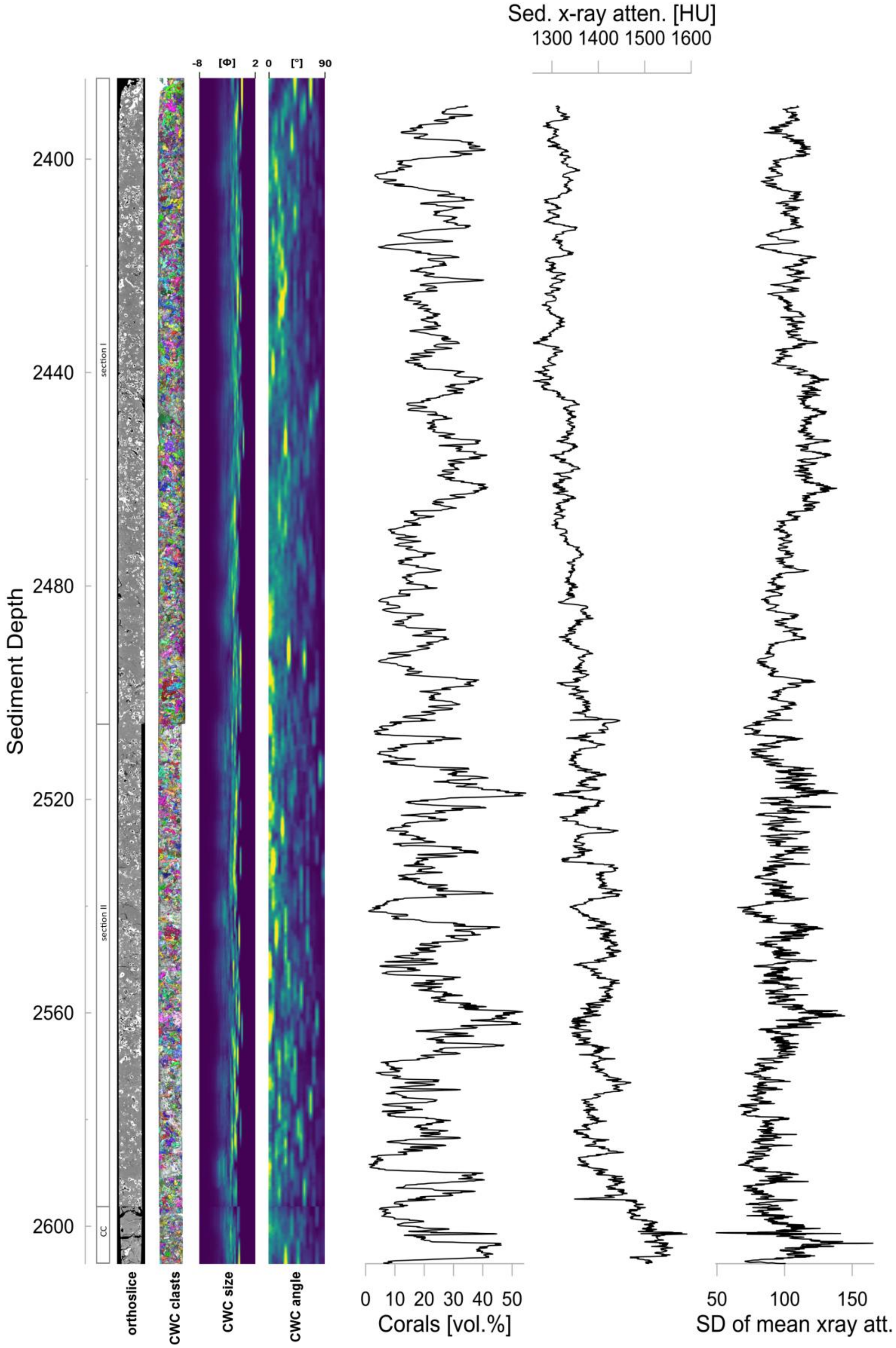

Fig. S19: CT-derived core data for GeoB18116-2 Barrel P11, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

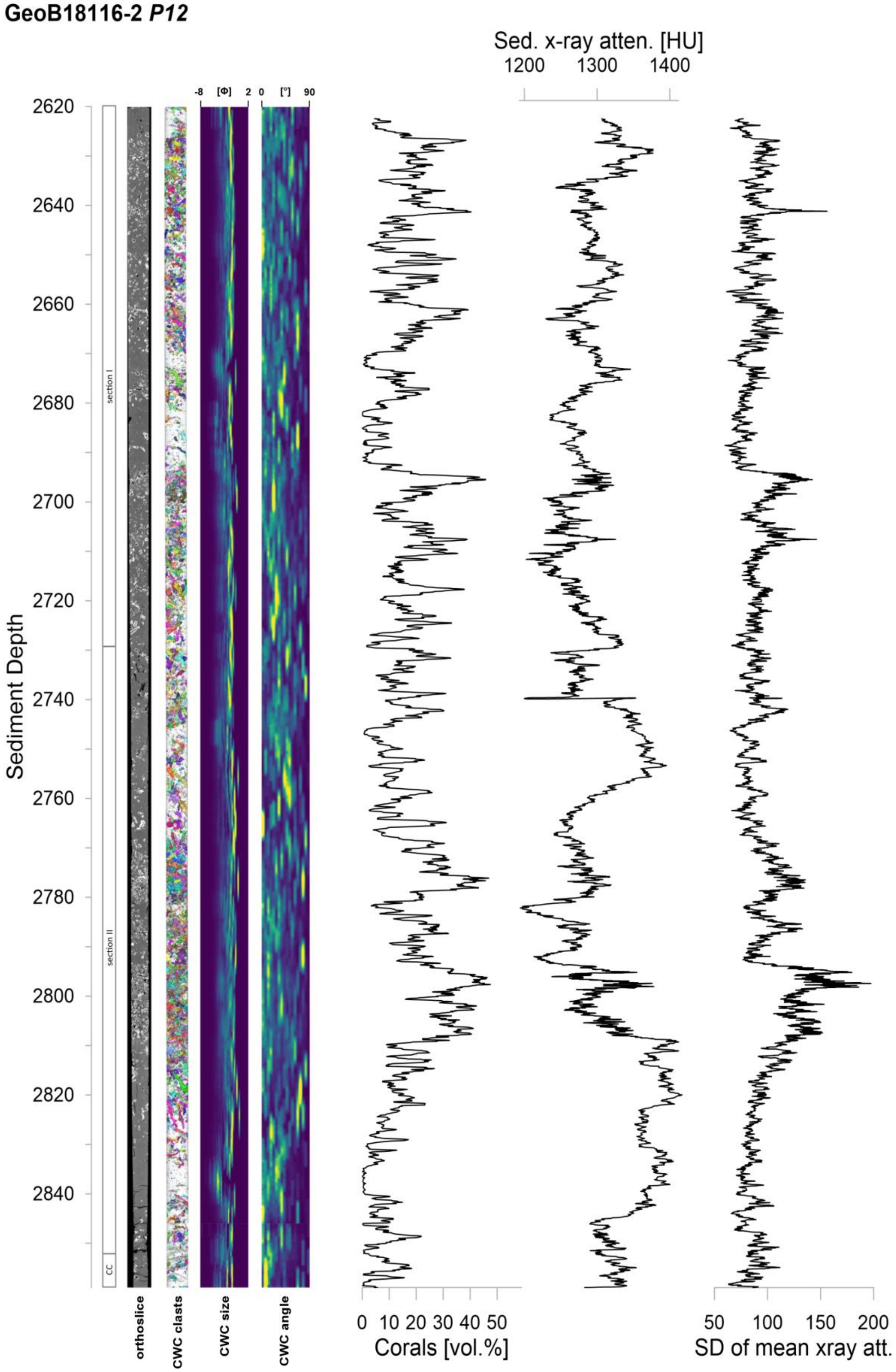

Fig. S20: CT-derived core data for GeoB18116-2 Barrel P12, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P13*

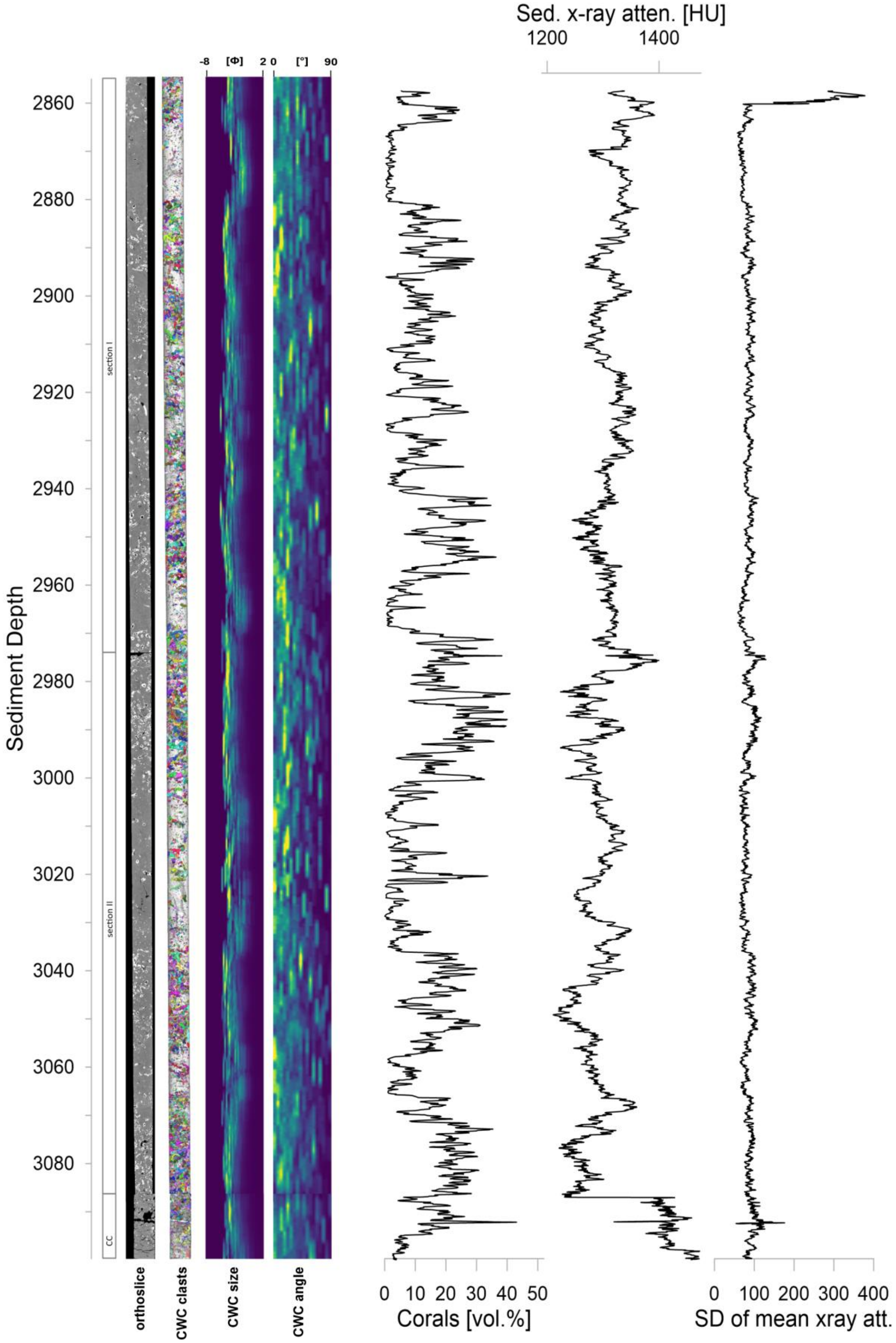

Fig. S21: CT-derived core data for GeoB18116-2 Barrel P13, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

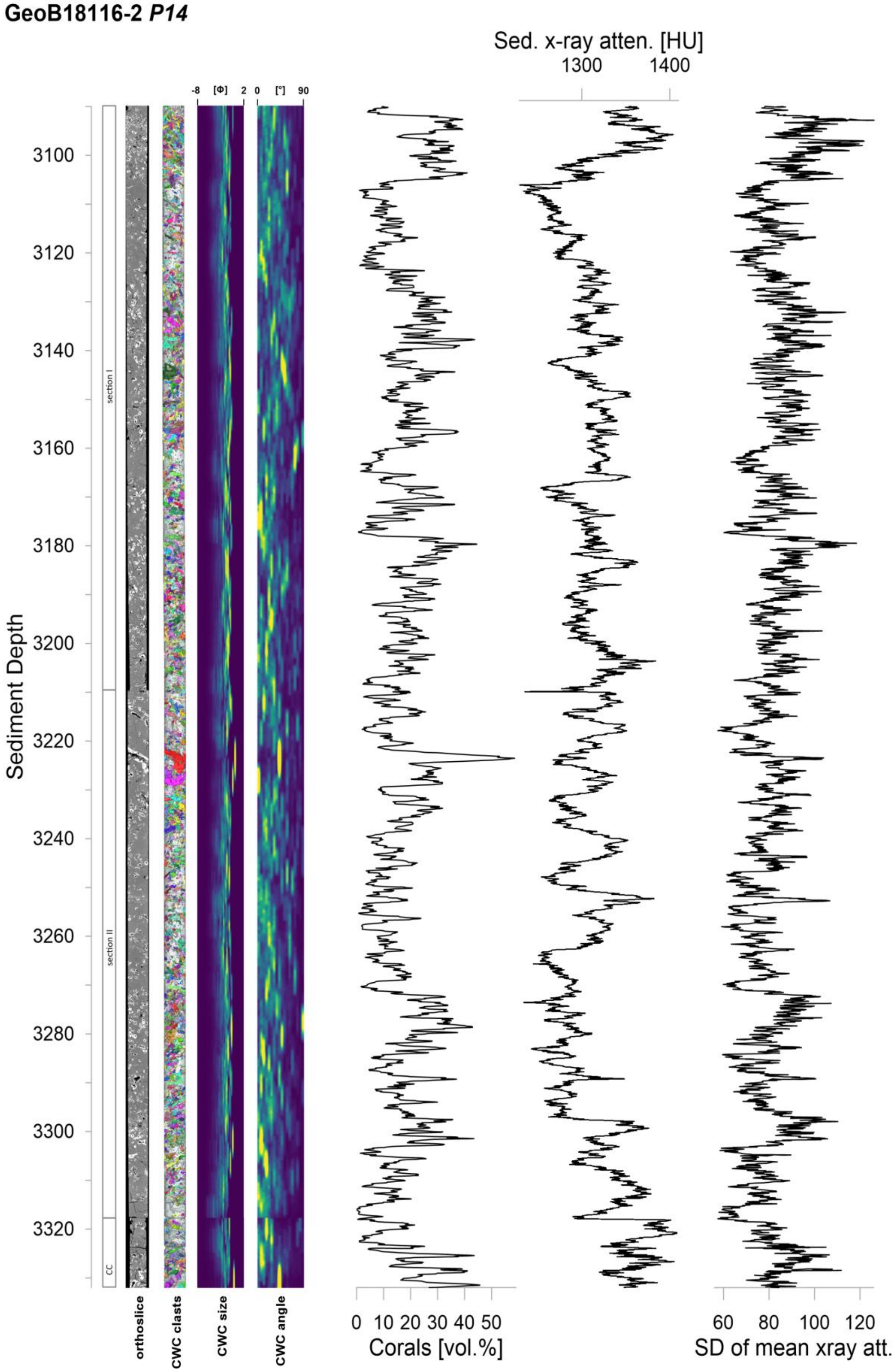

Fig. S22: CT-derived core data for GeoB18116-2 Barrel P14, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P15*

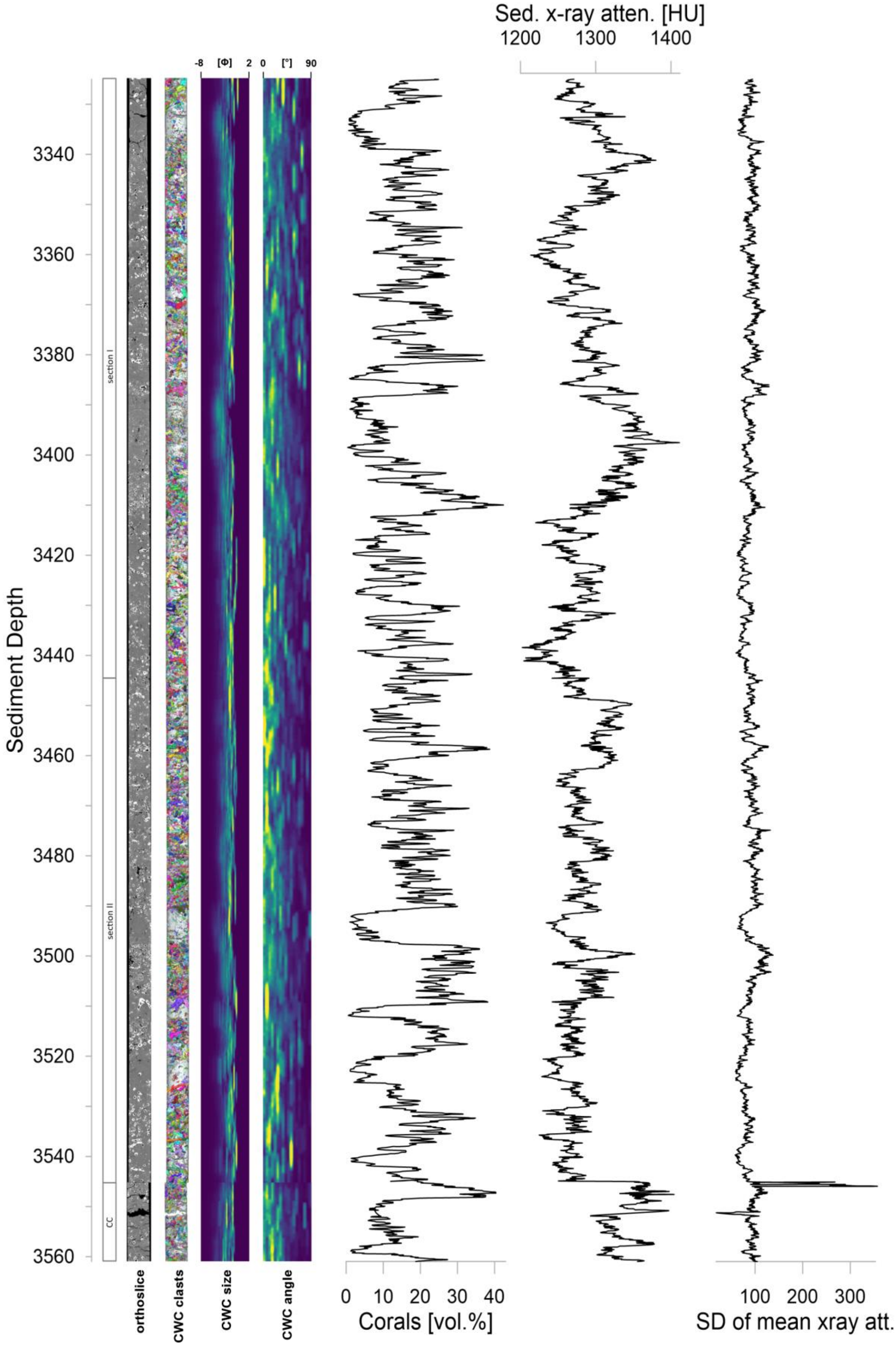

Fig. S23: CT-derived core data for GeoB18116-2 Barrel P15, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

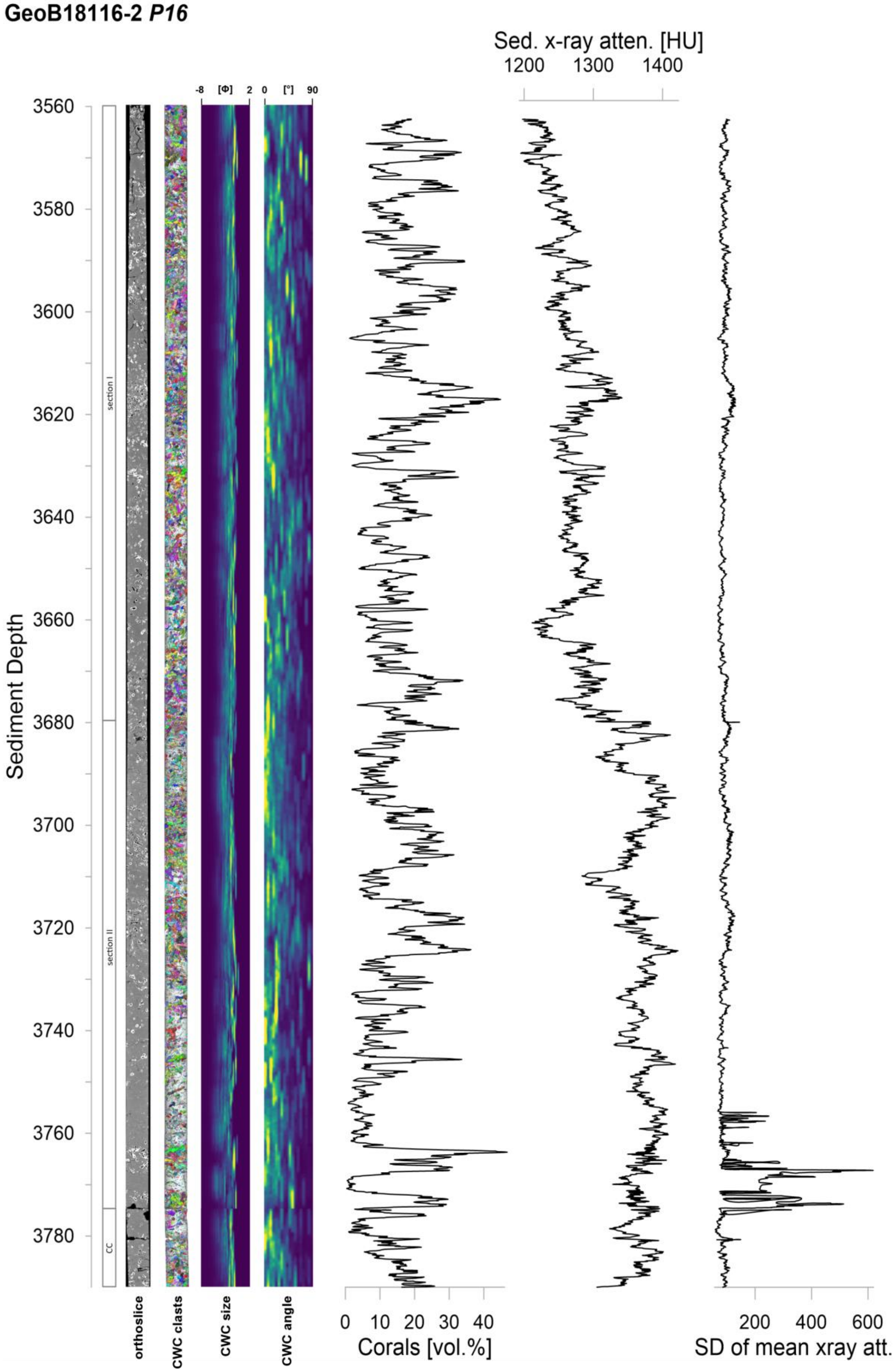

Fig. S24: CT-derived core data for GeoB18116-2 Barrel P16, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P17*

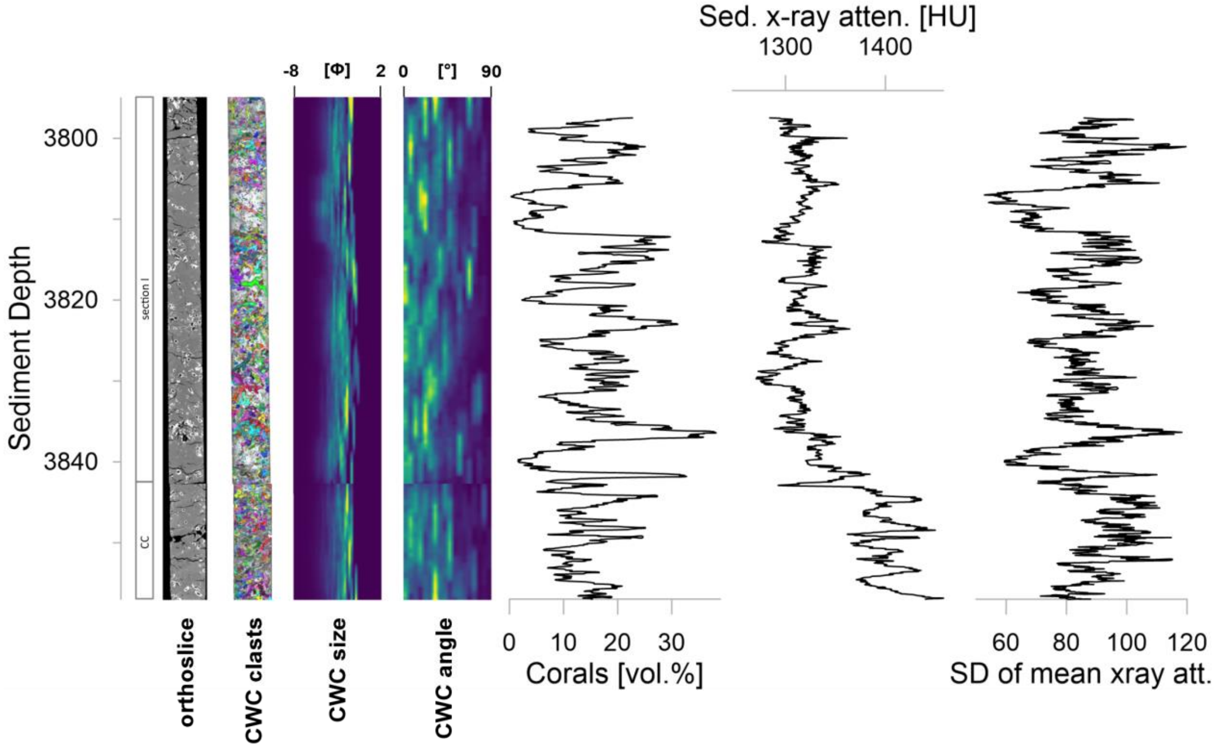

Fig. S25: CT-derived core data for GeoB18116-2 Barrel P17, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

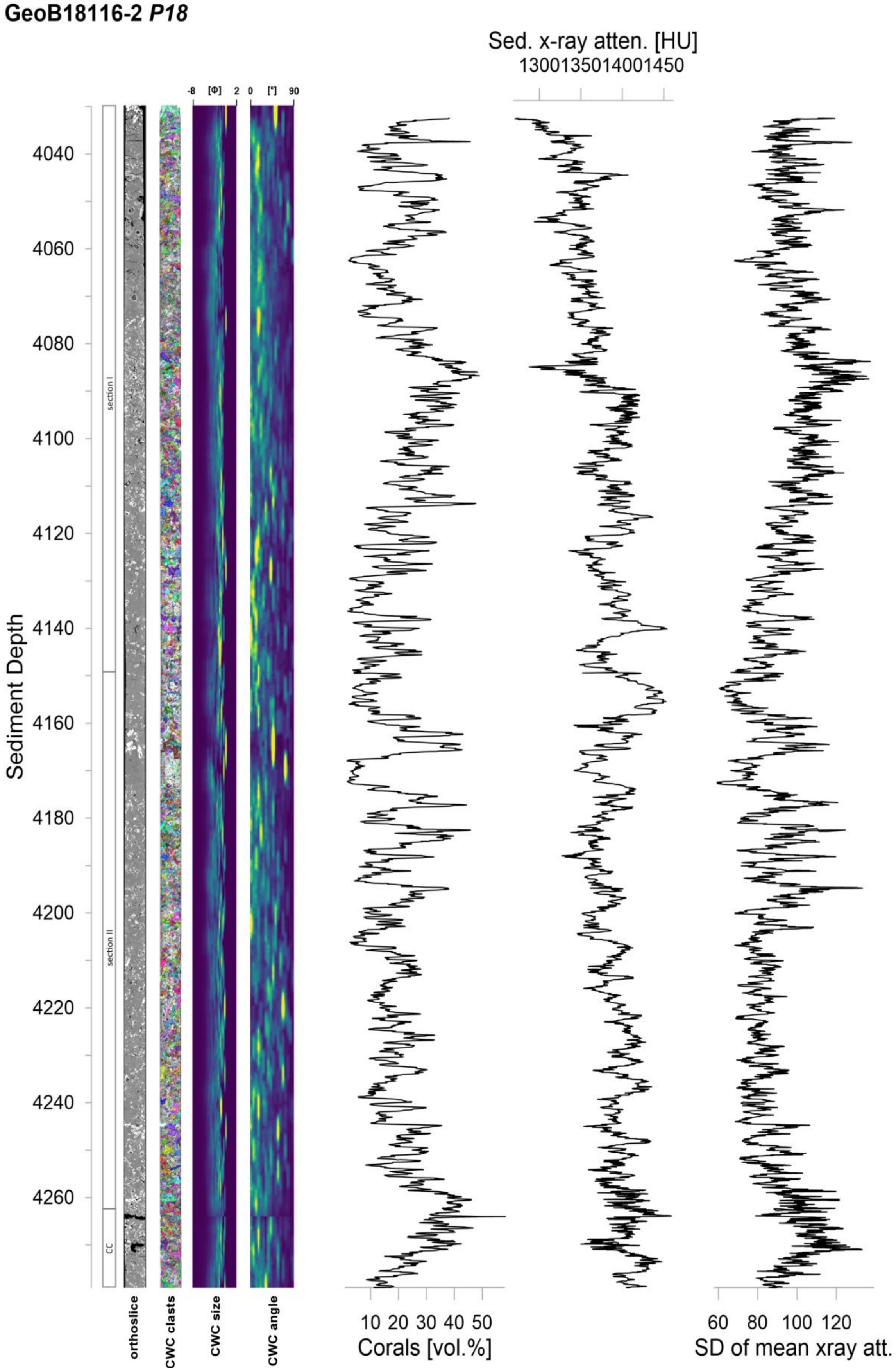

Fig. S26: CT-derived core data for GeoB18116-2 Barrel P18, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P19*

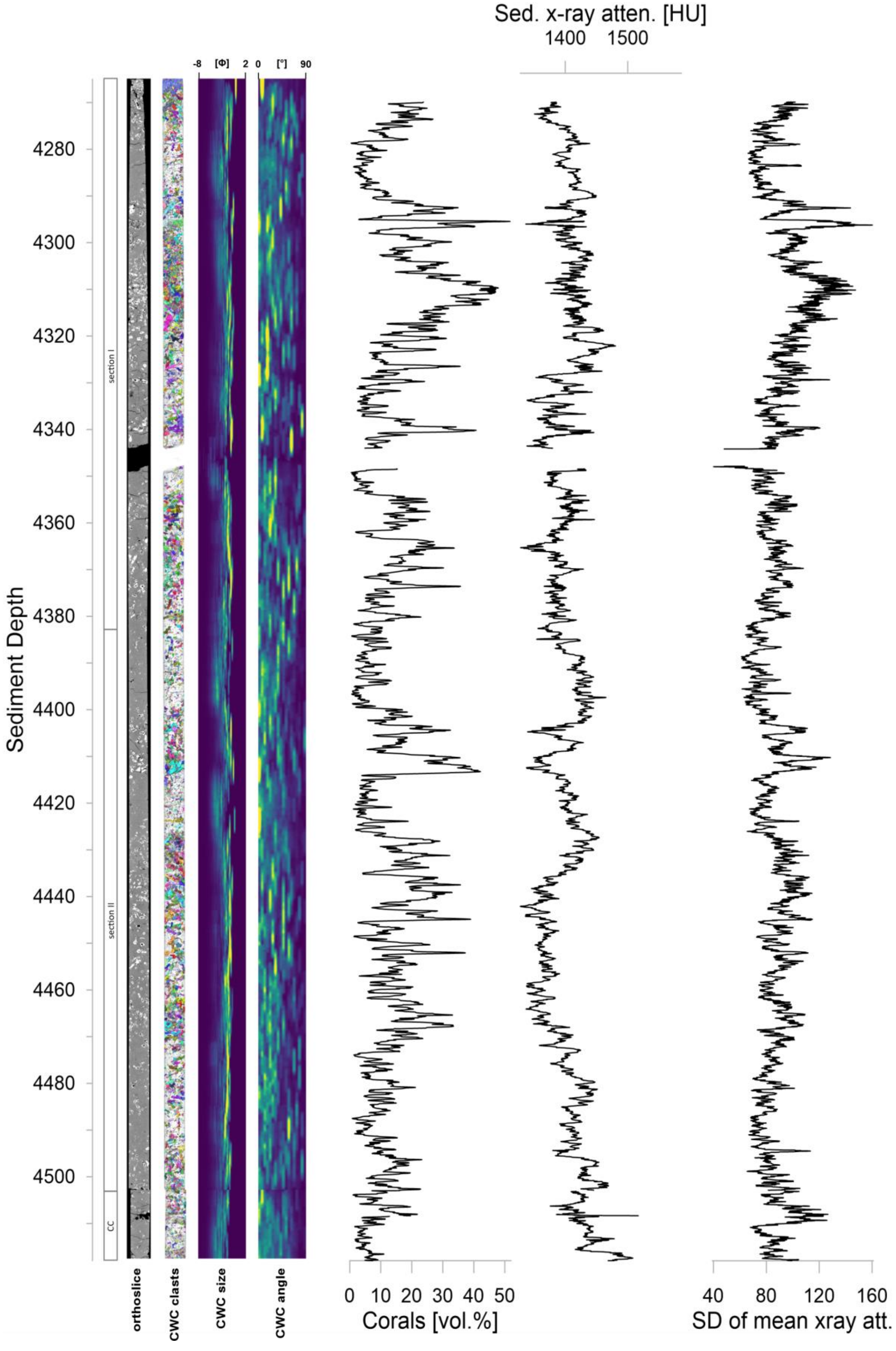

Fig. S27: CT-derived core data for GeoB18116-2 Barrel P19, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P20*

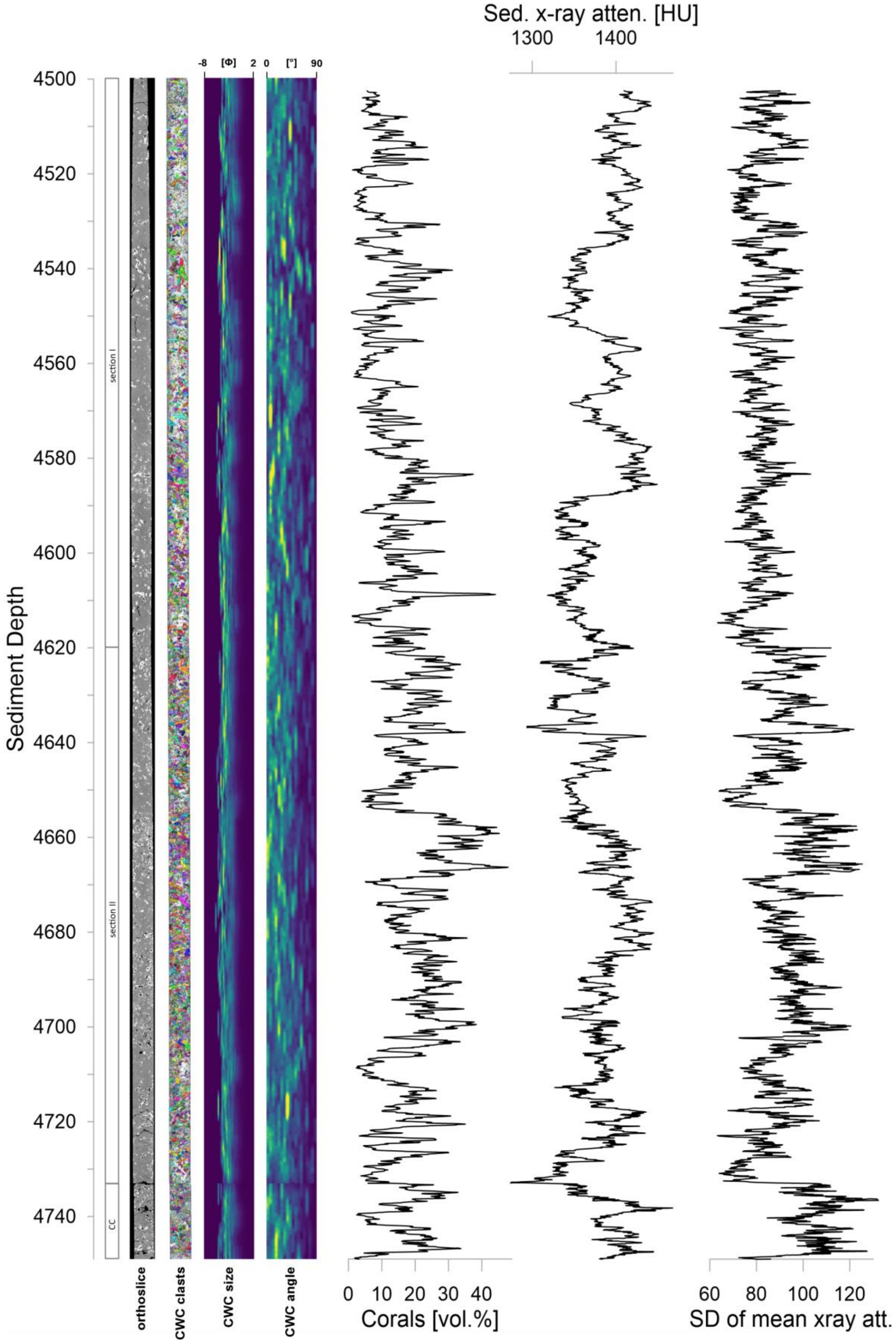

Fig. S28: CT-derived core data for GeoB18116-2 Barrel P20, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

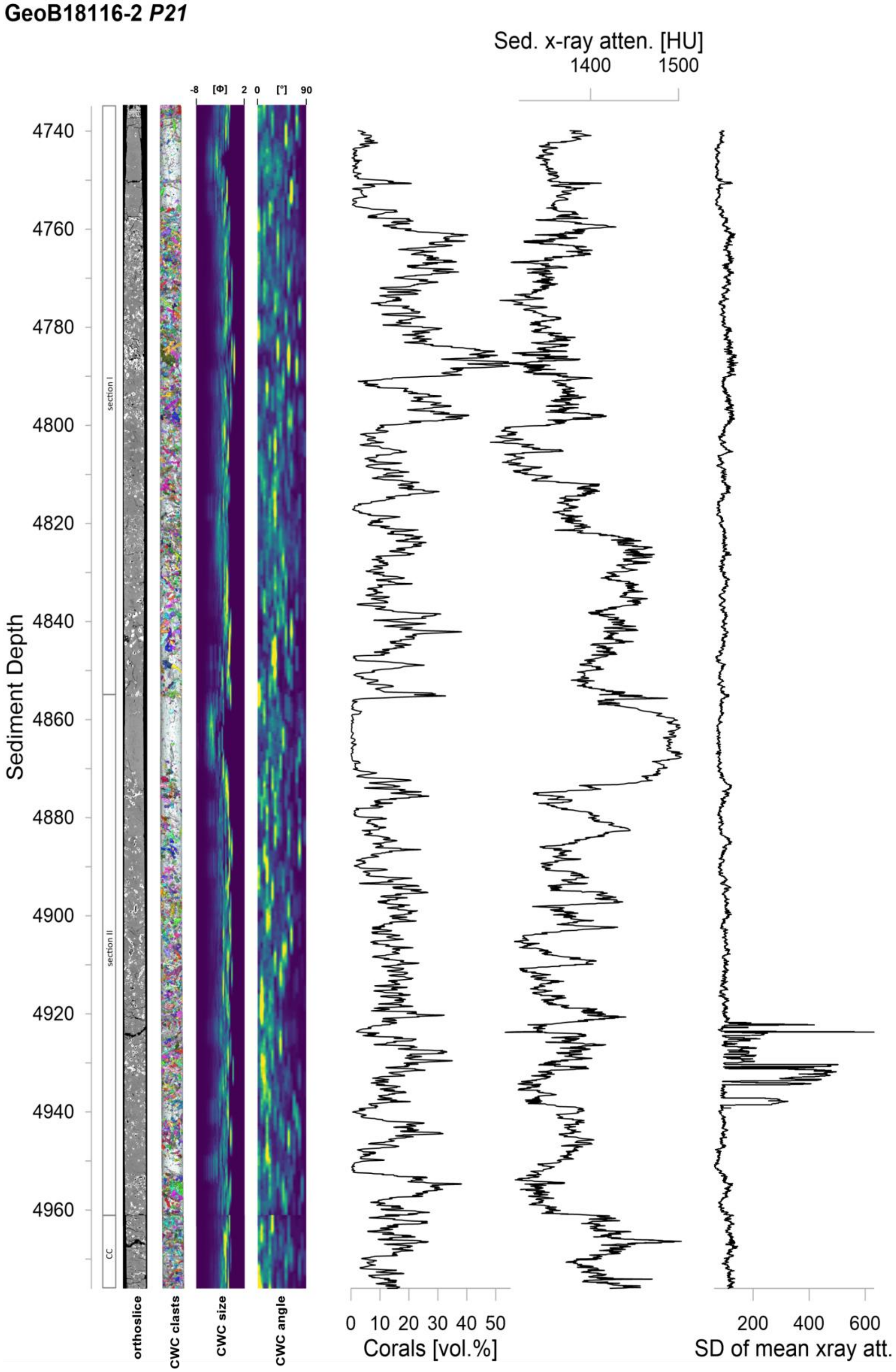

Fig. S29: CT-derived core data for GeoB18116-2 Barrel P21, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P22*

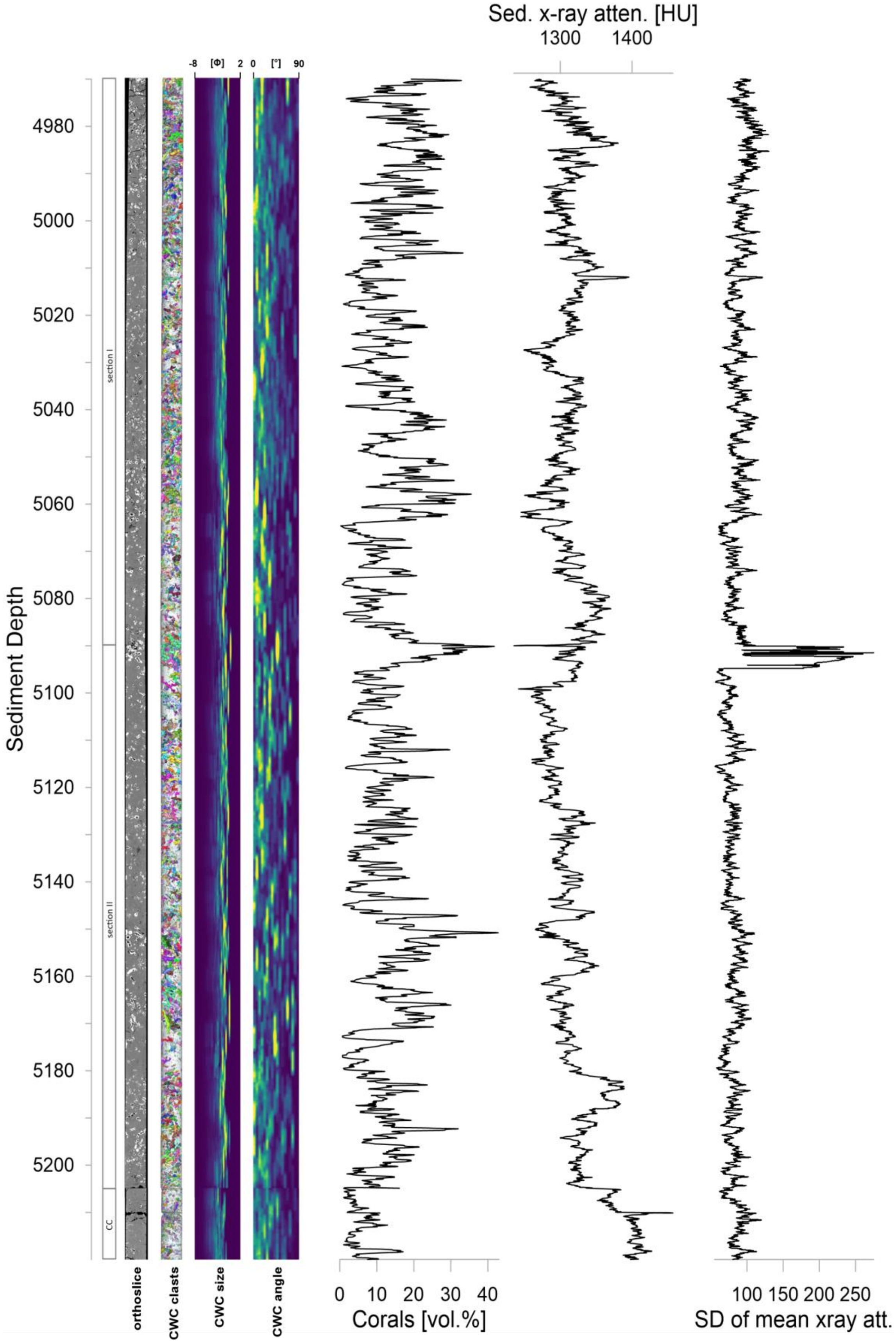

Fig. S30: CT-derived core data for GeoB18116-2 Barrel P22, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

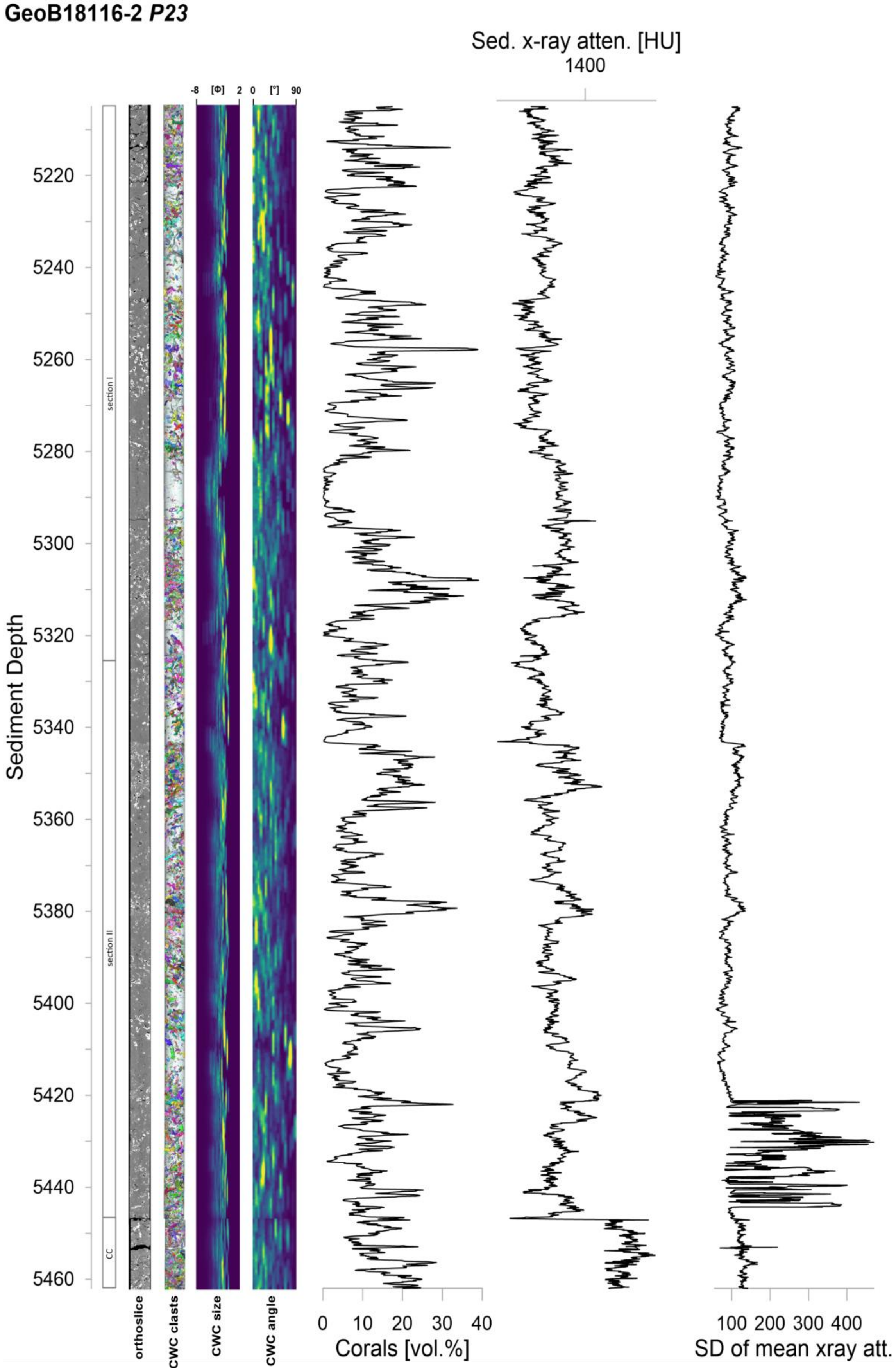

Fig. S31: CT-derived core data for GeoB18116-2 Barrel P23, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P24*

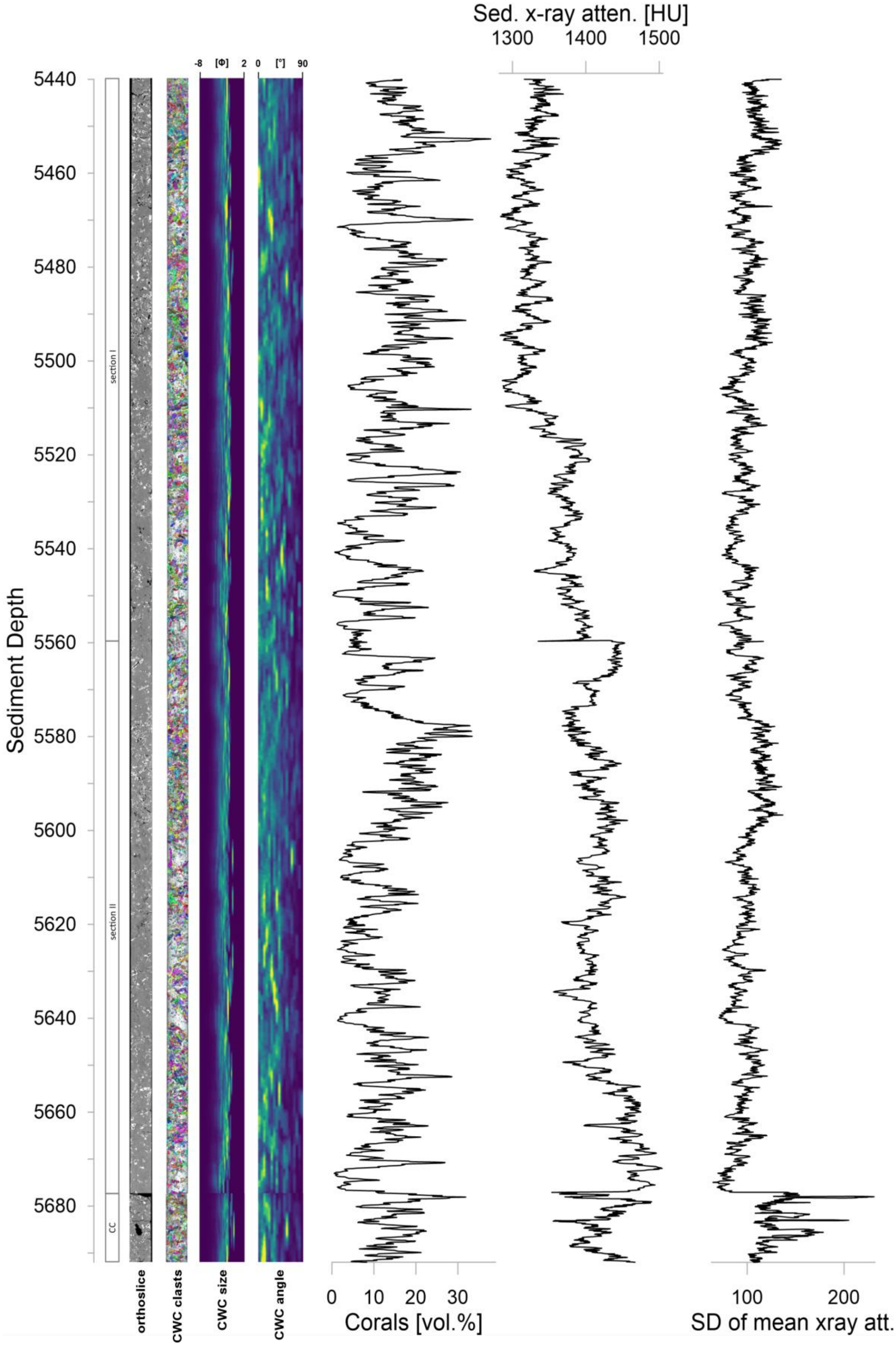

Fig. S32: CT-derived core data for GeoB18116-2 Barrel P24, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

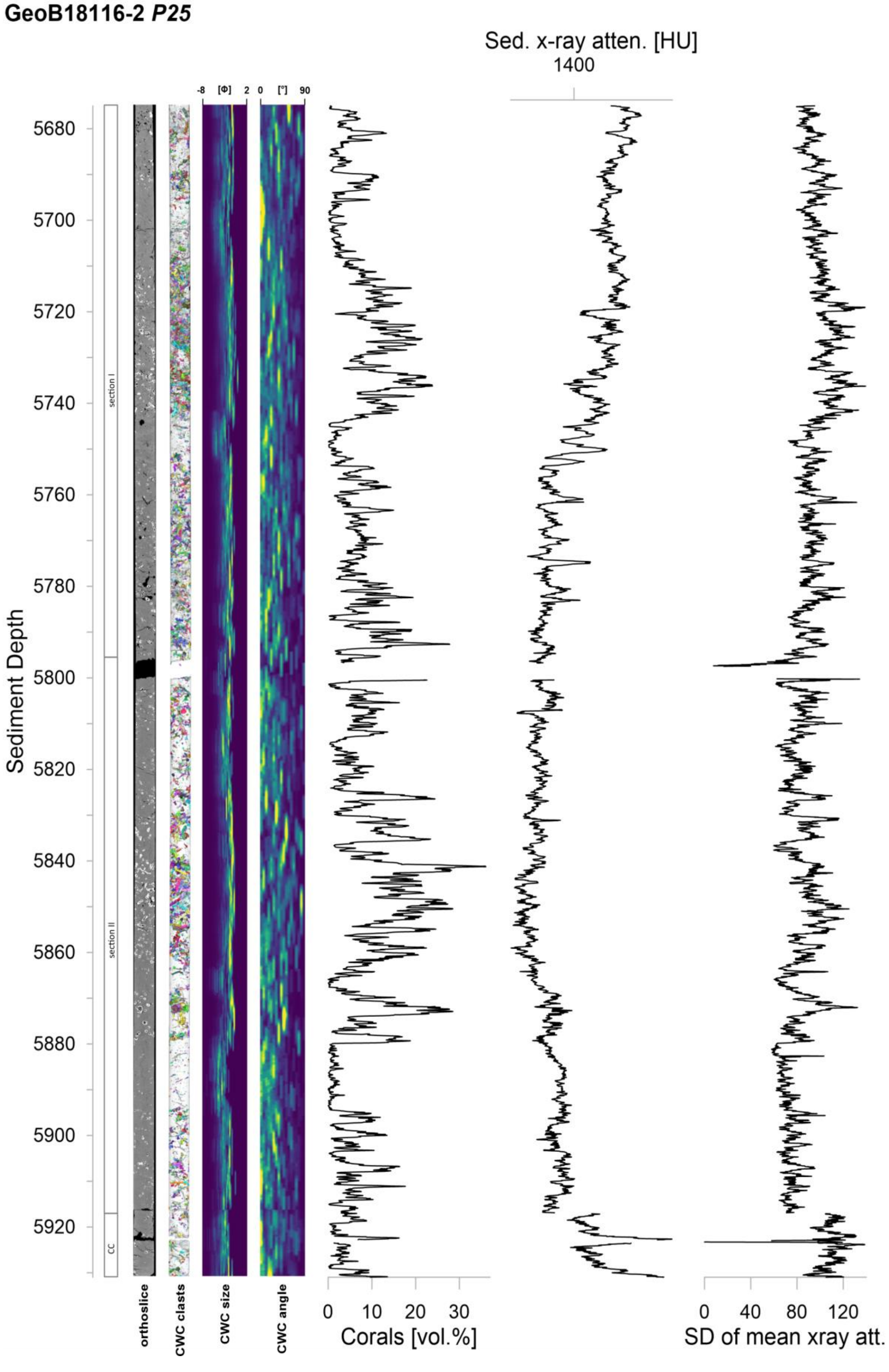

Fig. S33: CT-derived core data for GeoB18116-2 Barrel P25, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.

GeoB18116-2 *P26*

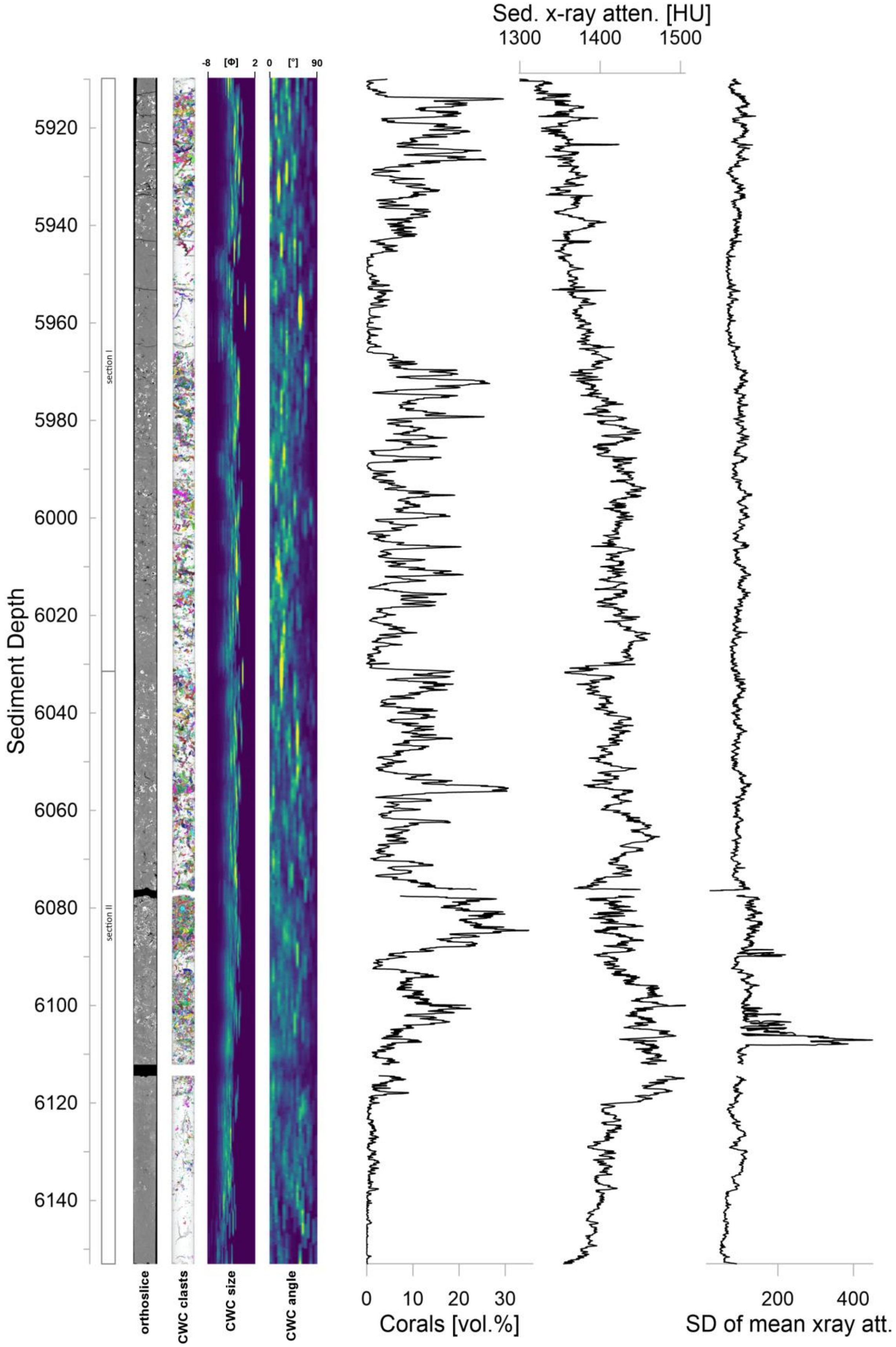

Fig. S34: CT-derived core data for GeoB18116-2 Barrel P26, with Sediment Depth as CSF-A (mbsf), orthoslice, section number (CC = core catcher), cold-water coral fossil clast quantification, size and angle, coral volume and mean x-ray attenuation in HU (Hounsfield units), and SD.