Supplementary Materials

Blue carbon cycling in the coastal areas of Qatar

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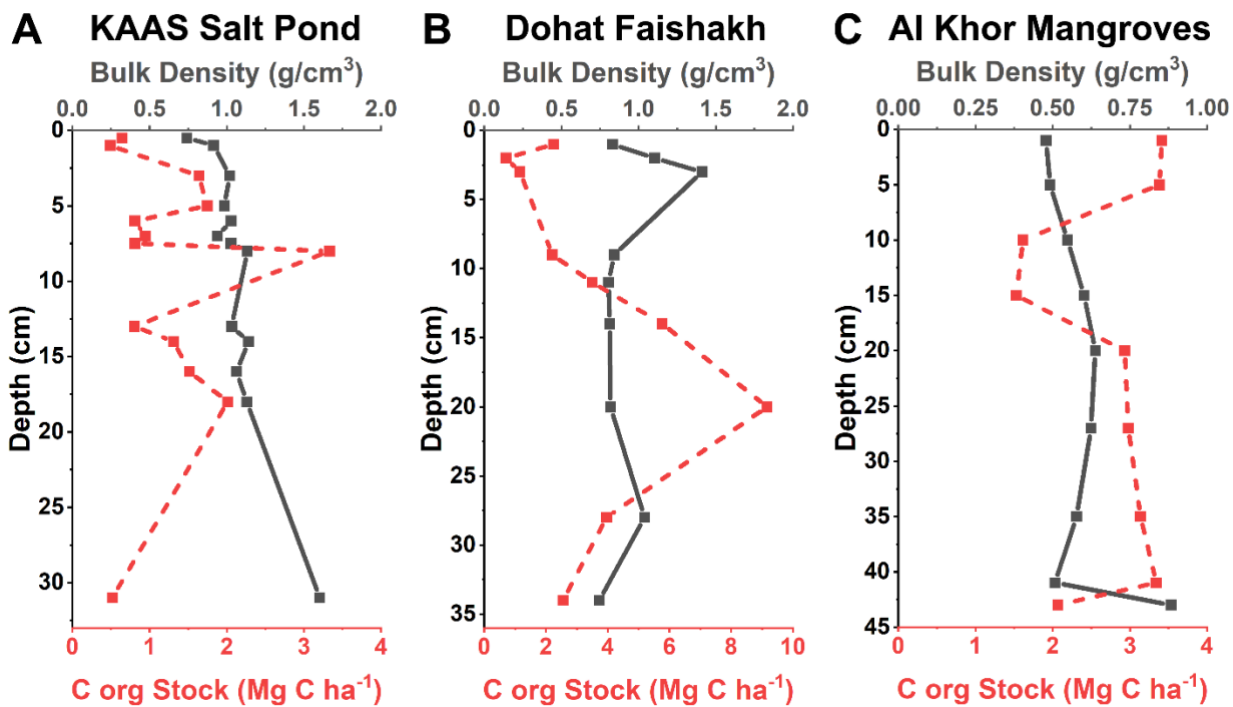
Figure S1: Depth profiles of bulk density (in g/cm^3) and C_{org} stock (in Mg C ha^{-1}) in the sediment cores of the coastal sites. A) KAAS Salt Pond site; B) DF sabkha site; C) AK mangroves site. Bulk density is represented by the black solid line and C_{org} stock by the red dashed line.
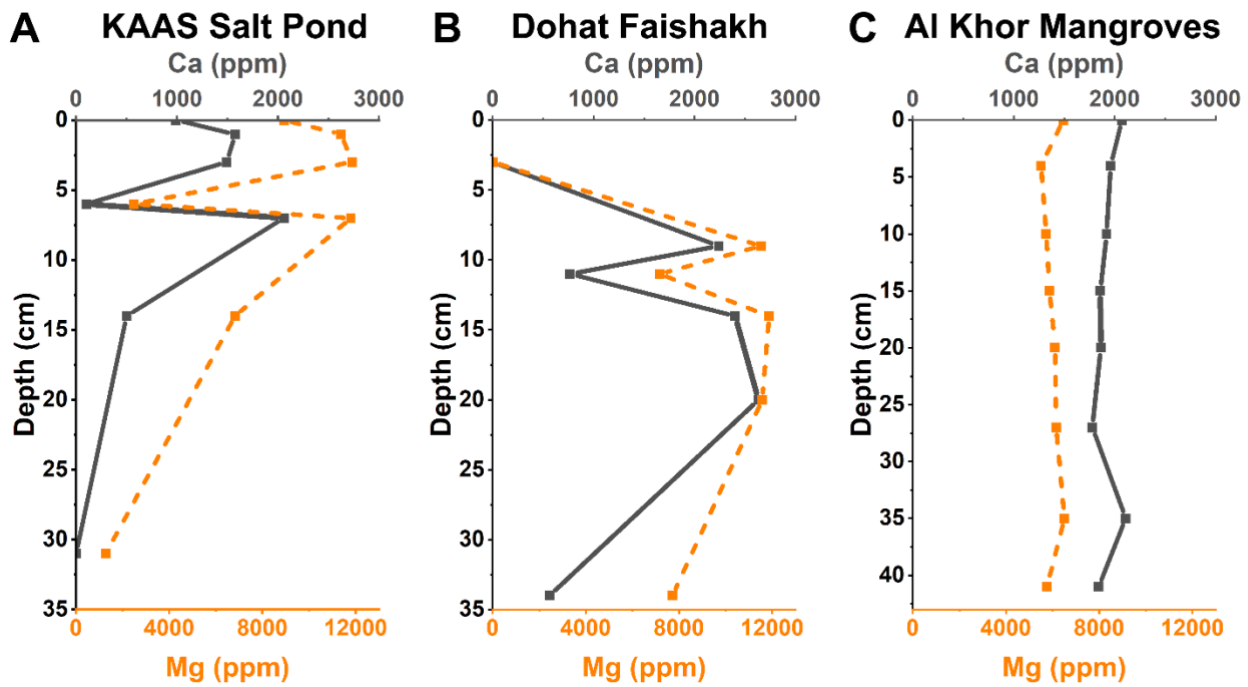
Figure S2: Depth profiles of Ca and Mg concentrations in porewater of the sediments. A) KAAS Salt Pond site; B) DF sabkha site; C) AK mangroves site. Solid black line shows Ca concentration in ppm, and dotted orange line shows Mg concentration in ppm.
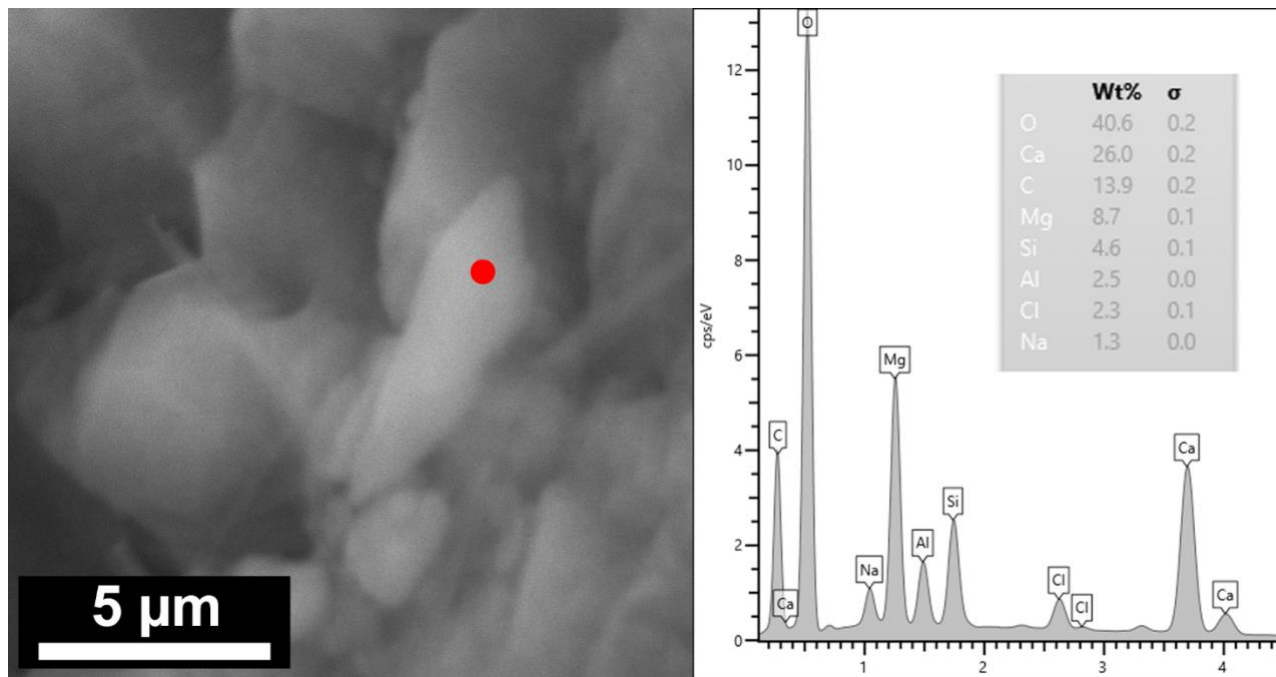
Figure S3: SEM imaging of AK mangroves sediment at 20 cm depth, showing rhombohedral crystals (left). The elemental composition determined by EDXS (right) in the region of the crystal marked by the red dot shows that the crystals have a calcium-magnesium carbonate composition.

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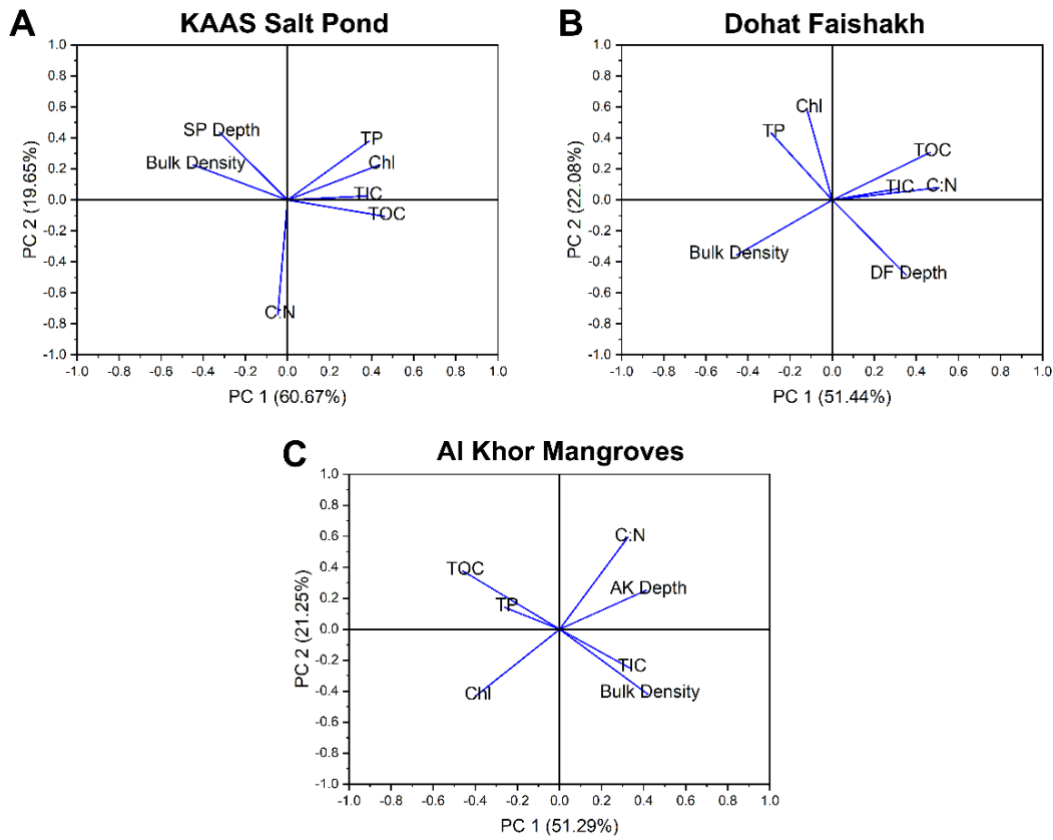
Figure S4: Principal component analysis loading plots showing the correlation and grouping of sediment characteristic eigenvectors based on their alignment to two principal components. Eigenvector groupings vary between sites. A) KAAS Salt Pond site; B) Dohat Faishakh sabkha site; C) Al Khor Mangroves site.
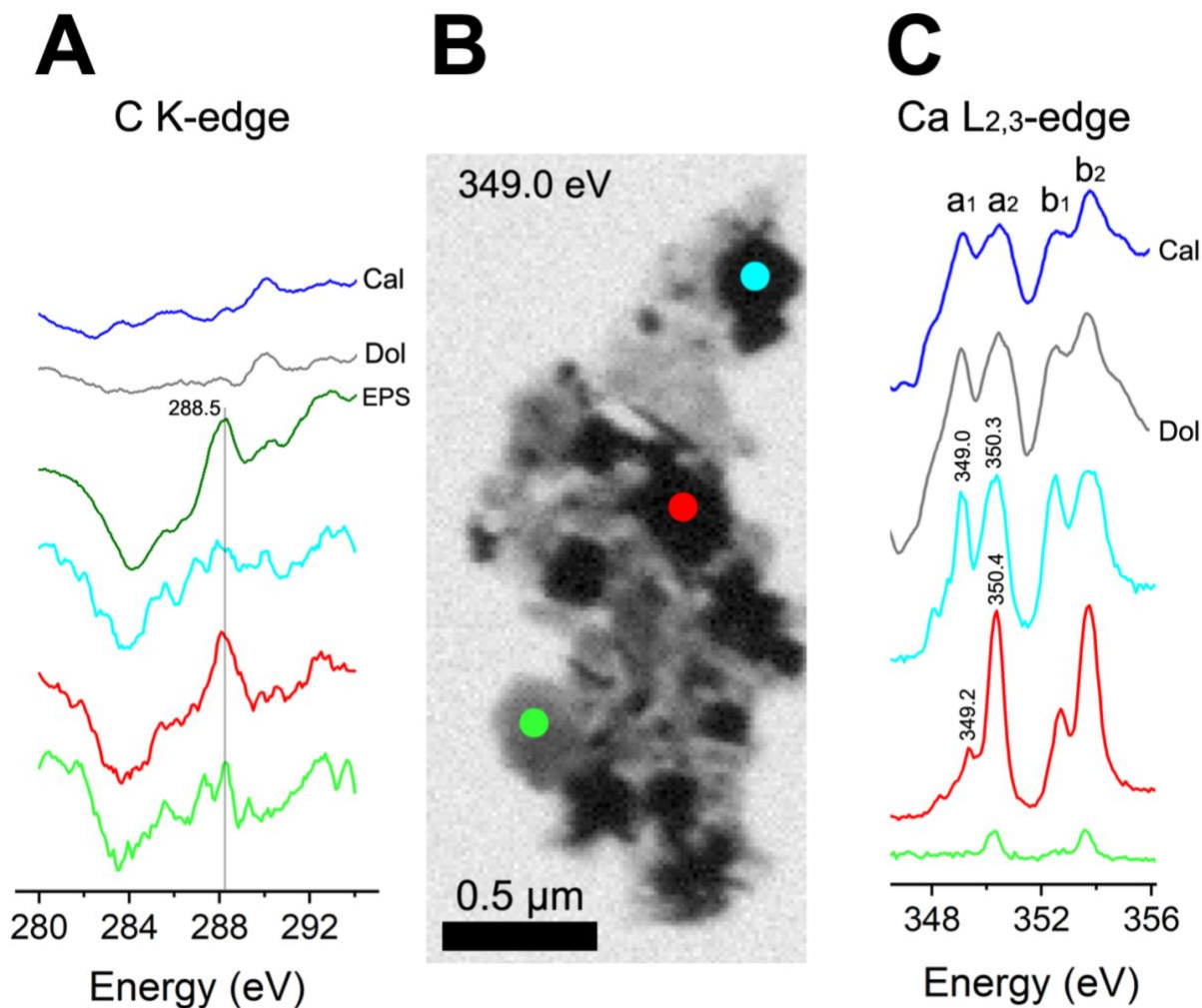
Figure S5: STXM micrograph (B) and spectra (A, C) of DF 11 cm depth sediment particle showing unique NEXAFS signatures corresponding to calcite, dolomite and EPS; A) C K-edge spectra of calcite and dolomite mineral standards, green EPS standard, and three ROIs along the sediment particle, defined in B. Strong peak at 288.5 eV observed in green and red ROIs and EPS standard indicating abundance of carboxyl functional groups; B) Spectral image of sediment particle collected at 349.0 eV with dots marking the ROIs from which spectra were produced. Green dot corresponds to green spectra, and likewise for red and light-blue dots; C) Ca $L_{2,3}$-edge spectra of calcite and dolomite mineral standards, and spectra collected from the three ROIs marked in B. Slight shifts in the positions of a_1 and a_2 carbonate characteristic peaks are observed between light-blue and red ROIs corresponding to calcite (a_1 = 349.0 eV, a_2 = 350.3 eV) and dolomite (a_1 = 349.2 eV, a_2 = 350.4 eV) carbonate mineral identities, respectively.
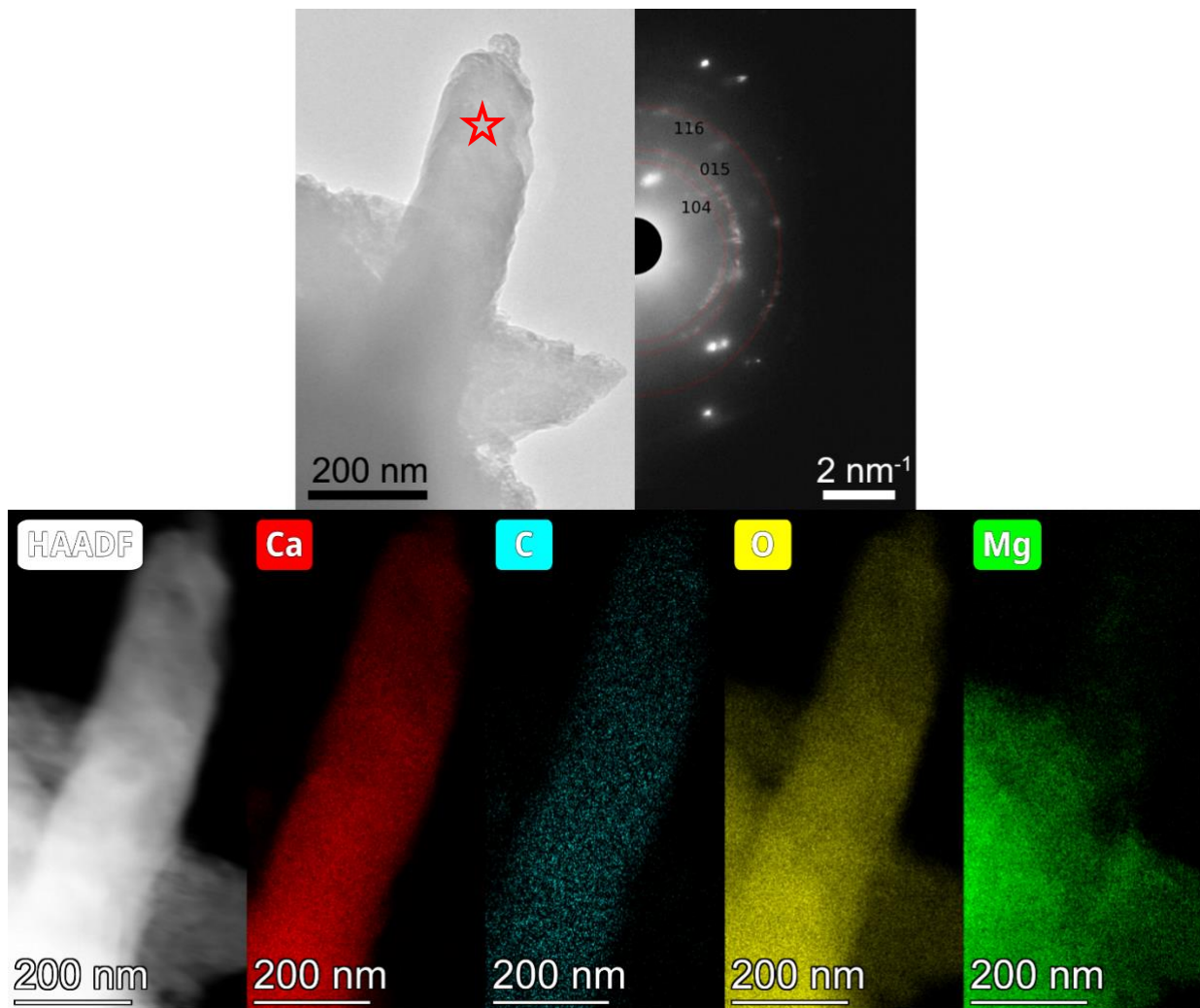
Figure S6: TEM micrograph, diffraction pattern and EDXS imaging of a carbonate polycrystalline particle from DF site sediment at 11 cm depth. Top, left: HR-TEM bright-field image of crystal. Top, right: Indexed diffraction rings using SAED aperture of region marked by red star in the same crystal, showing (104), (015) and (116) dolomite crystal plane reflections. Bottom: Same particle imaged using EDXS chemical imaging showing elemental abundance of Ca, C, O and Mg.

Table S1: Pearson linear correlation coefficients and p-values of sediment characteristics

Site	Parameter 1	Parameter 2	R^2 value	p-value
KAAS Salt Pond	**Depth**	**TOC**	**0.6170**	**0.0247***
	Depth	**C:N**	**0.5821**	**0.0228***
	Depth	**TP**	**0.5130**	**0.0352***
	Depth	**TIC**	**0.5789**	**0.0301***
	Depth	**Bulk Density**	**0.8008**	**<0.001***
	TOC	TP	0.5314	0.0616
	TOC	**Bulk Density**	**0.8174**	**<0.001***
	TOC	**Chlorophyll**	**0.6115**	**0.0264***
	TOC	Mg/Ca ratio	0.7399	0.0927
	TP	Bulk Density	0.5144	0.0721
	TIC	C:N ratio	0.4684	0.0912
	TIC	**TP**	**0.6224**	**0.0175***
Dohat Faishakh	Depth	TP	0.5008	0.1697
	TOC	**C:N ratio**	**0.7223**	**0.0280***
	TOC	**Bulk Density**	**0.9456**	**<0.001***
	TOC	Mg/Ca ratio	0.6377	0.1731
	C:N ratio	**Bulk Density**	**0.6759**	**0.0457***
Al Khor Mangroves	**TOC**	**Bulk Density**	**0.9658**	**<0.001***

	TOC	TIC	0.5758	0.1353
	C:N ratio	Chlorophyll	0.5962	0.0901
	Mg/Ca ratio	Chlorophyll	0.5605	0.1484

*Denotes significant correlation where **p<α; α=0.05**

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