

Electronic Supplementary Information (ESI)

Multi-genomic analysis of the Cation Diffusion Facilitator transporters from algae

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Supplementary Information

CDF protein sequence information was obtained from individual sequence database depositions followed published characterisation of selected CDF proteins or from genome annotations. Individual sequence, reference and database (including website address) information is provided in Supplementary Table S1 (below). All individual bacterial proteins sequences were obtained from National Center for Biotechnology Information (NCBI) Protein Database.

Genome assemblies and annotations from 38 species were used in this study. The details of each genome are described below. The majority of the genome data was accessed from the DOE Joint Genome Institute (JGI) Genome Portal (Grigoriev et al. 2012; Nordberg et al. 2014), including JGI MycoCosm (Grigoriev et al. 2014) and JGI PhycoCosm, and JGI Phytozome v.12 (Goodstein et al. 2012).

For the non-algal organisms the following genomes were analysed. *Nostoc punctiforme* PCC 73102 genome data was obtained from JGI Genome Portal. *Homo sapiens* sequence data was obtained from NCBI. *Saccharomyces cerevisiae* strain S288C genome data (genome version R64-2-1) was obtained from the *Saccharomyces* Genome Database (SGD) (Cherry et al. 2012; Engel et al. 2014). *Arabidopsis thaliana* cv. Col-0 genome (The Arabidopsis Genome Initiative 2000) release v.9 data was obtained from The Arabidopsis Information Resource (TAIR) v.10 (Lamesch et al. 2012). *Schizochytrium aggregatum* ATCC 28209 draft genome release v.1 data was obtained from JGI MycoCosm.

For a charophyte genome, *Klebsormidium nitens* NIES-2285 genome release v.1.1 data was obtained from the *Klebsormidium nitens* NIES-2285 genome project (Hori et al. 2014).

For the chlorophyte organisms the following genomes were analysed. *Bathycoccus prasinus* RCC1105 genome (Moreau et al. 2012) assembly ASM222023v1 data was obtained from JGI PhycoCosm. *Botryococcus braunii* Race B (Showa strain) genome release v.2.1 (*Botryococcus braunii* Showa v2.1 DOE-JGI, <http://phytozome.jgi.doe.gov/>) data was obtained from JGI Phytozome. *Chlamydomonas reinhardtii* CC-503 genome (Merchant et al. 2007) assembly and annotation v.5.5 data was obtained from JGI Phytozome. *Chlorella* sp. NC64A draft genome (Blanc et al. 2010) assembly and annotation v.1 data was obtained from JGI PhycoCosm. *Chromochloris zofingiensis* SAG 211-14 genome (Roth et al. 2017) assembly and annotation v.5.2.3.2 data was obtained from JGI PhycoCosm. *Coccomyxa subellipsoidea* C-169 genome (Blanc et al. 2012) assembly and annotation v.2 data was obtained from JGI Phytozome. *Dunaliella salina* CCAP19-18 draft genome (Polle et al. 2017) assembly and annotation v.1 data was obtained from JGI Phytozome. *Micromonas pusilla* CCMP1545 genome (Worden et al. 2009) assembly and annotation v.3 data was obtained from JGI Phytozome. *Micromonas* sp. RCC299 genome (Worden et al. 2009) assembly and annotation v.3 data was obtained from JGI Phytozome. *Ostreococcus lucimarinus* genome

(Palenik et al. 2007) assembly and annotation v.2 data was obtained from JGI Phytozome. *Ostreococcus* sp. RCC809 draft genome (Palenik et al. 2007) assembly and annotation v.2 data was obtained from JGI PhycoCosm. *Ostreococcus tauri* RCC4221 genome (Palenik et al. 2007; Blanc-Mathieu et al. 2014) assembly and annotation v.3 data was obtained from JGI PhycoCosm. *Volvox carteri* genome (Prochnik et al. 2010) assembly and annotation v.2.1 data was obtained from JGI Phytozome.

For the pelagophyte organisms the following genomes were analysed. *Aureococcus anophagefferens* clone 1984 genome (Gobler et al. 2011) assembly and annotation v.1 data was obtained from JGI PhycoCosm. *Pelagophyceae* sp. CCMP2097 draft genome assembly and annotation v.1 data was obtained from JGI PhycoCosm.

For the cryptophyte organisms the following genomes were analysed. *Cryptophyceae* sp. CCMP2293 draft genome assembly and annotation v.1 data was obtained from JGI PhycoCosm. *Guillardia theta* CCMP2712 draft genome (Curtis et al. 2012) assembly and annotation v.1 data was obtained from JGI PhycoCosm.

For the rhodophyte organisms the following genomes were analysed. *Cyanidioschyzon merolae* genome (Matsuzaki et al. 2004; Nozaki et al. 2007) assembly and annotation data was obtained from JGI PhycoCosm. *Galdieria sulphuraria* 074W genome (Schönknecht et al. 2013) assembly and annotation data was obtained from JGI PhycoCosm. *Porphyra umbilicalis* genome (Brawley et al. 2017) assembly and annotation v1.5 data was obtained from JGI Phytozome.

For the haptophyte organisms the following genomes were analysed. *Emiliania huxleyi* CCMP1516 draft genome (Read et al. 2013) assembly and annotation v.1 data was obtained from JGI PhycoCosm. *Pavlova* sp. CCMP2436 draft genome assembly and annotation v.1 data was obtained from JGI PhycoCosm. *Phaeocystis antarctica* CCMP1374 genome assembly and annotation v.2.2 data was obtained from JGI PhycoCosm. *Phaeocystis globosa* Pg-G genome assembly and annotation v.2.3 data was obtained from JGI PhycoCosm.

For the bacillariophyte organisms the following genomes were analysed. *Fragilariopsis cylindrus* CCMP 1102 genome (Mock et al. 2017) assembly and annotation v.1 data was obtained from JGI PhycoCosm. *Phaeodactylum tricornutum* CCAP 1055/1 genome (Bowler et al. 2008) assembly and annotation v.2 data was obtained from JGI PhycoCosm. *Pseudo-nitzschia* multiseries CLN-47 draft genome assembly and annotation v.1 data was obtained from JGI PhycoCosm. *Thalassiosira pseudonana* CCMP 1335 genome (Armbrust et al. 2004) assembly and annotation v.3 data was obtained from JGI PhycoCosm.

For the ochrophyte organisms the following genomes were analysed. *Ectocarpus siliculosus* Ec 32 genome (Cock et al. 2010) assembly and annotation data was obtained from JGI PhycoCosm. *Nannochloropsis oceanica* CCMP1779 draft genome assembly and annotation v.2 data was obtained from JGI PhycoCosm. *Ochromonadaceae* sp. CCMP2298 draft genome assembly and annotation v.1 data was obtained from JGI PhycoCosm.

For a chlorarachinophyte genome, *Bigelowiella natans* CCMP2755 draft genome assembly and annotation v.1 data was obtained from JGI PhycoCosm.

Supplementary Table S1. Details of each CDF protein from each analysed organism and genome used in the phylogenetic analysis. The genome Id number or accession number refer to the database listed in the adjacent column, Database website addresses are shown in the table footnotes. CDF group assignments were determined from phylogenetic analysis (Figure 1) and supported by cluster analysis (Figure 2). Eight sequences were classed as unassigned including seven sequences where the evidence for Group 2 assignment was not supported by cluster analysis.

Protein name	Species	Taxonomic classification	Genome ID or accession no.	Database	CDF Group	Known substrate	Reference
Bs_CzcD	<i>Bacillus subtilis</i>	Bacteria	NP_390542.1	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺ , Co ²⁺ , Cu ²⁺ , Ni ²⁺	Moore et al. (2005)
Bd_blr4938	<i>Bradyrhizobium diazoefficiens</i> USDA 110	Bacteria	NP_771578.1	NCBI ^a	Group 1 (Zn-CDF)		
Ec_ZitB	<i>Escherichia coli</i>	Bacteria	P75757.1	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺	Chao & Fu (2004)
Ec_YiiP	<i>Escherichia coli</i>	Bacteria	P69380.1	NCBI ^a	Group 2 (Fe/Zn CDF)	Fe ²⁺ , Zn ²⁺ , Cd ²⁺	Wei & Fu (2005)
Cm_FieF	<i>Ralstonia metallidurans</i> CH34	Bacteria	ZP_00593836.1	NCBI ^a	Group 2 (Fe/Zn CDF)	Fe ²⁺ , Co ²⁺ , Ni ²⁺ , Cd ²⁺ , Zn ²⁺	Munkelt et al. (2004)
Re_CepA	<i>Rhizobium etli</i> CFN 42	Bacteria	ABC90024.1	NCBI ^a	Group 1 (Zn-CDF)	Co ²⁺	Cubillas et al. (2013)
Re_NepA	<i>Rhizobium etli</i> CFN 42	Bacteria	ABC93653.1	NCBI ^a	Group 2 (Fe/Zn CDF)	Ni ²⁺ , Co ²⁺	Cubillas et al. (2013)
Sm_0683	<i>Sinorhizobium meliloti</i> 1021	Bacteria	NP_435608.2	NCBI ^a	Unassigned		
Sp_MntE	<i>Streptococcus pneumoniae</i> D39	Bacteria	ABJ55467.1	NCBI ^a	Group 2 (Fe/Zn CDF)	Mn ²⁺	Rosch et al. (2009)
Tt_CzrB	<i>Thermus thermophiles</i>	Bacteria	CAC83722.1	NCBI ^a	Group 2 (Fe/Zn CDF)	Zn ²⁺ , Cd ²⁺	Spada et al. (2002)
Ma_4394	<i>Methanosarcina acetivorans</i> C2A	Archaea	AAM07736.1	NCBI ^a	Group 2 (Fe/Zn CDF)		
Np_F1794	<i>Nostoc punctiforme</i> PCC 73102	Cyanobacteria	ACC80456.1	JGI Genome Portal ^b	Group 3 (undefined)		
Np_F0707	<i>Nostoc punctiforme</i> PCC 73102	Cyanobacteria	ACC79459.1	JGI Genome Portal ^b	Group 2 (Fe/Zn CDF)		
Np_R3104	<i>Nostoc punctiforme</i> PCC 73102	Cyanobacteria	ACC81585.1	JGI Genome Portal ^b	Group 3 (undefined)		
Np_F2455	<i>Nostoc punctiforme</i> PCC 73102	Cyanobacteria	ACC81016.1	JGI Genome Portal ^b	Group 2 (Fe/Zn CDF)		
Hs_Znt1	<i>Homo sapiens</i>	Metazoa	NP_067017.2	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺	Segal et al. (2004)

Hs_Znt2	<i>Homo sapiens</i>	Metazoa	NP_001004434.1	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺	Lopez & Kelleher (2009)
Hs_Znt3	<i>Homo sapiens</i>	Metazoa	NP_003450.2	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺	Salazar et al. (2009)
Hs_Znt4	<i>Homo sapiens</i>	Metazoa	NP_037441.2	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺	Murgia et al. (2011)
Hs_Znt5	<i>Homo sapiens</i>	Metazoa	NP_075053.2	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺	Ohana et al. (2009)
Hs_Znt6	<i>Homo sapiens</i>	Metazoa	NP_001180442.1	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺	Huang et al. (2002)
Hs_Znt7	<i>Homo sapiens</i>	Metazoa	NP_001138356.1	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺	Kirschke & Huang (2003)
Hs_Znt8	<i>Homo sapiens</i>	Metazoa	NP_776250.2	NCBI ^a	Group 1 (Zn-CDF)	Zn ²⁺	Chimienti et al. (2004)
Hs_Znt9	<i>Homo sapiens</i>	Metazoa	NP_006336.3	NCBI ^a	Group 3 (undefined)	Zn ²⁺	Perez et al. (2017)
Hs_Znt10	<i>Homo sapiens</i>	Metazoa	NP_061183.2	NCBI ^a	Group 1 (Zn-CDF)	Mn ²⁺ , Zn ²⁺ ?	Nishito et al. (2016)
Sc_ZRC1	<i>Saccharomyces cerevisiae</i> S288C	Ascomycota	SGD:S000004856	SGC ^c	Group 1 (Zn-CDF)	Zn ²⁺	MacDiarmid et al. (2002)
Sc_COT1	<i>Saccharomyces cerevisiae</i> S288C	Ascomycota	SGD:S000005843	SGC ^c	Group 1 (Zn-CDF)	Zn ²⁺ , Co ²⁺	MacDiarmid et al. (2002)
Sc_MSC2	<i>Saccharomyces cerevisiae</i> S288C	Ascomycota	SGD:S000002613	SGC ^c	Group 1 (Zn-CDF)	Zn ²⁺	Ellis et al. (2004)
Sc_ZRG17	<i>Saccharomyces cerevisiae</i> S288C	Ascomycota	SGD:S000005322	SGC ^c	Unassigned	Zn ²⁺	Ellis et al. (2005)
Sc_MMT1	<i>Saccharomyces cerevisiae</i> S288C	Ascomycota	SGD:S000004789	SGC ^c	Group 2 (Fe/Zn CDF)	Fe ²⁺	Li et al. (2014)
Sc_MMT2	<i>Saccharomyces cerevisiae</i> S288C	Ascomycota	SGD:S000006145	SGC ^c	Group 2 (Fe/Zn CDF)	Fe ²⁺	Li et al. (2014)
At_MTP1	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT2G46800.1	TAIR ^d	Group 1 (Zn-CDF)	Zn ²⁺	Kobae et al. (2004)
At_MTP2	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT3G61940.1	TAIR ^d	Group 1 (Zn-CDF)	Zn ²⁺	Sinclair et al. (2018)
At_MTP3	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT3G58810.1	TAIR ^d	Group 1 (Zn-CDF)	Zn ²⁺ , Cd ²⁺	Arrivault et al. (2006)
At_MTP4	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT2G29410.1	TAIR ^d	Group 1 (Zn-CDF)	Zn ²⁺	Fujiwara et al. (2015)
At_MTP5	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT3G12100.1	TAIR ^d	Group 1 (Zn-CDF)	Zn ²⁺	Fujiwara et al. (2015)

At_MTP6	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT2G47830.1	TAIR ^d	Group 2 (Fe/Zn CDF)		
At_MTP7	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT1G51610.1	TAIR ^d	Group 3 (undefined)		
At_MTP8	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT3G58060.1	TAIR ^d	Group 4 (Mn-CDF)	Mn ²⁺ , Fe ²⁺ ?	Eroglu et al. (2016)
At_MTP9	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT1G79520.2	TAIR ^d	Group 4 (Mn-CDF)	Mn ²⁺	Chu et al. (2017)
At_MTP10	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT1G16310.1	TAIR ^d	Group 4 (Mn-CDF)	Mn ²⁺	Chu et al. (2017)
At_MTP11	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT2G39450.1	TAIR ^d	Group 4 (Mn-CDF)	Mn ²⁺	Peiter et al. (2007)
At_MTP12	<i>Arabidopsis thaliana</i> columbia	Embryophyta	AT2G04620.1	TAIR ^d	Group 1 (Zn-CDF)	Zn ²⁺	Fujiwara et al. (2015)
Sa_54404	<i>Schizochytrium</i> <i>aggregatum</i> ATCC 28209	Thraustochytrid	Protein Id: 54404	JGI MycoCosm ^e	Group 1 (Zn-CDF)		
Sa_80149	<i>Schizochytrium</i> <i>aggregatum</i> ATCC 28209	Thraustochytrid	Protein Id: 80149	JGI MycoCosm ^e	Group 1 (Zn-CDF)		
Sa_81417	<i>Schizochytrium</i> <i>aggregatum</i> ATCC 28209	Thraustochytrid	Protein Id: 81417	JGI MycoCosm ^e	Group 1 (Zn-CDF)		
Sa_27533	<i>Schizochytrium</i> <i>aggregatum</i> ATCC 28209	Thraustochytrid	Protein Id: 27533	JGI MycoCosm ^e	Group 2 (Fe/Zn CDF)		
Sa_73731	<i>Schizochytrium</i> <i>aggregatum</i> ATCC 28209	Thraustochytrid	Protein Id: 73731	JGI MycoCosm ^e	Group 3 (undefined)		
Sa_13553	<i>Schizochytrium</i> <i>aggregatum</i> ATCC 28209	Thraustochytrid	Protein Id: 13553	JGI MycoCosm ^e	Group 4 (Mn-CDF)		
Sa_86437	<i>Schizochytrium</i> <i>aggregatum</i> ATCC 28209	Thraustochytrid	Protein Id: 86437	JGI MycoCosm ^e	Group 5 (undefined)		
Kn_00085_0150	<i>Klebsormidium nitens</i> NIES-2285	Charophyta	kfl00085_0150_v1.1	Klebsormidium genome project ^f	Group 1 (Zn-CDF)		
Kn_00345_0040	<i>Klebsormidium nitens</i> NIES-2285	Charophyta	kfl00345_0040_v1.1	Klebsormidium genome project ^f	Group 1 (Zn-CDF)		
Kn_00701_0020	<i>Klebsormidium nitens</i> NIES-2285	Charophyta	kfl00701_0020_v1.1	Klebsormidium genome project ^f	Group 1 (Zn-CDF)		
Kn_00804_0020	<i>Klebsormidium nitens</i> NIES-2285	Charophyta	kfl00804_0020_v1.1	Klebsormidium genome project ^f	Group 1 (Zn-CDF)		
Kn_00270_0190	<i>Klebsormidium nitens</i> NIES-2285	Charophyta	kfl00270_0190_v1.1	Klebsormidium genome project ^f	Group 2 (Fe/Zn CDF)		
Kn_00187_0105	<i>Klebsormidium nitens</i> NIES-2285	Charophyta	kfl00187_0105_v1.1	Klebsormidium genome project ^f	Group 3 (undefined)		

Kn_00078_0240	<i>Klebsormidium nitens</i> NIES-2285	Charophyta	kfl00078_0240_v1.1	Klebsormidium genome project ^f	Group 4 (Mn-CDF)		
Kn_00343_0090	<i>Klebsormidium nitens</i> NIES-2285	Charophyta	kfl00343_0090_v1.1	Klebsormidium genome project ^f	Group 4 (Mn-CDF)		
Bp_6660	<i>Bathycoccus prasinos</i> RCC1105	Chlorophyta	Protein Id: 6660	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)		
Bp_127	<i>Bathycoccus prasinos</i> RCC1105	Chlorophyta	Protein Id: 127	JGI PhycoCosm ^g	Group 3 (undefined)		
Bp_7715	<i>Bathycoccus prasinos</i> RCC1105	Chlorophyta	Protein Id: 7715	JGI PhycoCosm ^g	Group 4 (Mn-CDF)		
Bb_0249s0060	<i>Botryococcus braunii</i> Race B (Showa strain)	Chlorophyta	Bobra.0249s0060.1	JGI Phytozome ^h	Group 1 (Zn-CDF)		
Bb_0056s0042	<i>Botryococcus braunii</i> Race B (Showa strain)	Chlorophyta	Bobra.0056s0042.1	JGI Phytozome ^h	Group 3 (undefined)		
Cr_MTP1	<i>Chlamydomonas</i> <i>reinhardtii</i> CC-503	Chlorophyta	Cre03.g145087.t1.1	JGI Phytozome ^h	Group 1 (Zn-CDF)	Zn ²⁺ , Co ²⁺	This study
Cr_MTP2	<i>Chlamydomonas</i> <i>reinhardtii</i> CC-503	Chlorophyta	Cre03.g160800.t1.2	JGI Phytozome ^h	Group 4 (Mn-CDF)	Mn ²⁺	This study
Cr_MTP3	<i>Chlamydomonas</i> <i>reinhardtii</i> CC-503	Chlorophyta	Cre03.g160750.t1.1	JGI Phytozome ^h	Group 4 (Mn-CDF)	Mn ²⁺ , Zn ²⁺ , Co ²⁺	This study
Cr_MTP4	<i>Chlamydomonas</i> <i>reinhardtii</i> CC-503	Chlorophyta	Cre03.g160550.t1.1	JGI Phytozome ^h	Group 4 (Mn-CDF)	Mn ²⁺ , Cd ²⁺	Ibuot et al. (2017)
Cr_MTP5	<i>Chlamydomonas</i> <i>reinhardtii</i> CC-503	Chlorophyta	Cre06.g289150.t1.1	JGI Phytozome ^h	Group 3 (undefined)		
Chlsp_37115	<i>Chlorella</i> sp. NC64A	Chlorophyta	Protein Id: 37115	JGI PhycoCosm ^g	Group 1 (Zn-CDF)		
Chlsp_18700	<i>Chlorella</i> sp. NC64A	Chlorophyta	Protein Id: 18700	JGI PhycoCosm ^g	Group 3 (undefined)		
Chlsp_59655	<i>Chlorella</i> sp. NC64A	Chlorophyta	Protein Id: 59655	JGI PhycoCosm ^g	Group 4 (Mn-CDF)		
Cz_04g25040	<i>Chromochloris</i> <i>zofingensis</i> SAG 211-14	Chlorophyta	Cz04g25040.t1	JGI PhycoCosm ^g	Group 1 (Zn-CDF)		
Cz_11g13120	<i>Chromochloris</i> <i>zofingensis</i> SAG 211-14	Chlorophyta	Cz11g13120.t1	JGI PhycoCosm ^g	Group 3 (undefined)		
Cz_12g10240	<i>Chromochloris</i> <i>zofingensis</i> SAG 211-14	Chlorophyta	Cz12g10240.t1	JGI PhycoCosm ^g	Group 4 (Mn-CDF)		
Cz_Ug00396	<i>Chromochloris</i> <i>zofingensis</i> SAG 211-14	Chlorophyta	UNPLg00396.t1	JGI PhycoCosm ^g	Group 4 (Mn-CDF)		
Cs_14234	<i>Coccomyxa</i> <i>subellipsoidea</i> C-169	Chlorophyta	Protein Id: 14234	JGI Phytozome ^h	Group 1 (Zn-CDF)		

Cs_16095	<i>Coccomyxa subellipsoidea</i> C-169	Chlorophyta	Protein Id: 16095	JGI Phytozome ^h	Group 1 (Zn-CDF)
Cs_28593	<i>Coccomyxa subellipsoidea</i> C-169	Chlorophyta	Protein Id: 28593	JGI Phytozome ^h	Group 3 (undefined)
Cs_21325	<i>Coccomyxa subellipsoidea</i> C-169	Chlorophyta	Protein Id: 21325	JGI Phytozome ^h	Group 4 (Mn-CDF)
Cs_39175	<i>Coccomyxa subellipsoidea</i> C-169	Chlorophyta	Protein Id: 39175	JGI Phytozome ^h	Group 4 (Mn-CDF)
Ds_0333s00001	<i>Dunaliella salina</i> CCAP19-18	Chlorophyta	Dusal.0333s00001.1	JGI Phytozome ^h	Group 1 (Zn-CDF)
Ds_0333s00003	<i>Dunaliella salina</i> CCAP19-18	Chlorophyta	Dusal.0333s00003.1	JGI Phytozome ^h	Group 1 (Zn-CDF)
Ds_1360s00001	<i>Dunaliella salina</i> CCAP19-18	Chlorophyta	Dusal.1360s00001.1	JGI Phytozome ^h	Group 3 (undefined)
Ds_0199s00009	<i>Dunaliella salina</i> CCAP19-18	Chlorophyta	Dusal.0199s00009.1	JGI Phytozome ^h	Group 4 (Mn-CDF)
Mp_17485	<i>Micromonas pusilla</i> CCMP1545	Chlorophyta	Protein Id: 17485	JGI Phytozome ^h	Group 3 (undefined)
Mp_52662	<i>Micromonas pusilla</i> CCMP1545	Chlorophyta	Protein Id: 52662	JGI Phytozome ^h	Group 4 (Mn-CDF)
Msp_60348	<i>Micromonas</i> sp. RCC299	Chlorophyta	Protein Id: 60348	JGI Phytozome ^h	Group 1 (Zn-CDF)
Msp_102742	<i>Micromonas</i> sp. RCC299	Chlorophyta	Protein Id: 102742	JGI Phytozome ^h	Group 1 (Zn-CDF)
Msp_64402	<i>Micromonas</i> sp. RCC299	Chlorophyta	Protein Id: 64402	JGI Phytozome ^h	Group 2 (Fe/Zn CDF)
Msp_97795	<i>Micromonas</i> sp. RCC299	Chlorophyta	Protein Id: 97795	JGI Phytozome ^h	Group 3 (undefined)
Msp_55479	<i>Micromonas</i> sp. RCC299	Chlorophyta	Protein Id: 55479	JGI Phytozome ^h	Group 4 (Mn-CDF)
OI_39741	<i>Ostreococcus lucimarinus</i>	Chlorophyta	Protein Id: 39741	JGI Phytozome ^h	Group 3 (undefined)
OI_33926	<i>Ostreococcus lucimarinus</i>	Chlorophyta	Protein Id: 33926	JGI Phytozome ^h	Group 4 (Mn-CDF)
Ostsp_28125	<i>Ostreococcus</i> sp. RCC809	Chlorophyta	Protein Id: 28125	JGI PhycoCosm ^g	Group 3 (undefined)
Ostsp_30303	<i>Ostreococcus</i> sp. RCC809	Chlorophyta	Protein Id: 30303	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Ot_69157	<i>Ostreococcus tauri</i> RCC4221	Chlorophyta	Protein Id: 69157	JGI PhycoCosm ^g	Group 3 (undefined)

Ot_73435	<i>Ostreococcus tauri</i> RCC4221	Chlorophyta	Protein Id: 73435	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Vc_0014s0072	<i>Volvox carteri</i>	Chlorophyta	Vocar.0014s0072.1	JGI Phytozome ^h	Group 1 (Zn-CDF)
Vc_0063s0011	<i>Volvox carteri</i>	Chlorophyta	Vocar.0063s0011.1	JGI Phytozome ^h	Group 3 (undefined)
Vc_0005s0300	<i>Volvox carteri</i>	Chlorophyta	Vocar.0005s0300.1	JGI Phytozome ^h	Group 4 (Mn-CDF)
Aa_18887	<i>Aureococcus anophagefferens</i> clone 1984	Pelagophyta	Protein Id: 18887	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Aa_54063	<i>Aureococcus anophagefferens</i> clone 1984	Pelagophyta	Protein Id: 54063	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Aa_63403	<i>Aureococcus anophagefferens</i> clone 1984	Pelagophyta	Protein Id: 63403	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Aa_12227	<i>Aureococcus anophagefferens</i> clone 1984	Pelagophyta	Protein Id: 12227	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Psp_582096	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 582096	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Psp_474385	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 474385	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Psp_505673	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 505673	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Psp_623472	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 623472	JGI PhycoCosm ^g	Group 3 (undefined)
Psp_507764	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 507764	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Psp_522664	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 522664	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Psp_509680	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 509680	JGI PhycoCosm ^g	Group 5 (undefined)
Psp_614657	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 614657	JGI PhycoCosm ^g	Group 5 (undefined)
Psp_615359	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 615359	JGI PhycoCosm ^g	Group 5 (undefined)
Psp_617317	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 617317	JGI PhycoCosm ^g	Group 5 (undefined)

Psp_584138	<i>Pelagophyceae</i> sp. CCMP2097	Pelagophyta	Protein Id: 584138	JGI PhycoCosm ^g	Unassigned
Csp_1897108	<i>Cryptophyceae</i> sp. CCMP2293	Cryptophyta	Protein Id: 1897108	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Csp_1763656	<i>Cryptophyceae</i> sp. CCMP2293	Cryptophyta	Protein Id: 1763656	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Csp_1785488	<i>Cryptophyceae</i> sp. CCMP2293	Cryptophyta	Protein Id: 1785488	JGI PhycoCosm ^g	Group 5 (undefined)
Gt_65516	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 65516	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Gt_131845	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 131845	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Gt_133916	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 133916	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Gt_140741	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 140741	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Gt_163374	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 163374	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Gt_163373	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 163373	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Gt_137697	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 137697	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Gt_114253	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 114253	JGI PhycoCosm ^g	Group 3 (undefined)
Gt_77758	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 77758	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Gt_165502	<i>Guillardia theta</i> CCMP2712	Cryptophyta	Protein Id: 165502	JGI PhycoCosm ^g	Group 5 (undefined)
Cmer_CMF058C	<i>Cyanidioschyzon merolae</i> strain 10D	Rhodophyta	CMF058C	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Cmer_CMT536C	<i>Cyanidioschyzon merolae</i> strain 10D	Rhodophyta	CMT536C	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Cmer_CMC075C	<i>Cyanidioschyzon merolae</i> strain 10D	Rhodophyta	CMC075C	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Gs_1521	<i>Galdieria sulphuraria</i> 074W	Rhodophyta	Protein Id: 1521	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Pu_0152s0012	<i>Porphyra umbilicalis</i>	Rhodophyta	Pum0152s0012.1	JGI Phytozome ^h	Group 1 (Zn-CDF)
Pu_0222s0004	<i>Porphyra umbilicalis</i>	Rhodophyta	Pum0222s0004.1	JGI Phytozome ^h	Group 1 (Zn-CDF)

Pu_0333s0033	<i>Porphyra umbilicalis</i>	Rhodophyta	Pum0333s0033.1	JGI Phytozome ^h	Group 1 (Zn-CDF)
Pu_0056s0045	<i>Porphyra umbilicalis</i>	Rhodophyta	Pum0056s0045.1	JGI Phytozome ^h	Group 4 (Mn-CDF)
Eh_42691	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 42691	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Eh_53810	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 53810	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Eh_414632	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 414632	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Eh_98399	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 98399	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Eh_202761	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 202761	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Eh_210717	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 210717	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Eh_461752	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 461752	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Eh_42214	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 42214	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Eh_117787	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 117787	JGI PhycoCosm ^g	Group 5 (undefined)
Eh_203258	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 203258	JGI PhycoCosm ^g	Group 5 (undefined)
Eh_211062	<i>Emiliana huxleyi</i> CCMP1516	Haptophyta	Protein Id: 211062	JGI PhycoCosm ^g	Group 5 (undefined)
Pasp_262010	<i>Pavlova</i> sp. CCMP2436	Haptophyta	Protein Id: 262010	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Pasp_936591	<i>Pavlova</i> sp. CCMP2436	Haptophyta	Protein Id: 936591	JGI PhycoCosm ^g	Group 1 (Zn-CDF)
Pasp_580610	<i>Pavlova</i> sp. CCMP2436	Haptophyta	Protein Id: 580610	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Pasp_597035	<i>Pavlova</i> sp. CCMP2436	Haptophyta	Protein Id: 597035	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Pasp_407315	<i>Pavlova</i> sp. CCMP2436	Haptophyta	Protein Id: 407315	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Pasp_915848	<i>Pavlova</i> sp. CCMP2436	Haptophyta	Protein Id: 915848	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Pasp_939555	<i>Pavlova</i> sp. CCMP2436	Haptophyta	Protein Id: 939555	JGI PhycoCosm ^g	Group 5 (undefined)

Pasp_1059224	<i>Pavlova</i> sp. CCMP2436	Haptophyta	Protein Id: 1059224	JGI PhycoCosm ⁹	Group 5 (undefined)
Pasp_1061345	<i>Pavlova</i> sp. CCMP2436	Haptophyta	Protein Id: 1061345	JGI PhycoCosm ⁹	Group 5 (undefined)
Pa_1122	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 1122	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pa_9803	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 9803	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pa_16275	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 16275	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pa_24855	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 24855	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pa_30362	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 30362	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pa_1127	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 1127	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pa_2008	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 2008	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pa_9269	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 9269	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pa_17347	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 17347	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pa_17350	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 17350	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pa_19534	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 19534	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pa_27928	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 27928	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pa_35928	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 35928	JGI PhycoCosm ⁹	Group 3 (undefined)
Pa_24952	<i>Phaeocystis antarctica</i> CCMP1374	Haptophyta	Protein Id: 24952	JGI PhycoCosm ⁹	Group 4 (Mn-CDF)
Pg_215	<i>Phaeocystis globosa</i> Pg-G	Haptophyta	Protein Id: 215	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pg_11101	<i>Phaeocystis globosa</i> Pg-G	Haptophyta	Protein Id: 11101	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pg_2185	<i>Phaeocystis globosa</i> Pg-G	Haptophyta	Protein Id: 2185	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pg_4331	<i>Phaeocystis globosa</i> Pg-G	Haptophyta	Protein Id: 4331	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)

Pg_30462	<i>Phaeocystis globosa</i> Pg-G	Haptophyta	Protein Id: 30462	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pg_25361	<i>Phaeocystis globosa</i> Pg-G	Haptophyta	Protein Id: 25361	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pg_17382	<i>Phaeocystis globosa</i> Pg-G	Haptophyta	Protein Id: 17382	JGI PhycoCosm ⁹	Group 4 (Mn-CDF)
Pg_2642	<i>Phaeocystis globosa</i> Pg-G	Haptophyta	Protein Id: 2642	JGI PhycoCosm ⁹	Group 5 (undefined)
Pg_5451	<i>Phaeocystis globosa</i> Pg-G	Haptophyta	Protein Id: 5451	JGI PhycoCosm ⁹	Group 5 (undefined)
Fc_185721	<i>Fragilariopsis cylindrus</i> CCMP 1102	Bacillariophyta	Protein Id: 185721	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Fc_197703	<i>Fragilariopsis cylindrus</i> CCMP 1102	Bacillariophyta	Protein Id: 197703	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Fc_138643	<i>Fragilariopsis cylindrus</i> CCMP 1102	Bacillariophyta	Protein Id: 138643	JGI PhycoCosm ⁹	Group 3 (undefined)
Fc_179287	<i>Fragilariopsis cylindrus</i> CCMP 1102	Bacillariophyta	Protein Id: 179287	JGI PhycoCosm ⁹	Group 5 (undefined)
Fc_243722	<i>Fragilariopsis cylindrus</i> CCMP 1102	Bacillariophyta	Protein Id: 243722	JGI PhycoCosm ⁹	Group 5 (undefined)
Fc_244237	<i>Fragilariopsis cylindrus</i> CCMP 1102	Bacillariophyta	Protein Id: 244237	JGI PhycoCosm ⁹	Group 5 (undefined)
Pt_23557	<i>Phaeodactylum</i> <i>tricornutum</i> CCAP 1055/1	Bacillariophyta	Protein Id: 23557	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pt_45119	<i>Phaeodactylum</i> <i>tricornutum</i> CCAP 1055/1	Bacillariophyta	Protein Id: 45119	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pt_13994	<i>Phaeodactylum</i> <i>tricornutum</i> CCAP 1055/1	Bacillariophyta	Protein Id: 13994	JGI PhycoCosm ⁹	Group 3 (undefined)
Pt_48955	<i>Phaeodactylum</i> <i>tricornutum</i> CCAP 1055/1	Bacillariophyta	Protein Id: 48955	JGI PhycoCosm ⁹	Group 4 (Mn-CDF)
Pt_46297	<i>Phaeodactylum</i> <i>tricornutum</i> CCAP 1055/1	Bacillariophyta	Protein Id: 46297	JGI PhycoCosm ⁹	Group 5 (undefined)
Pn_98747	<i>Pseudo-nitzschia</i> multiseries CLN-47	Bacillariophyta	Protein Id: 98747	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pn_260498	<i>Pseudo-nitzschia</i> multiseries CLN-47	Bacillariophyta	Protein Id: 260498	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Pn_290477	<i>Pseudo-nitzschia</i> multiseries CLN-47	Bacillariophyta	Protein Id: 290477	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Pn_247016	<i>Pseudo-nitzschia</i> multiseries CLN-47	Bacillariophyta	Protein Id: 247016	JGI PhycoCosm ⁹	Group 3 (undefined)

Pn_153478	<i>Pseudo-nitzschia</i> multiseries CLN-47	Bacillariophyta	Protein Id: 153478	JGI PhycoCosm ⁹	Group 4 (Mn-CDF)
Pn_302540	<i>Pseudo-nitzschia</i> multiseries CLN-47	Bacillariophyta	Protein Id: 302540	JGI PhycoCosm ⁹	Group 5 (undefined)
Tp_26530	<i>Thalassiosira</i> <i>pseudonana</i> CCMP 1335	Bacillariophyta	Protein Id: 26530	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Tp_260789	<i>Thalassiosira</i> <i>pseudonana</i> CCMP 1335	Bacillariophyta	Protein Id: 260789	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Tp_7978	<i>Thalassiosira</i> <i>pseudonana</i> CCMP 1335	Bacillariophyta	Protein Id: 7978	JGI PhycoCosm ⁹	Group 3 (undefined)
Tp_31951	<i>Thalassiosira</i> <i>pseudonana</i> CCMP 1335	Bacillariophyta	Protein Id: 31951	JGI PhycoCosm ⁹	Group 4 (Mn-CDF)
Tp_22171	<i>Thalassiosira</i> <i>pseudonana</i> CCMP 1335	Bacillariophyta	Protein Id: 22171	JGI PhycoCosm ⁹	Unassigned
Es_24050	<i>Ectocarpus siliculosus</i> Ec 32	Ochrophyta	Protein Id: 24050	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Es_26403	<i>Ectocarpus siliculosus</i> Ec 32	Ochrophyta	Protein Id: 26403	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
Es_21867	<i>Ectocarpus siliculosus</i> Ec 32	Ochrophyta	Protein Id: 21867	JGI PhycoCosm ⁹	Group 3 (undefined)
Es_29376	<i>Ectocarpus siliculosus</i> Ec 32	Ochrophyta	Protein Id: 29376	JGI PhycoCosm ⁹	Group 5 (undefined)
Es_18100	<i>Ectocarpus siliculosus</i> Ec 32	Ochrophyta	Protein Id: 18100	JGI PhycoCosm ⁹	Unassigned
No_630191	<i>Nannochloropsis</i> <i>oceanica</i> CCMP1779	Ochrophyta	Protein Id: 630191	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
No_672670	<i>Nannochloropsis</i> <i>oceanica</i> CCMP1779	Ochrophyta	Protein Id: 672670	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
No_639981	<i>Nannochloropsis</i> <i>oceanica</i> CCMP1779	Ochrophyta	Protein Id: 639981	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
No_577472	<i>Nannochloropsis</i> <i>oceanica</i> CCMP1779	Ochrophyta	Protein Id: 577472	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)
No_630732	<i>Nannochloropsis</i> <i>oceanica</i> CCMP1779	Ochrophyta	Protein Id: 630732	JGI PhycoCosm ⁹	Group 3 (undefined)
No_556631	<i>Nannochloropsis</i> <i>oceanica</i> CCMP1779	Ochrophyta	Protein Id: 556631	JGI PhycoCosm ⁹	Group 4 (Mn-CDF)
Osp_404893	<i>Ochromonadaceae</i> sp. CCMP2298	Ochrophyta	Protein Id: 404893	JGI PhycoCosm ⁹	Group 1 (Zn-CDF)
Osp_402386	<i>Ochromonadaceae</i> sp. CCMP2298	Ochrophyta	Protein Id: 402386	JGI PhycoCosm ⁹	Group 2 (Fe/Zn CDF)

Osp_447574	<i>Ochromonadaceae</i> sp. CCMP2298	Ochrophyta	Protein Id: 447574	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Osp_452074	<i>Ochromonadaceae</i> sp. CCMP2298	Ochrophyta	Protein Id: 452074	JGI PhycoCosm ^g	Group 5 (undefined)
Osp_483158	<i>Ochromonadaceae</i> sp. CCMP2298	Ochrophyta	Protein Id: 483158	JGI PhycoCosm ^g	Group 5 (undefined)
Osp_198761	<i>Ochromonadaceae</i> sp. CCMP2298	Ochrophyta	Protein Id: 198761	JGI PhycoCosm ^g	Unassigned
Osp_422041	<i>Ochromonadaceae</i> sp. CCMP2298	Ochrophyta	Protein Id: 422041	JGI PhycoCosm ^g	Unassigned
Bn_83139	<i>Bigelowiella natans</i> CCMP2755	Chlorarachniophyta	Protein Id: 83139	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Bn_89846	<i>Bigelowiella natans</i> CCMP2755	Chlorarachniophyta	Protein Id: 89846	JGI PhycoCosm ^g	Group 2 (Fe/Zn CDF)
Bn_74255	<i>Bigelowiella natans</i> CCMP2755	Chlorarachniophyta	Protein Id: 74255	JGI PhycoCosm ^g	Group 3 (undefined)
Bn_34339	<i>Bigelowiella natans</i> CCMP2755	Chlorarachniophyta	Protein Id: 34339	JGI PhycoCosm ^g	Group 4 (Mn-CDF)
Bn_76194	<i>Bigelowiella natans</i> CCMP2755	Chlorarachniophyta	Protein Id: 76194	JGI PhycoCosm ^g	Group 5 (undefined)
Bn_88808	<i>Bigelowiella natans</i> CCMP2755	Chlorarachniophyta	Protein Id: 88808	JGI PhycoCosm ^g	Group 5 (undefined)
Bn_135221	<i>Bigelowiella natans</i> CCMP2755	Chlorarachniophyta	Protein Id: 135221	JGI PhycoCosm ^g	Group 5 (undefined)

^a www.ncbi.nlm.nih.gov/protein/

^b genome.jgi.doe.gov/portal/

^c www.yeastgenome.org

^d www.arabidopsis.org

^e mycocosm.jgi.doe.gov/mycocosm/home

^f www.plantmorphogenesis.bio.titech.ac.jp/~algae_genome_project/klebsormidium/

^g phycocosm.jgi.doe.gov/phycocosm/home

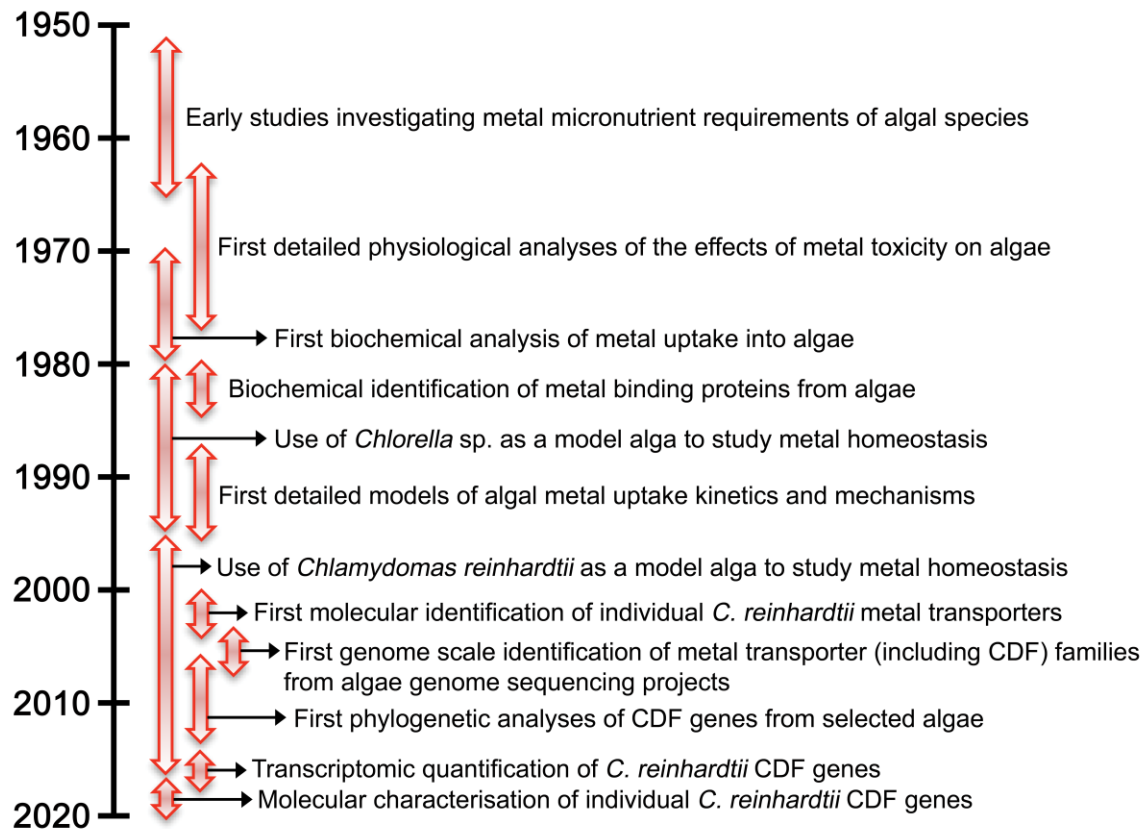
^h phytozome.jgi.doe.gov/pz/portal.html

Supplementary Table S2. Oligonucleotide PCR primer sequences used for full-length amplification of *C. reinhardtii* MTP cDNAs. Underlined sequence indicates restriction enzyme site used for cloning.

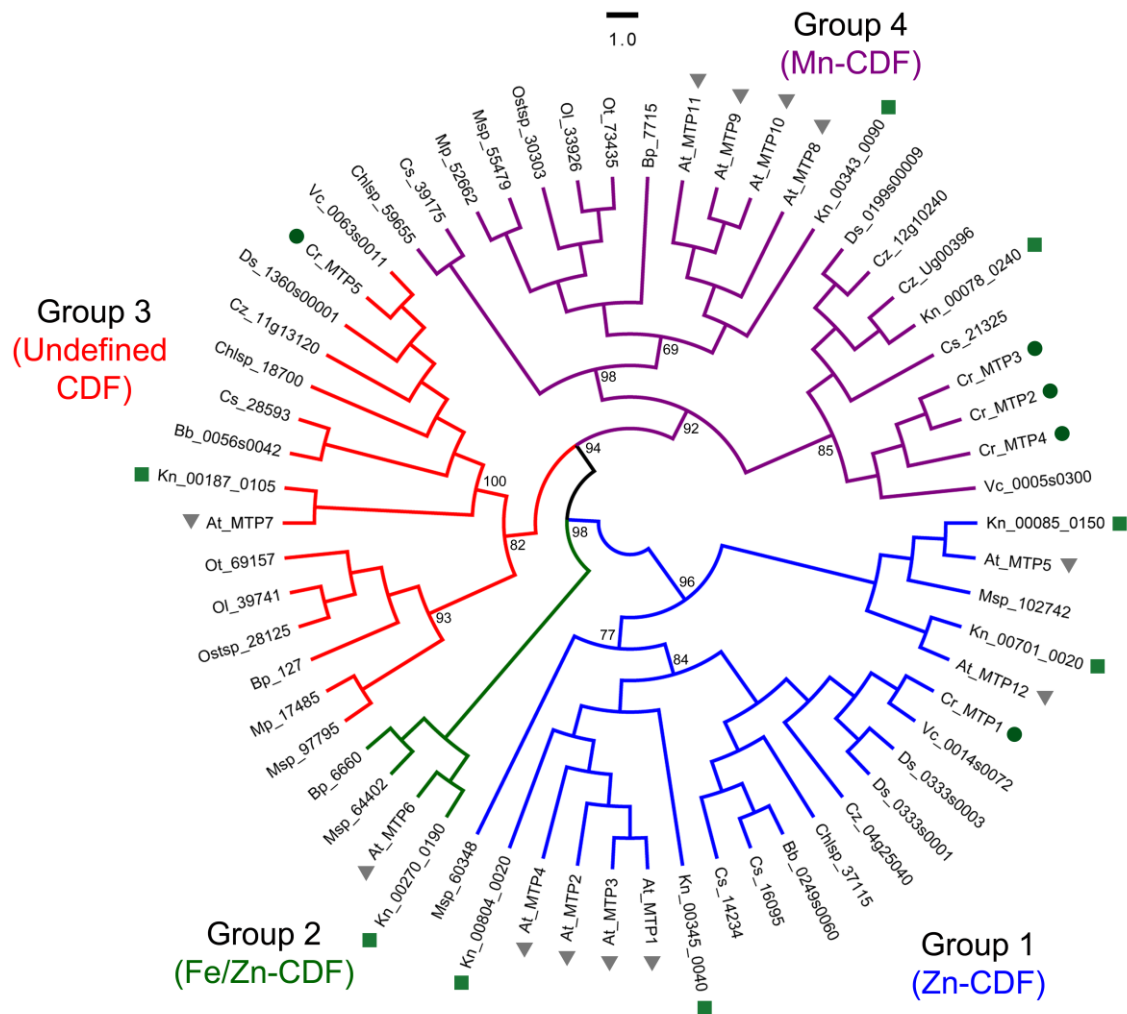
Gene	Primer name	Sequence (5' – 3')
<i>MTP1</i>	MTP1XbaIF	AAATCTAGAAAAATGTCAGAAAGAACGCCTCTTC
	MTP1SaclR	AAAGAGCTCCTAGACCTGTGCGTCGCCAGCGGC
<i>MTP2</i>	MTP2BamHIF	AAAGGATCCAAAAATGGCGCAATTAGCTCGTGAAG
	MTP2XbaIR	AAATCTAGAAACTGGGCTGCAAACGGGCTACTTC
<i>MTP3</i>	MTP3BamHIF	AAAGGATCCAAAAATGGCTCAGTTAGCACGCGAAG
	MTP3XbaIR	AAATCTAGACAGCCTACTGTGCCGCGGCGCCAG

Supplementary Table S3. Oligonucleotide PCR primer sequences used for qPCR for *C. reinhardtii* MTP genes.

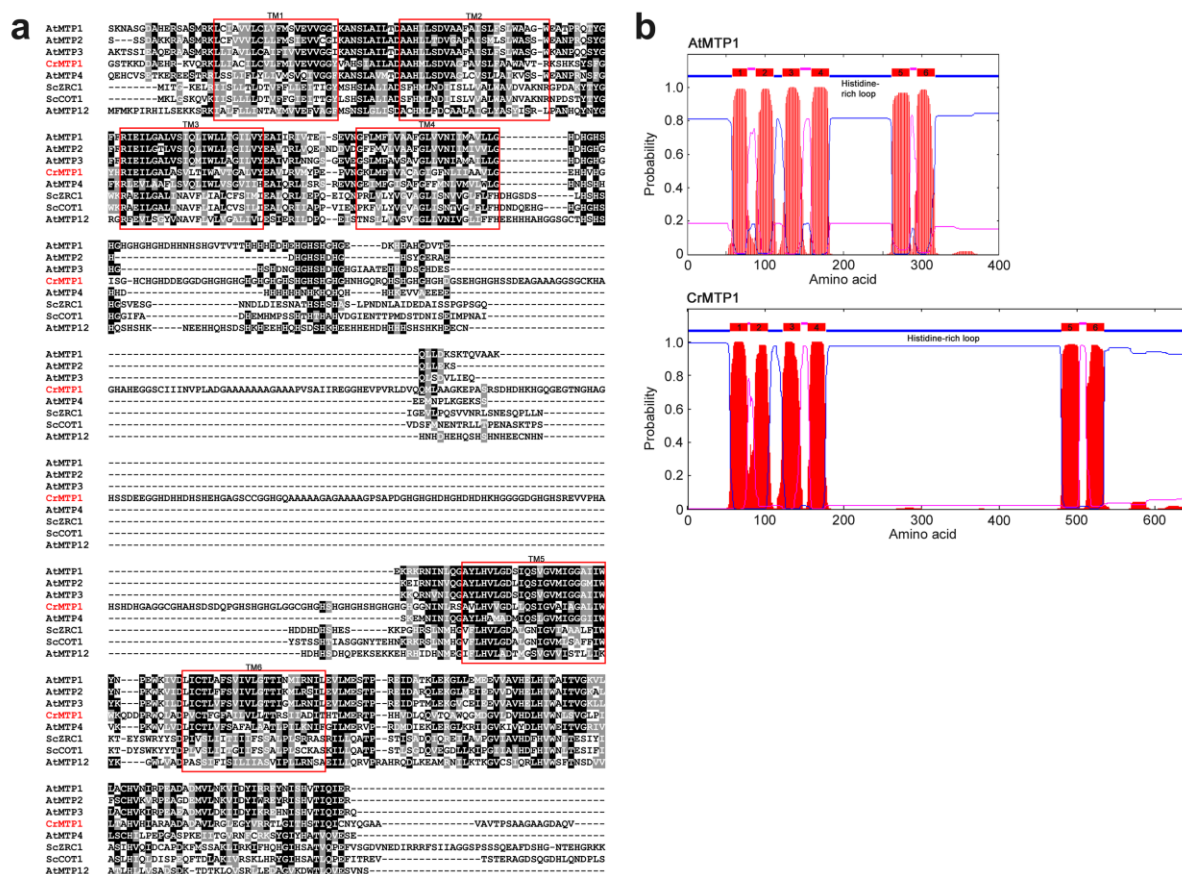
Gene	Primer name	Sequence (5' – 3')
<i>MTP1</i>	MTP1F	CGTGTGGCTTGAGCGAAGAG
	MTP1R	GCTTGCGTGCGATGATACGA
<i>MTP2</i>	MTP2F	ATGAGTGTGCGGGAGTCGCA
	MTP2R	GGCAGTGGCTTCATCACGTC
<i>MTP3</i>	MTP3F	ATCGAGGCTCTTGACACTGT
	MTP3R	GTAAGGCGCTGCTCAGCGTC
<i>MTP4</i>	MTP4F	ACATGTGTGTGCGGGAGTCG
	MTP4R	CTTGTGCCGGTGCAGGGACC
<i>MTP5</i>	MTP5F	CCTTCATCCTCAGCCATAGCA
	MTP5R	CGAGAGGTTGGGAAGTGAG
<i>CBLP</i>	CBLPF	CTTCTCGCCCATGACCAC
	CBLPR	CCCACCAGGTTGTTCTTCAG



Supplementary Figure S1. A timeline of key events in algal metallomics and CDF transporter research over the last 70 years.



Supplementary Figure S2. Phylogenetic analysis of CDF transporter family proteins from chlorophyta algae. CDF protein sequences from the charophyte *Klebsormidium nitens* (square symbols) and land plant *Arabidopsis thaliana* (triangle symbols) were included for comparison. The *Chlamydomonas reinhardtii* sequences are highlighted (circle symbols). The genome identifier or accession numbers of all sequences used are provided in Table S1. Four major groups are highlighted. The tree was constructed using the maximum likelihood method and derived from alignments of full length amino acid sequence. A consensus tree following 1000 bootstrap replications is shown, with bootstrap percentage values indicated at the nodes of major branches. The branch length scale bar indicates the evolutionary distance of one amino acid substitution per site.



Supplementary Figure S3. Sequence analysis of *Chlamydomonas reinhardtii* MTP1 with other Group 1 Zn-CDF proteins. (a) Partial-length multiple sequence alignment of CrMTP1 in comparison with AtMTP1, AtMTP2, AtMTP3, AtMTP4, AtMTP12, ScZRC1 and ScCOT1. The N-terminal tail sequences of CrMTP1 and the *Arabidopsis* MTPs, and the N- and C-terminal tail sequences of the yeast ZRC1/COT1 are not shown. The sequence of CrMTP1 from amino acids 39 and AtMTP1 from amino acid 41 are shown. Amino acids that are identical or similar are shaded in black or grey, respectively. The six putative transmembrane (TM) spans are shown as red boxes and determined by hydropathy analysis (b). (b) Topology models of CrMTP1 in comparison with AtMTP1, generated by TMHMM. Red areas indicate the predicted TM spans.

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