Supporting information for

RADIv1: a non-steady-state early diagenetic model for ocean sediments in Julia and MATLAB/GNU Octave

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Table S1. Environmental conditions, bottom-water and sediment properties for the North-western Atlantic Ocean station.

Variable	Value	Source
Station ID	Station #9	Hales et al. (1994)
Location	North Atlantic	Hales et al. (1994)
Coordinates	34.33N / 70.35W	Hales et al. (1994)
Depth	5210 m	Hales et al. (1994)
Temperature	2.2 °C	Hales et al. (1994)
Salinity	34.9	Hales et al. (1994)
DBL thickness	938 µm	Sulpis et al. (2018)
Solid fluxes to the seafloor (mol m^{-2} a^{-1})		
POC flux (F_{POC})	0.18 (6.0 g POM m^2 a^{-1})	Hales et al. (1994)
Fast-decay POC	0.70 x F_{POC}	Assumed
Slow-decay POC	0.27 x F_{POC}	Assumed
Refractory POC	0.03 x F_{POC}	Assumed
$CaCO_3$ flux (F_{CaCO3})	0.20 (20.02 g $CaCO_3$ m^{-2} a^{-1})	Hales et al. (1994)
Calcite	F_{CaCO3}	Assumed
Aragonite	0	Assumed
MnO_2 flux (F_{MnO2})	0.0005	Assumed
$Fe(OH)_3$ flux ($F_{Fe(OH)3}$)	0.0005	Assumed
FeS flux (F_{FeS})	0	Boudreau (1996)
Sediment surface properties		
Surface [$CaCO_3$]	27 dry wt %	Hales et al. (1994)
Surface [POC]	0.31 dry wt %	Hales et al. (1994)
Clay flux	26 g m^{-2} a^{-1}	Assumed
Surface porosity	0.91	Assumed
Porosity at depth	0.74	Assumed
Bottom-water chemistry		
TAlk	2342 µmol kg^{-1}	Hales et al. (1994)
ΣCO_2	2186 µmol kg^{-1}	Hales et al. (1994)
[O_2]	266.6 µmol kg^{-1}	Hales et al. (1994)
[ΣNO_3]	20.0668 µmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[ΣSO_4]	29.180 mmol kg^{-1}	Computed from S (Millero, 2013)
[ΣPO_4]	1.3561 µmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[ΣNH_4]	0	Assumed
[ΣH_2S]	0	Assumed
[Mn^{2+}]	0.5 nmol kg^{-1}	Typical deep-sea value (Morton et al., 2019)
[Fe^{2+}]	0.5 nmol kg^{-1}	Typical deep-sea value (Abadie et al., 2017)
[Ca^{2+}]	10.255 mmol kg^{-1}	Computed from S (Riley and Tongudai, 1967)
$[CO_3^{2-}]_{SW}$ (µmol kg^{-1})	102.6 µmol kg^{-1}	Computed (RADI)
$[CO_3^{2-}]_{eq\ Calcite}$ (µmol kg^{-1})	117.6 µmol kg^{-1}	Computed (RADI)
$[CO_3^{2-}]_{eq\ Arag.}$ (µmol kg^{-1})	175.5 µmol kg^{-1}	Computed (RADI)
Ω_{ca}	0.88	Computed (RADI)
Ω_{ar}	0.59	Computed (RADI)

Table S2. Environmental conditions, bottom-water and sediment properties for the Southern Pacific station.

Variable	Value	Source
Station ID	Station #7.3	Sayles et al. (2001)
Location	Southern Pacific	Sayles et al. (2001)
Coordinates	60.15S / 170.11W	Sayles et al. (2001)
Depth	3860 m	Sayles et al. (2001)
Temperature	0.84 °C	Sayles et al. (2001)
Salinity	34.696	Sayles et al. (2001)
DBL thickness	715 μm	Sulpis et al. (2018)
Solid fluxes to the seafloor (mol m^{-2} a^{-1})		
POC flux (F_{POC})	0.138 (4.6 g POM m^2 a^{-1})	Assumed
Fast-decay POC	0.70 x F_{POC}	Assumed
Slow-decay POC	0.27 x F_{POC}	Assumed
Refractory POC	0.03 x F_{POC}	Assumed
$CaCO_3$ flux (F_{CaCO3})	0.25 (25.02 g $CaCO_3$ m^{-2} a^{-1})	Assumed
Calcite	F_{CaCO3}	Assumed
Aragonite	0	Assumed
MnO_2 flux (F_{MnO2})	0.0005	Assumed
$Fe(OH)_3$ flux ($F_{Fe(OH)3}$)	0.0005	Assumed
FeS flux (F_{FeS})	0	Boudreau (1996)
Sediment surface properties		
Surface [$CaCO_3$]	37.7 dry wt %	Sayles et al. (2001)
Surface [POC]	0.37 dry wt %	Sayles et al. (2001)
Clay flux	32 g m^{-2} a^{-1}	Sayles et al. (2001), November – February average
Surface porosity	0.91	Sayles et al. (2001)
Porosity at depth	0.87	Assumed
Bottom-water chemistry		
TAlk	2365 μmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
ΣCO_2	2260 μmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[O_2]	215.7 μmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[ΣNO_3]	32.2416 μmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[ΣSO_4]	29.010 mmol kg^{-1}	Computed from S (Millero, 2013)
[ΣPO_4]	2.2428 μmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[ΣNH_4]	0	Assumed
[ΣH_2S]	0	Assumed
[Mn^{2+}]	0.5 nmol kg^{-1}	Typical deep-sea value (Morton et al., 2019)
[Fe^{2+}]	0.5 nmol kg^{-1}	Typical deep-sea value (Abadie et al., 2017)
[Ca^{2+}]	10.196 mmol kg^{-1}	Computed from S (Riley and Tongudai, 1967)
[CO_3^{2-}]$_{SW}$ (μmol kg^{-1})	77.5 μmol kg^{-1}	Computed (RADI)
[CO_3^{2-}]$_{eq\ Calcite}$ (μmol kg^{-1})	91.7 μmol kg^{-1}	Computed (RADI)
[CO_3^{2-}]$_{eq\ Arag.}$ (μmol kg^{-1})	138.9 μmol kg^{-1}	Computed (RADI)
Ω_{ca}	0.85	Computed (RADI)
Ω_{ar}	0.56	Computed (RADI)

Table S3. Environmental conditions, bottom-water and sediment properties for the Central Equatorial Pacific station.

Variable	Value	Source
Station ID	Station #W-2	Berelson et al. (1994) / Hammond et al. (1996)
Location	Equatorial Pacific	Berelson et al. (1994) / Hammond et al. (1996)
Coordinates	0.0N / 139.9W	Berelson et al. (1994) / Hammond et al. (1996)
Depth	4370 m	Berelson et al. (1994) / Hammond et al. (1996)
Temperature	1.4 °C	GLODAPv2 (Lauvset et al., 2016)
Salinity	34.69	GLODAPv2 (Lauvset et al., 2016)
DBL thickness	1 mm	Assumed
Solid fluxes to the seafloor (mol m^{-2} a^{-1})		
POC flux (F_{POC})	0.20 (6.6 g POM m^2 a^{-1})	Assumed
Fast-decay POC	0.70 x F_{POC}	Assumed
Slow-decay POC	0.27 x F_{POC}	Assumed
Refractory POC	0.03 x F_{POC}	Assumed
$CaCO_3$ flux (F_{CaCO3})	0.22 (22.02 g $CaCO_3$ m^{-2} a^{-1})	Assumed
Calcite	F_{CaCO3}	Assumed
Aragonite	0	Assumed
MnO_2 flux (F_{MnO2})	0.0005	Assumed
$Fe(OH)_3$ flux ($F_{Fe(OH)3}$)	0.0005	Assumed
FeS flux (F_{FeS})	0	Boudreau (1996)
Sediment surface properties		
Surface [$CaCO_3$]	76.1 dry wt %	Hammond et al (1996) Table 1
Surface [POC]	0.24 dry wt %	Hammond et al (1996) Table 1
Clay flux	2 g m^{-2} a^{-1}	Hammond et al (1996)
Surface porosity	0.85	Hammond et al (1996)
Porosity at depth	0.74 (4cm)	Berelson et al. (1994)
Bottom-water chemistry		
TAlk	2426.0 µmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
ΣCO_2	2324.3 µmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[O_2]	159.7 µmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[ΣNO_3]	36.93 µmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[ΣSO_4]	29.005 mmol kg^{-1}	Computed from S (Millero, 2013)
[ΣPO_4]	2.39 µmol kg^{-1}	GLODAPv2 (Lauvset et al., 2016)
[ΣNH_4]	0	Assumed
[ΣH_2S]	0	Assumed
[Mn^{2+}]	0.5 nmol kg^{-1}	Typical deep-sea value (Morton et al., 2019)
[Fe^{2+}]	0.5 nmol kg^{-1}	Typical deep-sea value (Abadie et al., 2017)
[Ca^{2+}]	10.193 mmol kg^{-1}	Computed from S (Riley and Tongudai, 1967)
[CO_3^{2-}]$_{SW}$ (µmol kg^{-1})	77.9 µmol kg^{-1}	Computed (RADI)
[CO_3^{2-}]$_{eq\ Calcite}$ (µmol kg^{-1})	100.0 µmol kg^{-1}	Computed (RADI)
[CO_3^{2-}]$_{eq\ Arag.}$ (µmol kg^{-1})	150.7 µmol kg^{-1}	Computed (RADI)
Ω_{ca}	0.78	Computed (RADI)
Ω_{ar}	0.52	Computed (RADI)

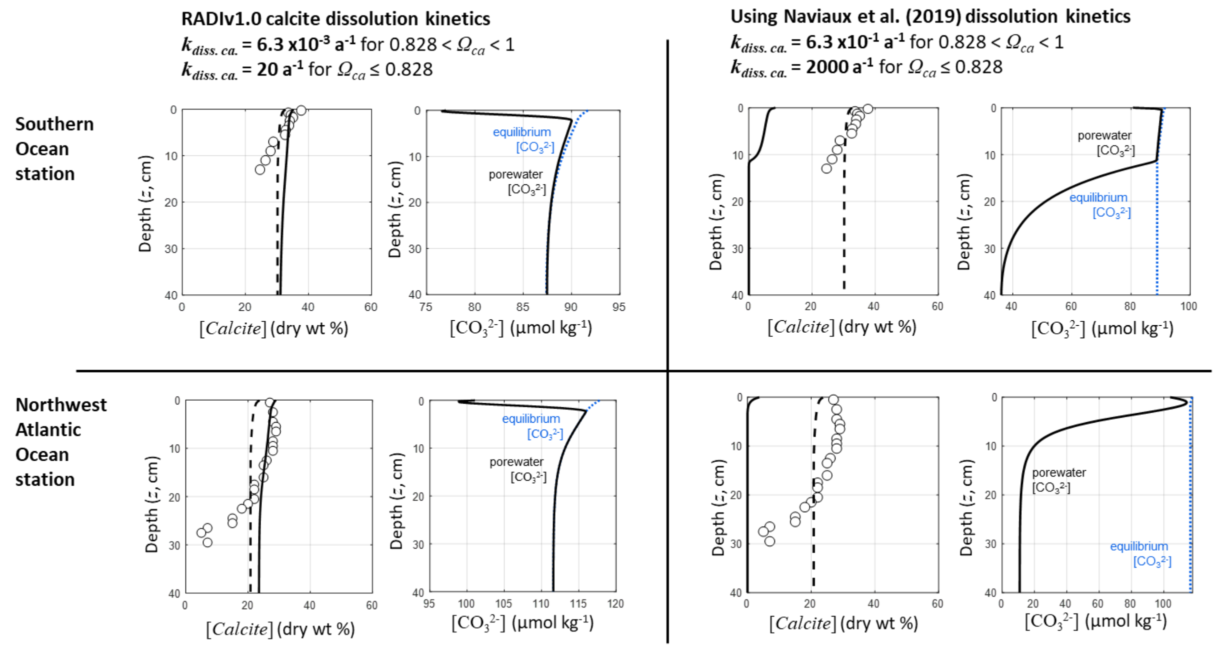

Figure S1. *Comparison of predicted calcite and CO_3^{2-} concentration profiles using the calcite dissolution kinetics implemented in RADIv1 (left) and using the rate constants from the original publication (Naviaux et al., 2019a) coupled with the surface area of foraminifera (400 m^2 mol^{-1}, from Subhas et al., 2018). The dashed line represents results from the MUDS model.*

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