# Appendix IV

# Model parameter values (baseline scenario)

| Parameter Description | Symbol (where applicable) | Equation number (where applicable) | Value |
|---|---|---|---|
| Model time step: primary (ocean-sediment) interactions | - | - | 1 year |
| Model time step: intra-ocean and ocean-atmosphere interactions | - | - | 1 month |
| Model time step: biological uptake and export | - | - | 1 day |
| Horizontal eddy diffusivity | - | - | $200.0\times10^{6}$ $cm^2$ $s^{-1}$ |
| Minimum (at surface) vertical eddy diffusivity | - | - | 0.33 $cm^2$ $s^{-1}$ |
| Maximum (at depth) vertical eddy diffusivity | - | - | 1.25 $cm^2$ $s^{-1}$ |
| Depth of the euphotic zone | $D_{euph}$ | 2-14a, 2-14b | 47 m |
| $PO_4$ uptake rate $Q_{10}$ temperature dependency (SP) | $Q_{10}$ | 2-9, 2-10 | 1.88 |
| $PO_4$ uptake rate $Q_{10}$ temperature dependency (NSP) | $Q_{10}$ | 2-9, 2-10 | 1.88 |
| Base $PO_4$ uptake rate (SP) | $u_{SP}^{PO_4}$ | 2-8a | 5.0 μmol $kg^{-1}$ $a^{-1}$ |
| Base $PO_4$ uptake rate (NSP) | $u_{NSP}^{PO_4}$ | 2-8b | 0.25 μmol $kg^{-1}$ $a^{-1}$ |
| $PO_4$ half-saturation constant (SP) | $K_{S,SP}^{PO_4}$ | 2-11 | 0.1 μmol $kg^{-1}$ |
| $H_4SiO_4$ half-saturation constant (SP) | $K_{S,SP}^{H_4SiO_4}$ | 2-12 | 4.0 μmol $kg^{-1}$ |
| Fe half-saturation constant (SP) | $K_{S,SP}^{Fe}$ | 2-13 | 0.125 nmol $kg^{-1}$ |
| $PO_4$ half-saturation constant (NSP) | $K_{S,NSP}^{PO_4}$ | - | 0.05 μmol $kg^{-1}$ |
| Fe half-saturation constant (NSP) | $K_{S,NSP}^{Fe}$ | - | 0.068 nmol $kg^{-1}$ |
| Particulate organic matter export partition coefficient (SP) | $\lambda_{SP}$ | 2-16a | 1.0 |
| Particulate organic matter export partition coefficient (NSP) | $\lambda_{NSP}$ | 2-16b | 1.0 |
| Particulate organic matter N:P export ratio (SP) | $r_{SP}^{PON:POP}$ | 2-18 | 16 |
| Particulate organic matter C:P export ratio (SP) | $r_{SP}^{POC:POP}$ | 2-17 | 106 |
| Particulate organic matter $O_2$:P export ratio (SP) | - | - | 177 |
| Opal:POC export ratio value under Fe-replete conditions (SP) | $r_{0,SP}^{opal:POC}$ | 2-26 | 0.175 |
| Opal:POC export ratio function [Fe] half-saturation constant | $K_S^{Fe}$ | 2-26 | 0.25 nmol $kg^{-1}$ |
| Opal:POC export ratio function [Fe] off-set | $[Fe]_{off}$ | 2-26 | 0.125 nmol $kg^{-1}$ |
| Particulate organic matter N:P export ratio (NSP) | $r_{NSP}^{PON:POP}$ | 2-22 | 16 |
| Particulate organic matter C:P export ratio (NSP) | $r_{NSP}^{POC:POP}$ | 2-21 | 106 |
| Particulate organic matter $O_2$:P export ratio (NSP) | - | - | 177 |
| $CaCO_3$:POC export ratio (NSP) | $r_{NSP}^{CaCO_3:POC}$ | 2-22 | 0.3 |
| Base POM remineralization depth | $z_0$ | 2-28a, 2-28b | 97 m |
| Base calcite remineralization depth | $z_0$ | 2-29a, 2-29b | 97 m |
| Opal settling velocity | - | 2-35 | 125 m $s^{-1}$ |
| Opal water-column base dissolution rate constant | $k_0^{opal}$ | 2-33 | 0.019 $d^{-1}$ |
| Minimum allowed oceanic $O_2$ concentration | - | - | 25.0 μmol $kg^{-1}$ |
| Fe scavenging rate: by POC | $kscav_{POC}^{Fe}$ | 2-38 | 0.0025 $a^{-1}$ (mol C $m^{-2}$ $a^{-1}$)$^{-1}$ |
| Fe scavenging rate: by opal | $kscav_{opal}^{Fe}$ | 2-38 | 0.00025 $a^{-1}$ (mol C $m^{-2}$ $a^{-1}$)$^{-1}$ |
| Fe scavenging rate: by calcite | $kscav_{cal}^{Fe}$ | 2-38 | 0.00025 $a^{-1}$ (mol C $m^{-2}$ $a^{-1}$)$^{-1}$ |
| Fe scavenging rate: by aragonite | $kscav_{arg}^{Fe}$ | 2-38 | 0.00025 $a^{-1}$ (mol C $m^{-2}$ $a^{-1}$)$^{-1}$ |
| Fe 'self-scavenging' rate (by dust) | $kscav_{dust}^{Fe}$ | 2-43 | 0.0750 $a^{-1}$ (mol C $m^{-2}$ $a^{-1}$)$^{-1}$ |
| Fe abundance in dust | $Fefrac^{dust}$ | 2-43 | 3.5% |

| Parameter Description | Symbol (where applicable) | Equation number (where applicable) | Value |
|---|---|---|---|
| Enzymic $^{13}C$ fraction factor (SP) | $\varepsilon_f$ | 2-56, 2-58 | 25‰ |
| Enzymic $^{13}C$ fraction factor (NSP) | $\varepsilon_f$ | 2-56, 2-58 | 20‰ |
| $CO_{2(aq)}$ diffusion $^{13}C$ fraction factor | $\varepsilon_d$ | 2-56, 2-58 | 0.7‰ |
| $CO_{2(aq)}$ uptake rate per cell surface area | $Q_s$ | 2-56, 2-59 | $1.62\times10^{-7}$ mol C $m^{-2}$ $s^{-1}$ |
| Surface area equivalent cell radius | $r$ | 2-56, 2-59 | $5.0\times10^{-5}$ m |
| Reacto-diffusive length | $r_k$ | 2-56, 2-59 | $2.06\times10^{-4}$ m |
| Cell wall permeability to $CO_{2(aq)}$ | $P$ | 2-56, 2-59 | $10^{-4}$ m $s^{-1}$ |
| Activation energy of diffusion | $E_d$ | 2-57 | 19510 J $mol^{-1}$ |
| Prescribed POC sedimentary preservation efficiency | - | - | 5% |
| Prescribed additional sedimentary rain flux of detrital material | - | - | 0.167 g $cm^{-2}$ $ka^{-1}$ |
| Thickness of 'well mixed' surface sediment layer | - | - | 5 cm |
| Porosity of 'well mixed' surface sediment layer | $\phi$ | 3-4 | 0.776 $cm^3$ $cm^{-3}$ |
| Thickness of (complete) sedimentary stack layers | - | - | 1 cm |
| Porosity of sedimentary stack | $\phi$ | 3-4 | 0.705 $cm^3$ $cm^{-3}$ |
| Bioturbation rate at top of sedimentary stack | - | - | 120 $cm^2$ $ka^{-1}$ |
| Calcite dissolution rate constant | - | - | 20 % $d^{-1}$ |
| Calcite dissolution power | - | - | 4.5 |
| Aragonite dissolution rate constant | - | - | 20 % $d^{-1}$ |
| Aragonite dissolution power | - | - | 4.2 |
| Riverine input of carbon | - | - | 15 Tmol $a^{-1}$ |
| $^{13}C$ isotopic signature of riverine carbon | - | - | 3.1‰ |
| Volcanic input of carbon | - | - | 5 Tmol $a^{-1}$ |
| $^{13}C$ isotopic signature of volcanic carbon | - | - | 3.1‰ |
| Riverine input of alkalinity | - | - | 40 Tmol eq $a^{-1}$ |
| Total input of dissolved silica | - | - | 6 Tmol $a^{-1}$ |
| Accumulation rate of neritic $CaCO_3$ | - | - | 10 Tmol $a^{-1}$ |
| $^{13}C$ isotopic signature of neritic $CaCO_3$ | - | - | 3.1‰ |