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Supplement of

Impact of small-scale disturbances on geochemical conditions, biogeochemical processes and element fluxes in surface sediments of the eastern Clarion–Clipperton Zone, Pacific Ocean

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Figure S1: Measured porosity (dots) and numerical approximation (solid line) for the BGR-RA (left) and IOM (right) sites. See Table S2 for fitting details.
Table S1: Electron-equivalent redox reactions used in the transient transport-reaction model for the 1-day-old EBS disturbance in the BGR-RA area and for the 20-year-old IOM-BIE disturbance in the IOM area.

| Reaction name               | Reaction | Redox reaction |
|-----------------------------|----------|----------------|
| Aerobic respiration         | R₁       | \((CH₂O)(NH₄⁺)_{16\over 106} + O₂ \rightarrow CO₂ + {16 \over 106}NH₄⁺ + H₂O\) |
| Heterotrophic denitrification | R₂      | \(5(CH₂O)(NH₄⁺)_{16\over 106} + 4NO₃⁻ + 4H⁺ \rightarrow 2N₂ + 5CO₂ + 5{16 \over 106}NH₄⁺ + 7H₂O\) |
| Dissimilatory Mn(IV) reduction | R₃       | \((CH₂O)(NH₄⁺)_{16\over 106} + 2MnO₂ + 4H⁺ \rightarrow 2Mn^{2+} + CO₂ + {16 \over 106}NH₄⁺ + 3H₂O\) |
| Mn²⁺ oxidation              | R₄       | \(2Mn^{2+} + O₂ + 2H₂O \rightarrow 2MnO₂ + 4H⁺\) |
| Nitrification               | R₅       | \(NH₄⁺ + 2O₂ \rightarrow NO₃⁻ + 2H⁺ + H₂O\) |
| Mn-anammox                  | R₆       | \(3MnO₂ + 2NH₄⁺ + 4H⁺ \rightarrow 3Mn^{2+} + N₂ + 6H₂O\) |
Table S2: Species, boundary conditions and fitted parameter values used in the transient transport-reaction models for the 1-day-old EBS disturbance in the BGR-RA area and the 20-year-old IOM-BIE disturbance in the IOM area.

| Species and boundary conditions | Symbol | Unit     | BGR   | IOM   |
|----------------------------------|--------|----------|-------|-------|
| Porosity at SWI                  | $\phi_0$ |          | 0.82  | 0.8   |
| Porosity at compacted depth      | $\phi_\infty$ | cm    | 0.69  | 0.67  |
| Sedimentation rate               | $\omega_1$ | cm kyr$^{-1}$ | 0.65  | 1.15  |
| Oxygen$_{bw}$                    | $O_2$ | µM     | 120   | 150   |
| Ammonium$_{bw}$                  | $NH_4^+$ | µM | 1     | 1     |
| Nitrate$_{bw}$                   | $NO_3^-$ | µM | 50    | 38    |
| Dissolved reduced manganese$_{bw}$ | $Mn^{2+}$ | µM | 1     | 1     |

| Fitted parameters                |        |          |       |       |
|----------------------------------|--------|----------|-------|-------|
| Sediment thickness               |        | m        | 10    | 10    |
| Removed sediment thickness       |        | cm       | 10    | 7     |
| Labile C$_{org}$                 | $TOC_1$ | mol m$^{-2}$ yr$^{-1}$ | 6.0E-02 | 4.5E-02 |
| Metabolizable C$_{org}$          | $TOC_2$ | mol m$^{-2}$ yr$^{-1}$ | 1.2E-04 | 1.1E-03 |
| Refractory C$_{org}$             | $TOC_3$ | mol m$^{-2}$ yr$^{-1}$ | 5.0E-04 | 7.8E-04 |
| Oxygen$_{bas}$                   | $O_2$ | µM     | 18    | 55    |
| Ammonium$_{bas}$                 | $NH_4^+$ | µM | 1     | 1     |
| Nitrate$_{bas}$                  | $NO_3^-$ | µM | 19    | 30    |
| Dissolved reduced manganese$_{bas}$ | $Mn^{2+}$ | µM | 1     | 1     |
| 1$^{st}$ order deg. coeff. TOC$_1$ | $\sigma_1$ | yr$^{-1}$ | 1.0E-03 | 1.0E-02 |
| 1$^{st}$ order deg. coeff. TOC$_2$ | $\sigma_2$ | yr$^{-1}$ | 1.0E-06 | 5.5E-06 |
| 1$^{st}$ order deg. coeff. TOC$_3$ | $\sigma_3$ | yr$^{-1}$ | 2.0E-09 | 2.5E-09 |
| Bioturbation coefficient         | $B_0$ | cm$^2$ yr$^{-1}$ | 0.5   | 0.2   |
| Biomixing half depth             | $z_{mix}$ | cm | 7.0   | 7.0   |
| Biomixing attenuation            | $z_{att}$ | cm | 0.1   | 0.1   |
| Bioirrigation coefficient        | $\alpha_0$ | yr$^{-1}$ | 0.65  | 2.0   |
| O$_2$ inhibition concentration for R$_1$ | $h_1$ | µM | 0.008 | 0.006 |
| NO$_3^-$ inhibition concentration for R$_2$ | $h_2$ | µM | 45    | 25    |
| R$_4$ rate constant              | $k_4$ | µM$^{-1}$ yr$^{-1}$ | 0.1   | 0.1   |
| R$_5$ rate constant              | $k_5$ | µM$^{-1}$ yr$^{-1}$ | 0.005 | 0.1   |
| R$_6$ rate constant              | $k_6$ | µM$^{-1}$ yr$^{-1}$ | 0.001 | 0.001 |
### Table S3: Electron-equivalent redox reactions and associated expressions used in the numerical diagenetic model.

| Reaction name                  | Reaction | Rate expression                                                                 |
|--------------------------------|----------|---------------------------------------------------------------------------------|
| Aerobic respiration R<sub>1</sub> |          | \( (\sigma_1 C_{\text{TOC1}} + \sigma_2 C_{\text{TOC2}} + \sigma_3 C_{\text{TOC3}}) \frac{C_{O_2}}{C_{O_2} + h_1} \) |
| Heterotrophic denitrification R<sub>2</sub> |          | \( (\sigma_1 C_{\text{TOC1}} + \sigma_2 C_{\text{TOC2}} + \sigma_3 C_{\text{TOC3}}) \gamma \frac{C_{\text{NO}_3^-}}{C_{\text{NO}_3^-} + h_2} \) |
| Dissimilatory Mn(IV) reduction R<sub>3</sub> |          | \( (\sigma_1 C_{\text{TOC1}} + \sigma_2 C_{\text{TOC2}} + \sigma_3 C_{\text{TOC3}}) \gamma \frac{h_2}{C_{\text{NO}_3^-} + h_2} \) |
| Mn<sup>2+</sup> oxidation R<sub>4</sub> |          | \( k_4 C_{O_2} C_{\text{Mn}^{2+}} \) |
| Nitrification R<sub>5</sub> |          | \( k_5 C_{O_2} C_{\text{NH}_4^+} \) |
| Mn-annamox R<sub>6</sub> |          | \( k_6 C_{\text{NH}_4^+} C_{\text{Mn}^{2+}} \gamma \frac{h_2}{C_{\text{NO}_3^-} + h_2} \) |

\( \gamma = \frac{h_1}{(h_1 + C_{O_2})} \)