Table 2. Mass balance of O_2 consumption. The diffusive uptake of O_2, as calculated from the O_2 depth profiles (column 2), was compared to the potential O_2 demand from the oxidation of NH_4^+, Fe^{2+} and Mn^{2+} (columns 3–5). The O_2 consumption of the oxidation of NH_4^+, Fe^{2+} and Mn^{2+} was determined based on the stoichiometry of NH_4^+, Fe^{2+} and Mn^{2+} oxidation with O_2, as described in Reed et al. (2011). The oxidation of dissolved Fe^{2+} and Mn^{2+} only played a minor role in the total O_2 consumption during the experiment, contributing only 0.9 % to 3.8 % and 0.1 % to 0.4 %, respectively. TS2

		Potential O_2 demand			
	O_2 (mmol m^{-2} d^{-1})	NH_4^+ (mmol m^{-2} d^{-1})	Fe^{2+} (mmol m^{-2} d^{-1})	Mn^{2+} (mmol m^{-2} d^{-1})	e^- (mmol m^{-2} d^{-1})
Day 5	−23.35	9.42	0.21	0.05	82.68
Day 12	−23.24	8.46	0.89	0.09	111.94
Day 18	−21.10	8.04	0.70	0.08	127.97
Day 26	−23.00	7.58	0.63	0.07	97.55
Day 33	−22.80	5.06	0.62	0.05	84.16
Day 40	−19.60	4.88	0.60	0.06	76.31
Day 207	−6.90	3.52	0.08	0.01	13.10
Day 621	−3.25	NA	0.03	0.01	9.47

NA – not available.

et al., 2001) but is low compared to sediments in eutrophic coastal systems (e.g. (Morgan et al., 2012; Kraal et al., 2013; Hermans et al., 2019a). The solid-phase depth profiles reveal a gradual removal of the FeS in the surface sediment in our experiment over time (Fig. 7). At the end of our experiment (621 d), there was no longer any FeS within the top 1.5 cm of the sediment. While approximately 90 mmol m^{-2} of FeS was removed from the surface sediment within the first 5 d, a total of ∼ 240 mmol m^{-2} was removed after 621 d (Fig. 10; Table 3). Likely, part of the FeS that was removed from the surface sediment within the first 5 d was removed through oxidation upon contact with O_2, rather than the metabolic activity of cable bacteria itself. The pore water acidification associated with cable bacteria activity led to a strong loss of siderite within the top 2 cm of the sediment, with a total removal of ∼ 560 mmol m^{-2} during the experiment (Figs. 7 and 10; Tables 3 and S5). The depletion of sedimentary FeS and siderite was directly proportional to the formation of Fe oxides near the sediment–water interface (Fig. 10) and accounted for 30 % and 70 % of the Fe oxides, respectively (Table 3).

With these data we cannot accurately determine the role of the FeS versus SO_4^{2-} reduction in supplying the $\sum H_2S$ sustaining the activity of cable bacteria throughout the experiment. This is primarily related to the variability between cores and, for this type of calculation, the low temporal resolution of sampling. However, we can make an estimation of the relative role of SO_4^{2-} reduction and FeS dissolution in $\sum H_2S$ production, based on the pore water profiles of SO_4^{2-} and dissolved Fe^{2+}, and the solid-phase mass balance of FeS and siderite (Fig. 6b and c; Table 4). This estimation shows that SO_4^{2-} was mainly responsible for $\sum H_2S$ production, accounting for 85 %–99 % TS3 (Table 4), and thus, that the dissolution of FeS only played a minor role in providing $\sum H_2S$.

Table 3. Mass balance of Fe. Time series of the depth-integrated (0–5 cm) increase in Fe oxides and the depth-integrated (0–5 cm) depletion of FeS and $FeCO_3$ (siderite) in mmol m^{-2}. All values are reported in mmol Fe m^{-2}. Negative values represent a decrease, whereas positive values indicate an increase in the mineral pools.

	ΔFe oxides (mmol m^{-2})	ΔFeS (mmol m^{-2})	Δ$FeCO_3$ (mmol m^{-2})
Day 5	120	−90	−42
Day 12	170	−90	−126
Day 18	189	−105	−92
Day 26	276	−174	−99
Day 33	315	−176	−109
Day 40	412	−223	−200
Day 207	523	−236	−341
Day 621	874	−242	−566

4.4 Impact of cable bacteria on Ca, P and Si cycling

Cable bacteria activity is known to lead to the dissolution of Ca carbonates because of the strong acidification of the pore water (Risgaard-Petersen et al., 2012; Rao et al., 2016). We indeed find similar maxima in pore water Ca^{2+} during the experiment (Fig. 5) and a high upward flux of Ca^{2+} (up to ∼ 18 mmol m^{-2} d^{-1}; Figs. 6e and S8), of which a substantial fraction (up to ∼ 55 %) escapes to the overlying water (Fig. S10; Table S4), which is consistent with a previous incubation experiment Rao et al. (2016).

Pore water depth profiles of HPO_4^{2-} reveal a production at depth and the removal of all upward-diffusing HPO_4^{2-} within the first 1–3 cm of the surface sediment (Fig. 5). A major proportion of this HPO_4^{2-} is bound to Fe oxides (Fig. 7). Given that a large proportion of the Fe oxides in our sediment cores