

Use of bi-potentiostat as a simple and accurate electrochemical approach for the determination of orthophosphate in seawater

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Supplementary information

Electrochemical Injection Analyzer

Enter parameters

Select COM port for valve

1

2

3

Time (seconds)

4

Move to

6

Pump state_1

7

Pump speed_1 [%]

5

Select COM port for pump

9

Pump state_2

10

Pump speed_2 [%]

11

Repeat number

12

13

measure?

Port 1 (Blank)

0

Port 1

OFF

0

Pump

OFF

0

Pump

0

Port 2 (Standard 1)

0

Port 2

OFF

0

Pump

OFF

0

Pump

0

Port 3 (Standard 2)

0

Port 3

OFF

0

Pump

OFF

0

Pump

0

Port 4 (Standard 3)

0

Port 4

OFF

0

Pump

OFF

0

Pump

0

Port 5 (Sample)

0

Port 5

OFF

0

Pump

OFF

0

Pump

0

Port 6 (deactivated)

0

Port 6

OFF

0

Pump

OFF

0

Pump

0

Port 7 (MiliQ)

0

Port 7

OFF

0

Pump

OFF

0

Pump

0

Port 8 (H2SO4)

0

Port 8

OFF

0

Pump

OFF

0

Pump

0

Port 9 (deactivated)

0

Port 9

OFF

0

Pump

OFF

0

Pump

0

Port 10 (wash)

0

Port 10

OFF

0

Pump

OFF

0

Pump

0

Number of cycles

1

15

16

Run

Stop

Status

17

14

1

OptionMenu button to select COM port for switching valve

2

Labels for Switching valve Ports

3

Entry widgets for the time to stay at the port

4

Button to manual switch between ports

5

OptionMenu button to select COM port for the peristaltic pump

6

OptionMenu button to select the 1st state for the peristaltic pump (CW, CC, Off)

7

Entry widgets for the time to set the speed (0-100 %) for the 1st state assigned for the pump

8

Button to manual set the 1st state of the pump

9

OptionMenu button to select the 1st state for the peristaltic pump (CW, CC, Off)

10

Entry widgets for the time to set the speed (0-100 %) for the 2nd state assigned for the pump

11

Button to manual set the 2nd state of the pump

12

Entry widgets to assign how many times each step can be repeated

13

Check button to perform the measurement

14

Picture showing at which the port, the switching valve is in

15

Entry widgets to assign how many times we want to repeat the full loop

16

Start button to start the loop stop button to abort the loop

17

Status bar showing the status of the pump

Figure S1 graphical user interface (GUI) of the ‘Electrochemical FIA.exe’ to program switching valve, peristaltic pump, and synchronization with the Metrohm μ Stat 400 Bi-potentiostat..

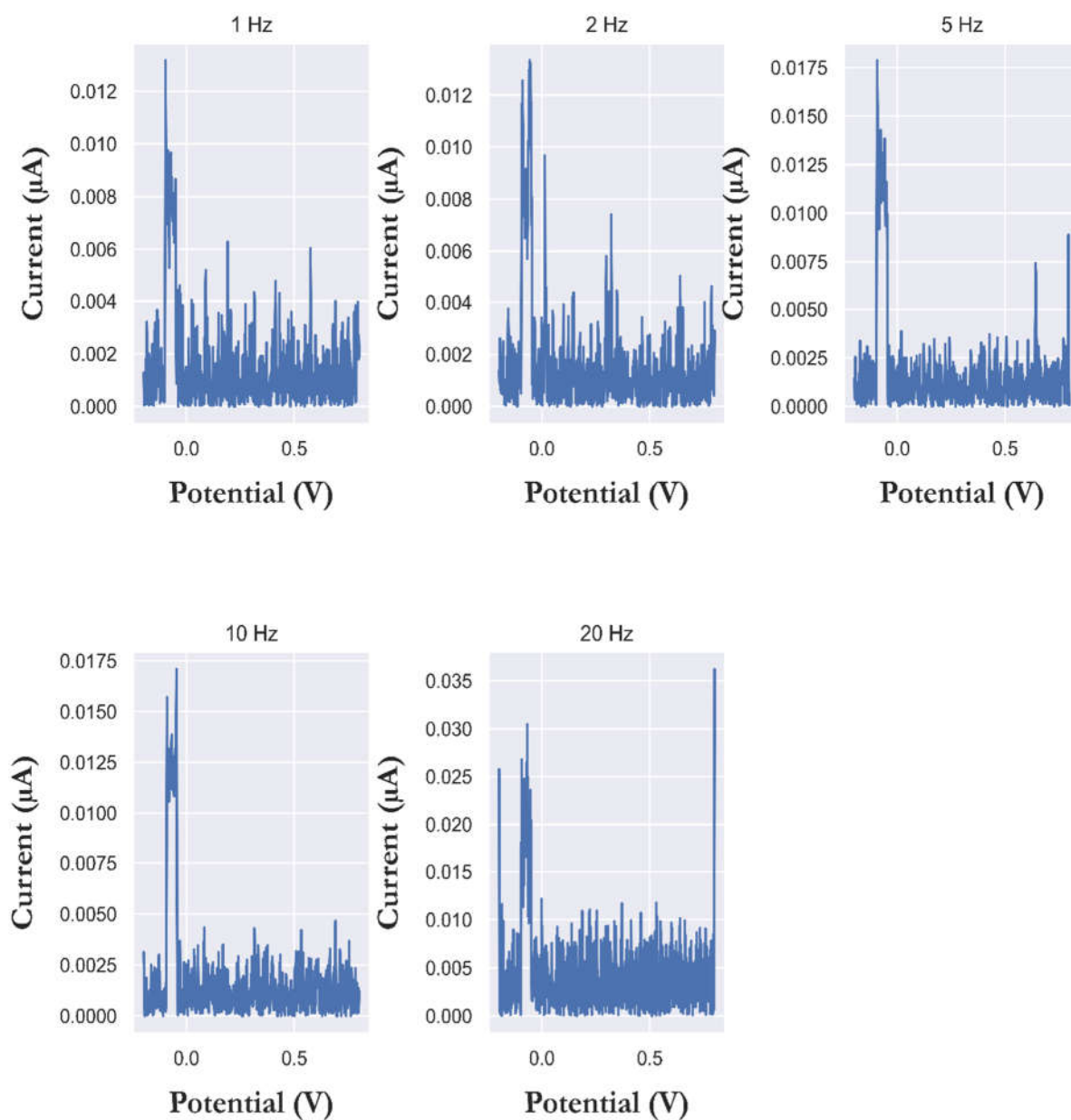


Figure S2 Square wave voltammograms of $0.5 \mu\text{M PO}_4^{3-}$ in 30 g/L NaCl ($\text{pH } 0.8$) (corrected voltammogram) at a step potential of 1 mV , square wave amplitude 25 mV at frequencies 1 Hz , 2 Hz , 5 Hz , 10 Hz and 20 Hz .

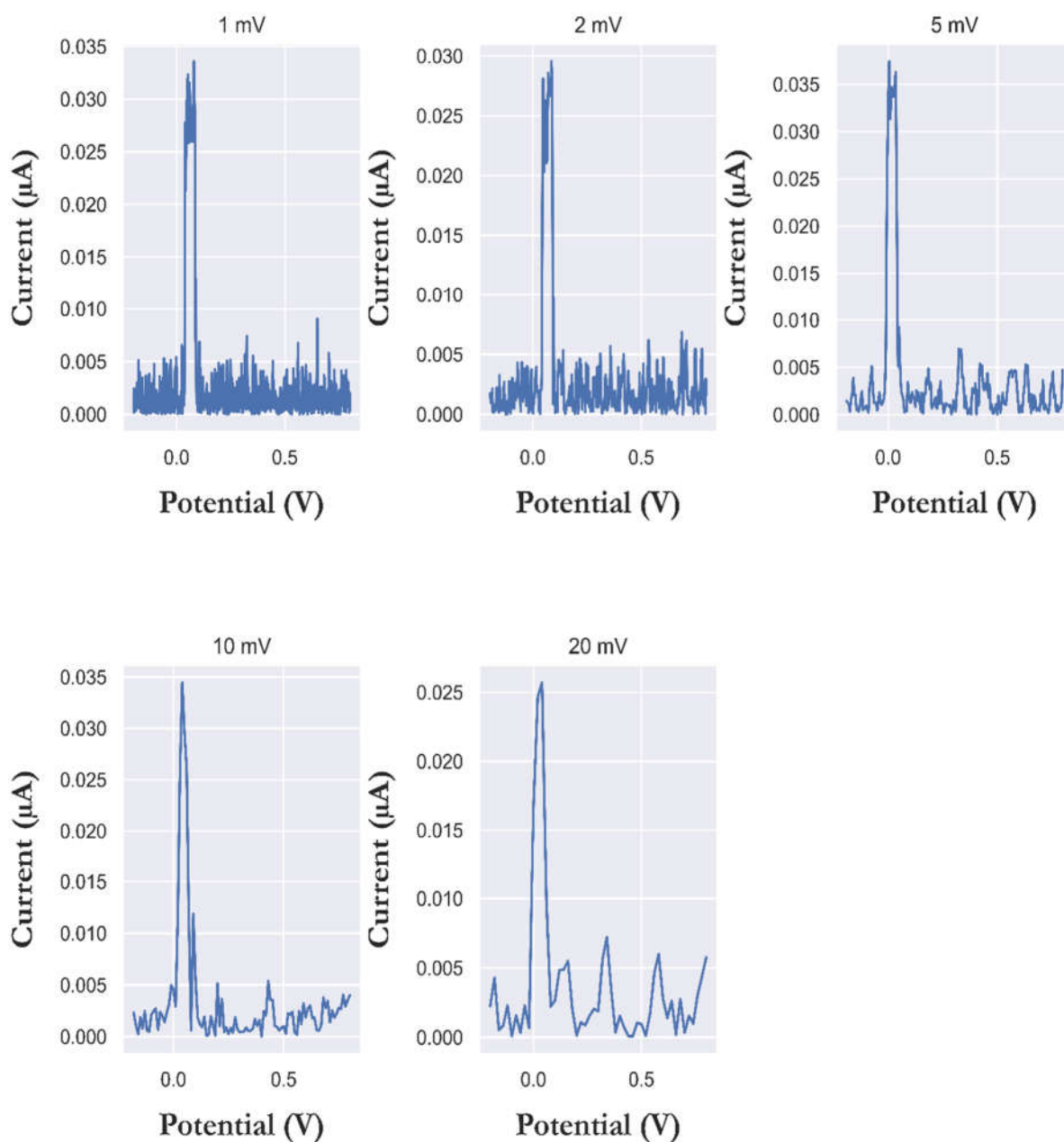


Figure S3 Square wave voltammograms of $0.5 \mu\text{M PO}_4^{3-}$ in 30 g/L NaCl (pH 0.8) (corrected voltammogram) at a frequency of 10 Hz, amplitude 25 mV at a step potential of 1 mV, 2 mV, 5 mV, 10 mV and 20 mV.

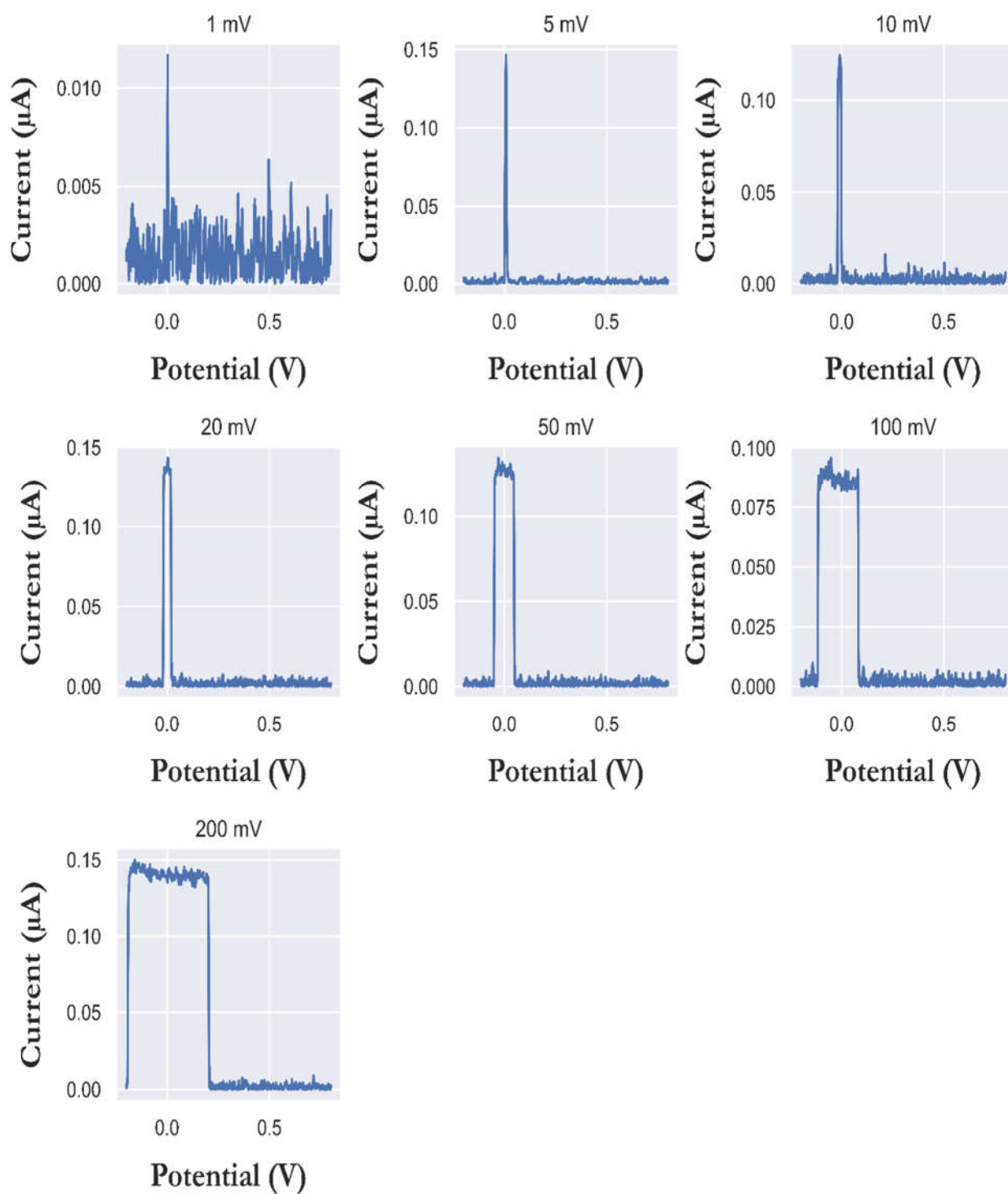


Figure S4 Square wave voltammograms of $0.5 \mu\text{M PO}_4^{3-}$ in 30 g/L NaCl (pH 0.8) (corrected voltammogram) at a step potential of 1 mV and a frequency of 10 Hz at square wave amplitudes of 1 mV, 5 mV, 10 mV, 20 mV, 50 mV, 100 mV and 200 mV.

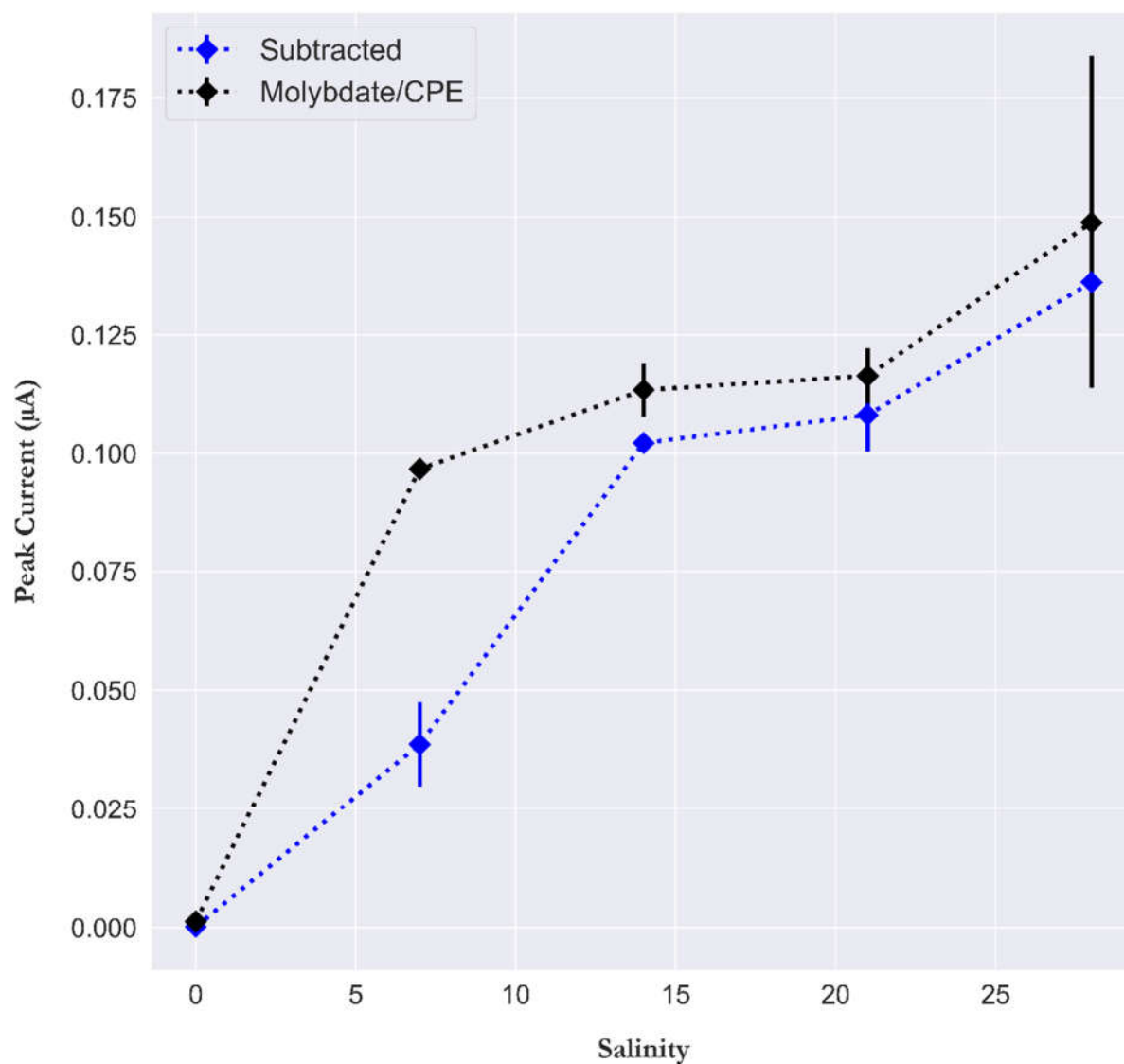


Figure S5 Effect of the variation of the salinity (0, 7, 14, 21 and 28) on the peak current of 1 μM PO_4^{3-} (pH 0.8) where the peak current of molybdate/CPE is shown as black circles and the peak current of corrected voltammogram is shown as blue circles. Error bar ($n = 5$).

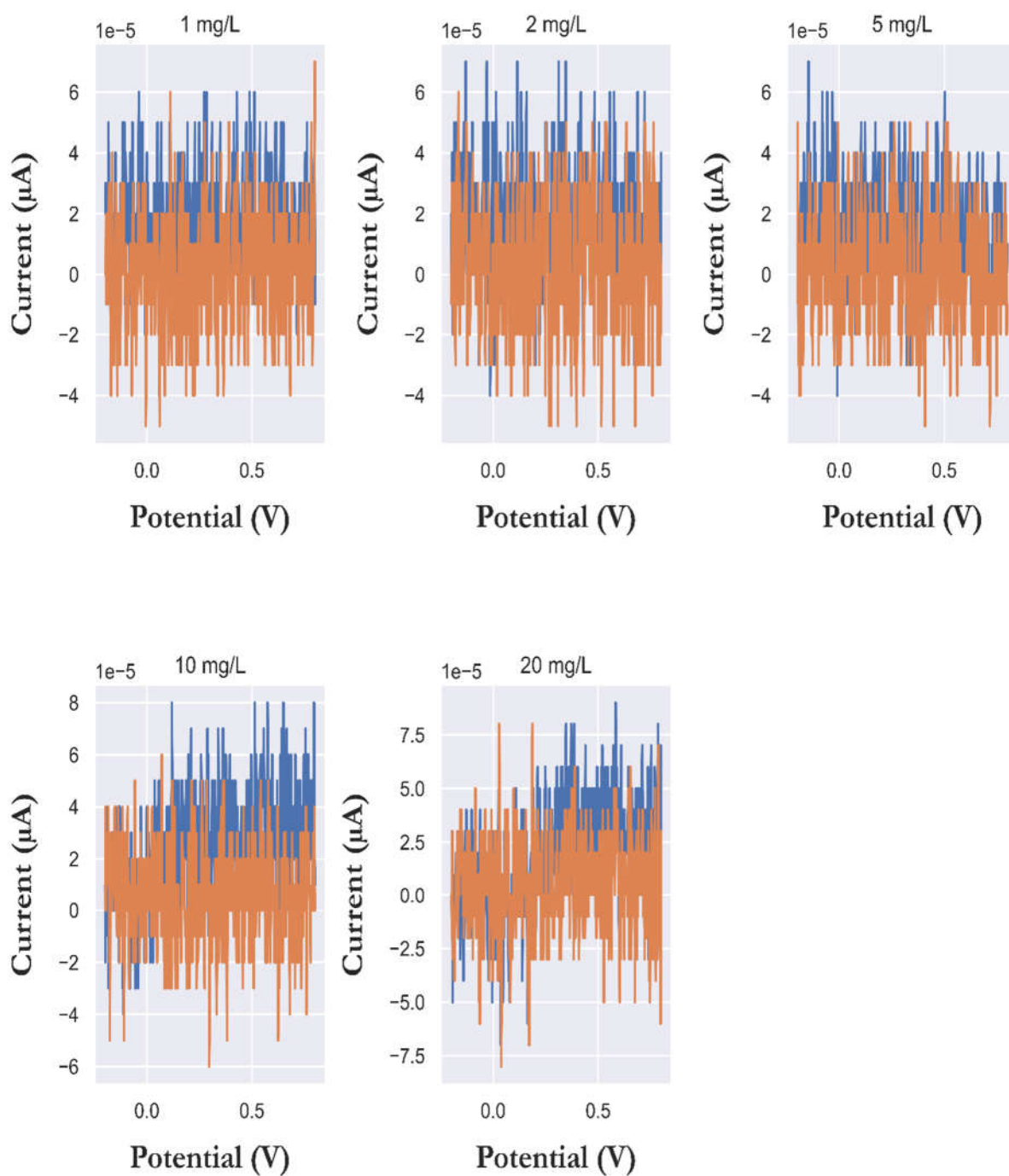


Figure S6 Square wave voltammograms of $1 \mu\text{M PO}_4^{3-}$ (30 g/L NaCl) pH 0.8 on molybdate/CPE (blue line) and CPE (orange line) in the presence of 1, 2, 5, 10, and 20 mg/L HA. Step potential 2 mV, frequency 10 Hz and amplitude of square wave 100 mV.

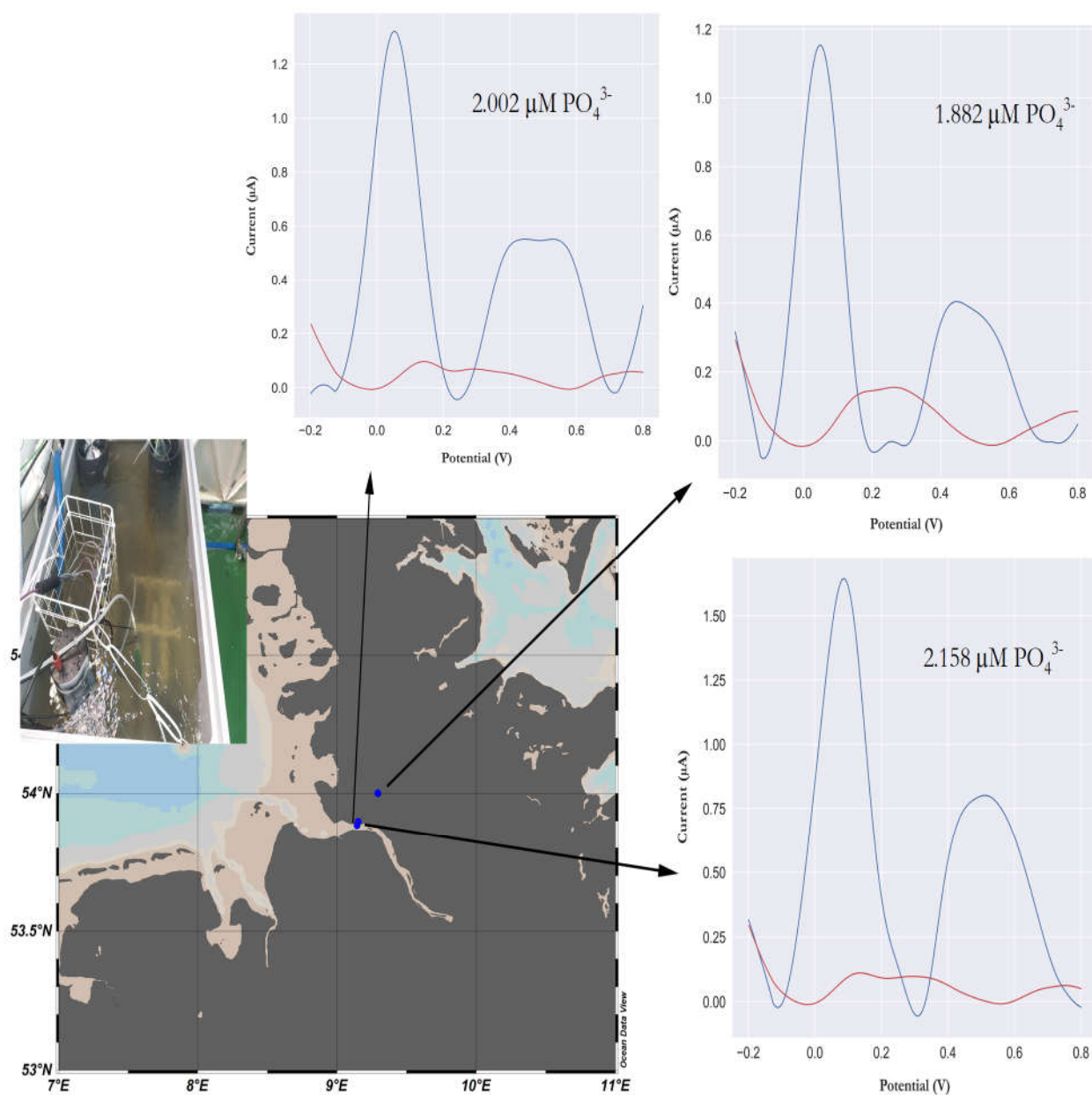


Figure S7 Location of three *on-site* data points taken at the Kiel Canal with square wave voltammograms at molybdate/CPE (blue line) and CPE (red line). The left inset shows the turbidity of the water entering the tank.

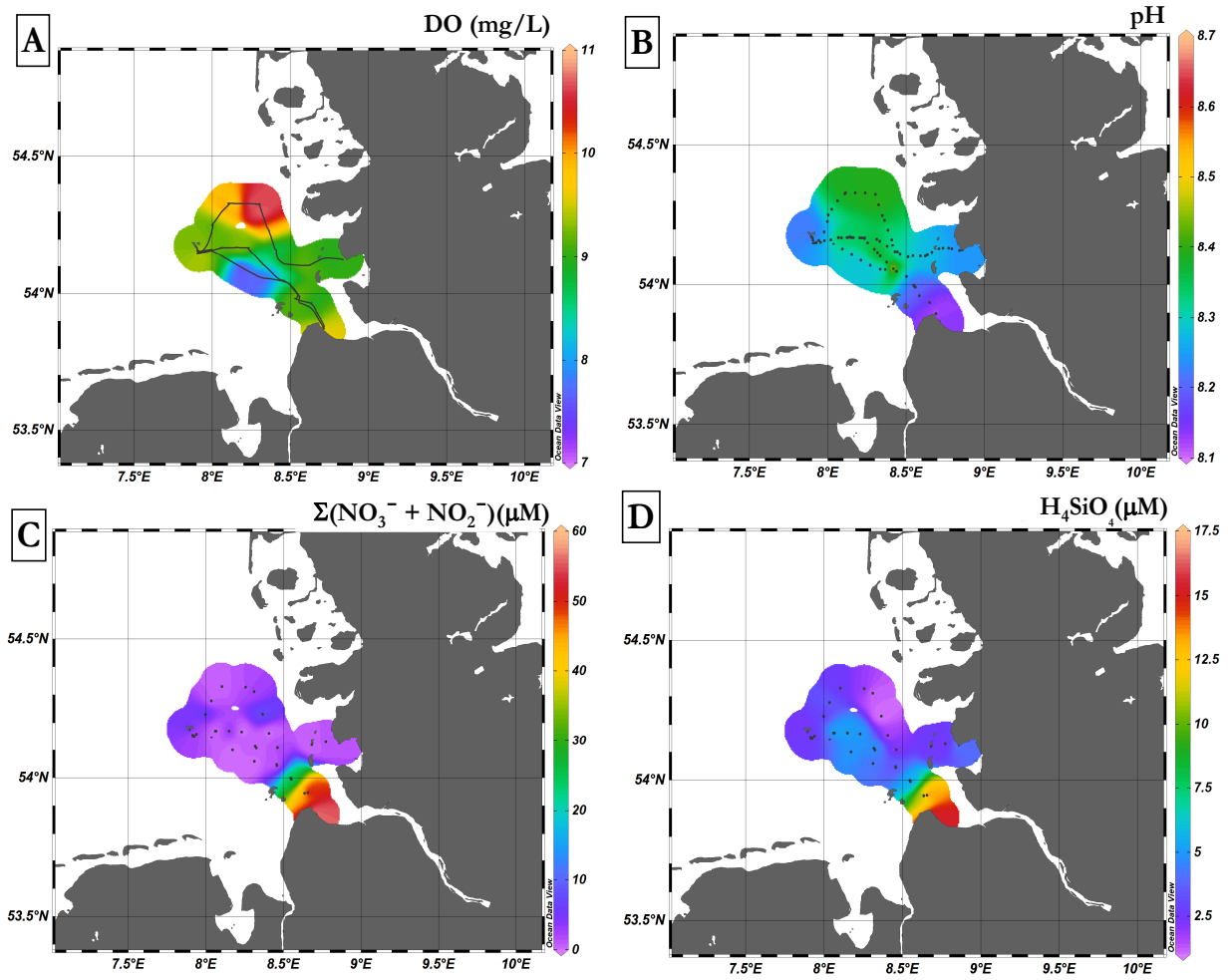


Figure S8 Overviews of (A) the distribution of surface dissolved oxygen (DO) in mg/L obtained from EXO sonde sensor, (B) distribution of pH obtained from sunburst SAMIpH and corrected for CTD salinity and temperature, (C) distribution of $\Sigma(\text{NO}_3^- + \text{NO}_2^-)$ in μM (bottom left panel) and (D) distribution of H_4SiO_4 in μM for the discrete samples collected from underway water supply and analyzed via QuAAtro air-segmented analyser.