Supplementary Information

Effects of Chloride Transport on the Bioelectrochemical Remediation of Nitrate Contaminated Groundwater

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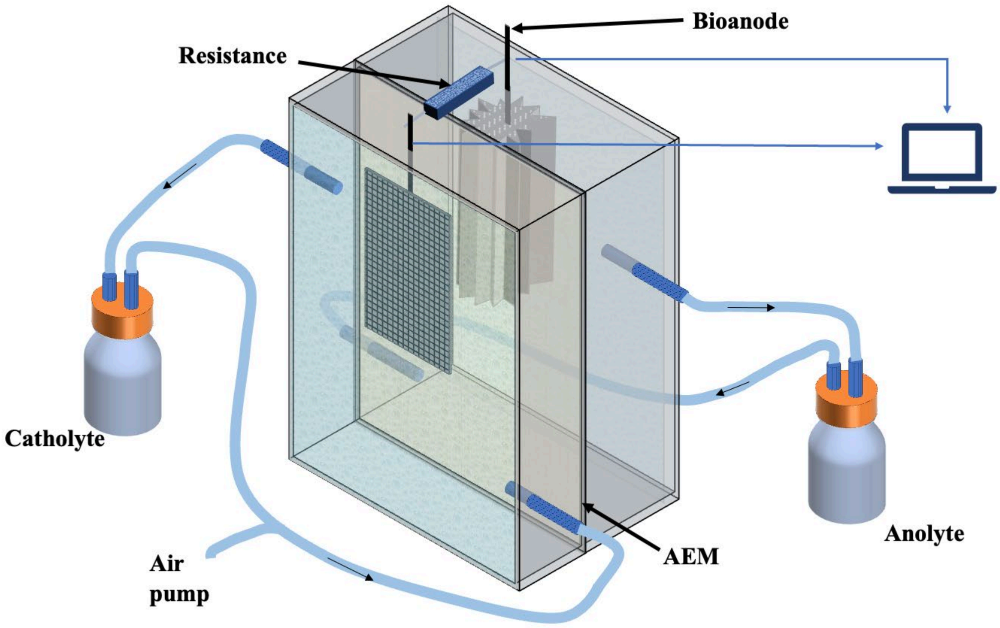

Figure S1. The schematic of membrane-based bioelectrochemical system (MBES).

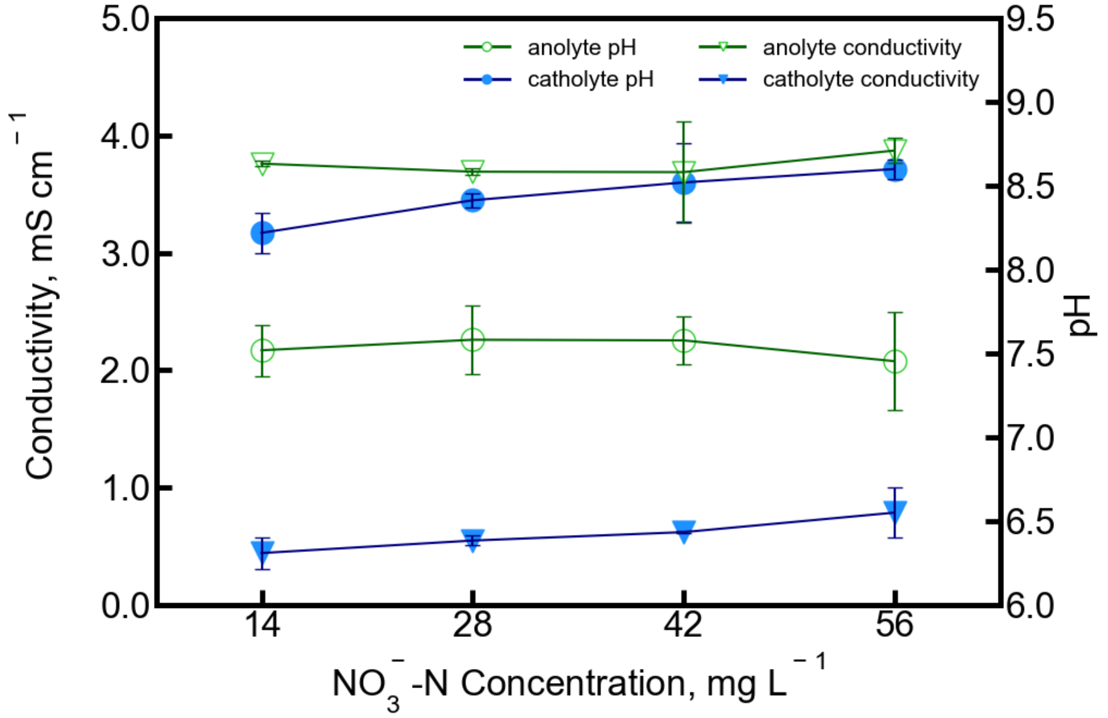

Figure S2. pH and conductivity of catholyte and anolyte of MBES under NO_3^--N concentration of 14, 28, 42, and 56 mg L^{-1}.

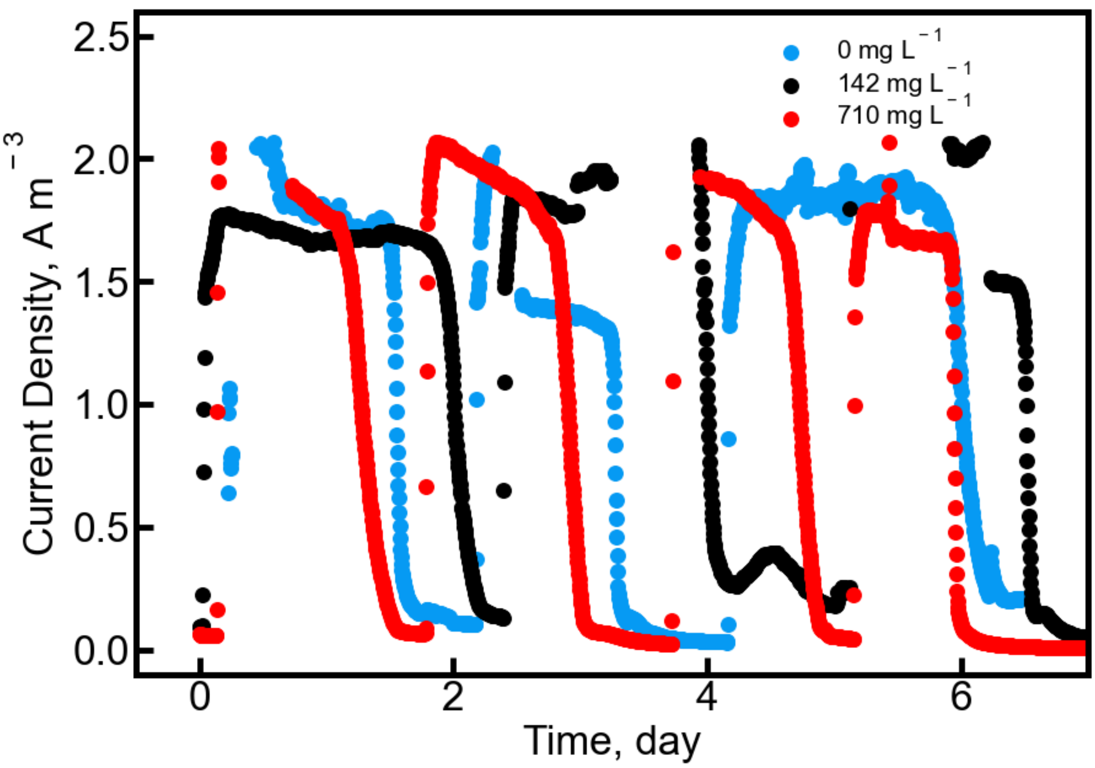

Figure S3. The current density profiles as a function of time under influent chloride concentrations of 0, 142, and 710 mg L^{-1}.

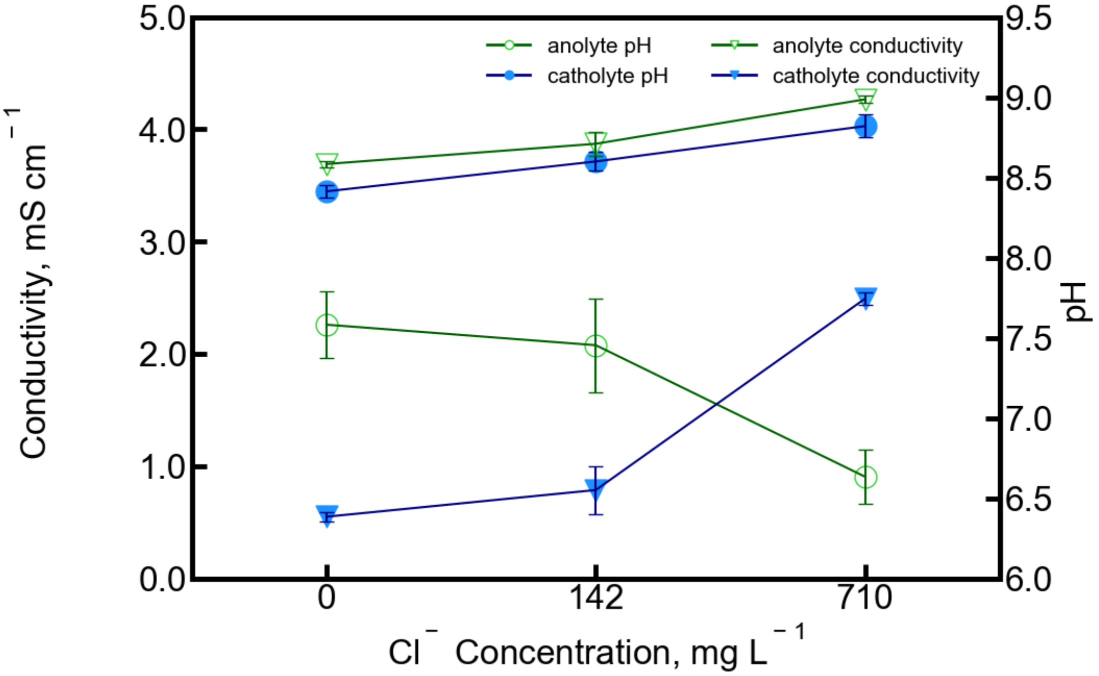

Figure S4. pH and conductivity of catholyte and anolyte of MBES fed with synthetic nitrate-rich waters with chloride concentration of 0, 142, and 710 mg L^{-1}.

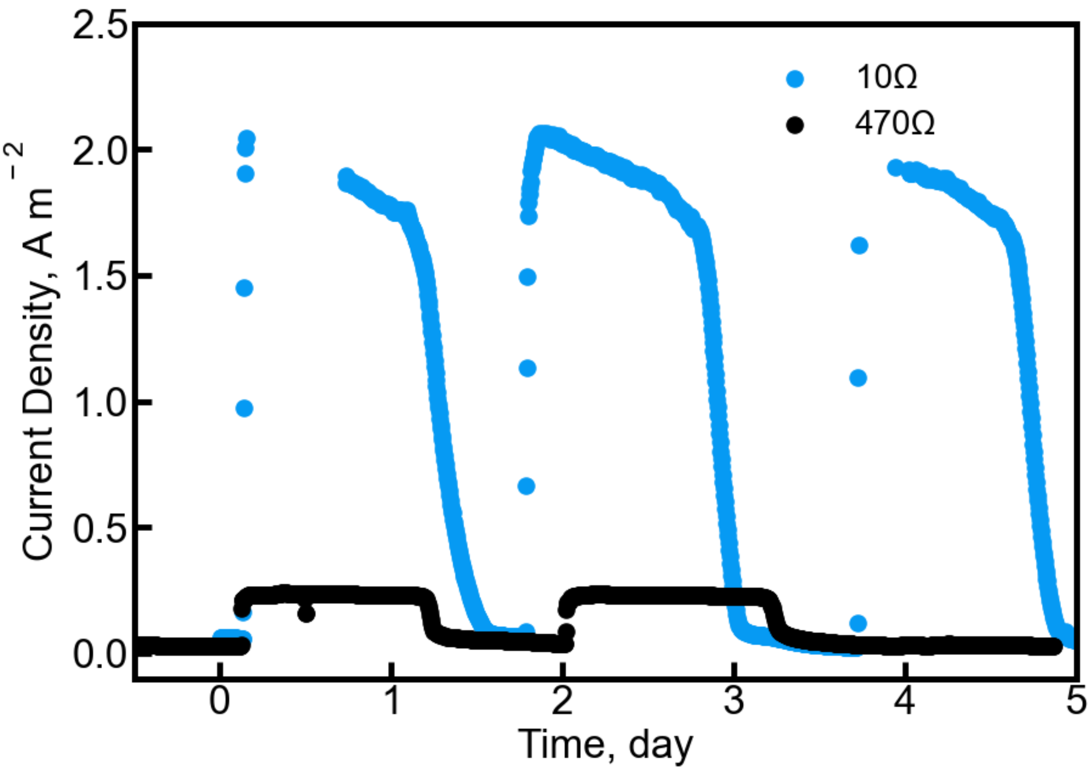

Figure S5. The current density profiles under external resistances of 10 Ω and 470 Ω without the presence of chloride ions in catholyte influent.

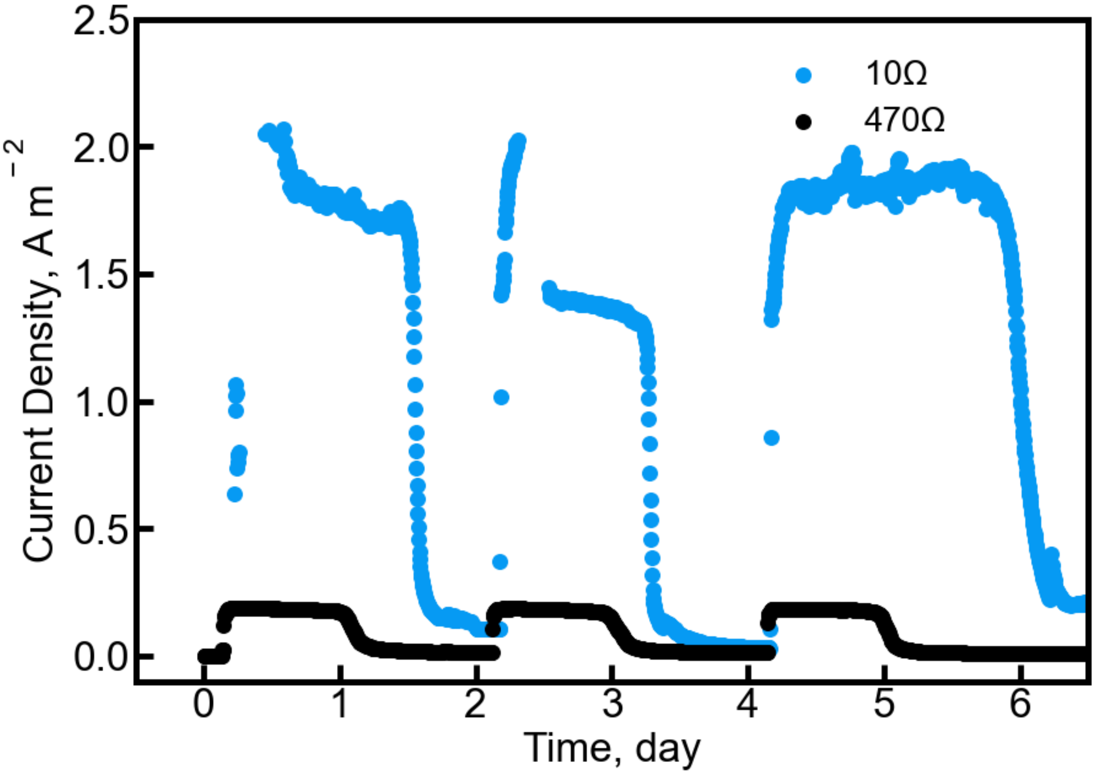

Figure S6. The current density profiles under external resistances of 10 Ω and 470 Ω with the presence of chloride ions (710 mg L^{-1}) in the catholyte influent.

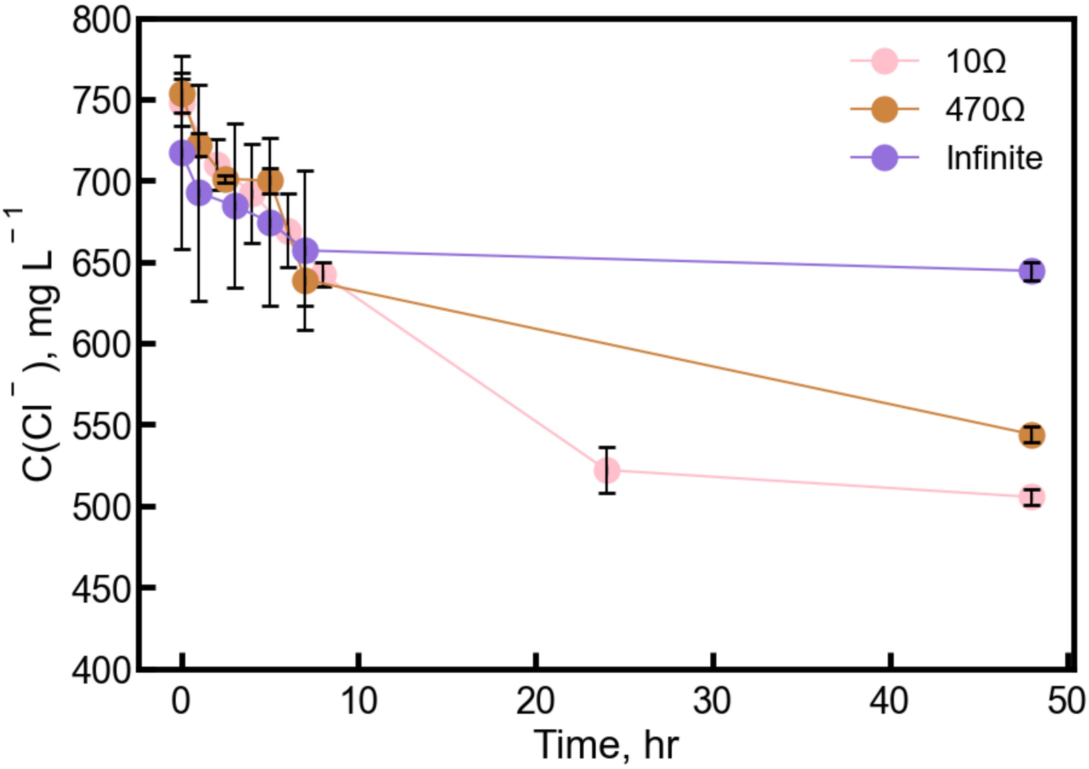

Figure S7. The catholyte chloride concentration as a function of time under external resistance of 10, 470 Ω and infinite (open circuit condition).

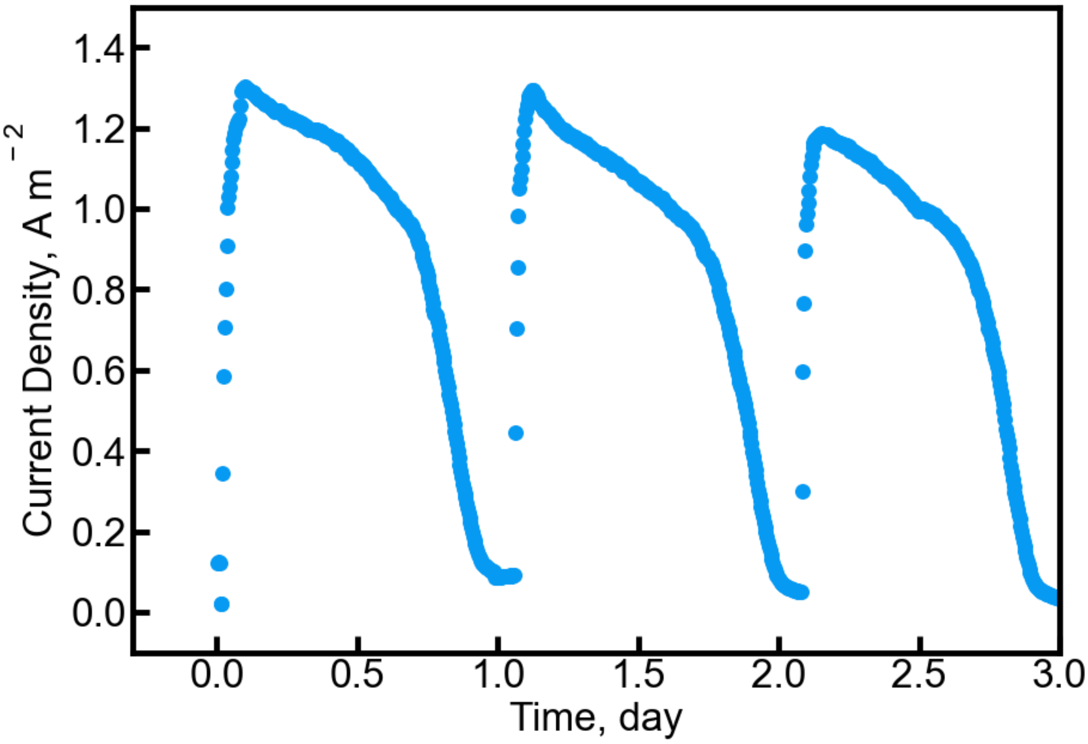

Figure S8 The current density profile when the catholyte influent was real groundwater.

Table S1. Influent compositions for each condition. The recipe of stock, trace and phosphate buffer (PBS) solutions can be found in Burns & Qin, 2023

Experimental Conditions	Anolyte	Catholyte[a]	External resistance
Impact of nitrate concentration	1g L^{-1} NaAc, 10 mL L^{-1} stock solution, 10 mL L^{-1} Phosphate-Buffered Saline (PBS), 1 mL L^{-1} trace solution [b]	14 mg L^{-1} NO_3^--N	10Ω
		28 mg L^{-1} NO_3^--N	10Ω
		42 mg L^{-1} NO_3^--N	10Ω
		56 mg L^{-1} NO_3^--N	10Ω
Impact of chloride concentration		28 mg L^{-1} NO_3^--N	10Ω
		28 mg $L^{-1}$$NO_3^-$-N 142 mg L^{-1} Cl^-	10Ω
		28 mg L^{-1} NO_3^--N 710 mg L^{-1} Cl^-	10Ω
Impact of current density (with Cl^-)		28 mg L^{-1} NO_3^--N 710 mg L^{-1} Cl^-	10Ω
		28 mg L^{-1} NO_3^--N 710 mg L^{-1} Cl^-	470Ω
		28 mg L^{-1} NO_3^--N 710 mg L^{-1} Cl^-	Infinite
Impact of current density (without Cl^-)		28 mg L^{-1} NO_3^--N	10Ω
		28 mg L^{-1} NO_3^--N	470Ω
		28 mg L^{-1} NO_3^--N	Infinite
Real groundwater		Groundwater	10Ω

[a] All of the catholyte solutions are added 0.02M of PBS.

[b] All of the anolyte solutions are the same which are 1 g L^{-1} NaAc, 10 mL L^{-1} stock solution, 10 mL L^{-1} Phosphate-Buffered Saline (PBS), 1 mL L^{-1} trace solution

Table S2. Nitrate removal rate, COD removal efficiency, coulombic efficiency and produced charge of the system when catholyte influent NO_3^--N concentrations were 14, 28, 42, and 56 mg L^{-1}.

c(NO_3^--N)/mg L^{-1}	NO_3^--N removal rate/ mg L^{-1} hr^{-1}	Coulombic efficiency/%	Produced charge/C
14	2.96 ± 0.24	15.8 ± 6.4	572 ± 246
28	4.77 ± 0.14	22.8 ± 7.8	815 ± 282
42	5.40 ± 0.33	5.5 ± 1.4	205 ± 22
56	8.28 ± 0.01	6.6 ± 5.3	230 ± 24

Table S3. Nitrate removal efficiency, nitrate removal rate, COD removal efficiency, and coulombic efficiency of the system when catholyte influent chloride concentrations were 0, 142, and 710 mg L^{-1}.

$c(Cl^-)$/mg L^{-1}	NO_3^--N removal efficiency /%	COD removal efficiency/%	Coulombic efficiency/%
0	100	89.0 ± 3.1	22.8 ± 7.8
142	100	92.4 ± 6.6	26.2 ± 9.2
710	97.84 ± 2.2	89.5 ± 2.4	19.5 ± 4.1

Table S4. Nitrate removal efficiency, COD removal rate, and coulombic efficiency of the system when external resistance is different

External resistance	NO_3^--N removal efficiency/%	COD removal/%	Coulombic efficiency/%
10Ω (710 Cl^- mg L^{-1})	97.8 ± 2.2	89.5 ± 2.4	19.5 ± 4.1
470Ω (710 Cl^- mg L^{-1})	100	96.3 ± 4.9	3.25 ± 2.2
Open circuit (710 Cl^- mg L^{-1})	92.4 ± 1.1	94.7 ± 2.1	/
10Ω (without Cl^-)	100	89.0 ± 3.1	22.8 ± 7.8
470Ω (without Cl^-)	96.1 ± 4.6	98.3 ± 0.1	1.67 ± 0.01
Open circuit (without Cl^-)	95.4 ± 0.1	95.6 ± 0.1	/

Table S5. The detailed concentration of major ions in the groundwater sample

Element	Concentration mg L^{-1}
Ca^{2+}	96.1
K^{+}	27.8
Mg^{2+}	33.3
Na^{+}	7.9
Cl^{-}	44.2
NO_3^{-}-N	44.5