Supporting Information

Ion Concentration Polarization Causes a Nearly Pore-Length-Independent Conductance of Nanopores

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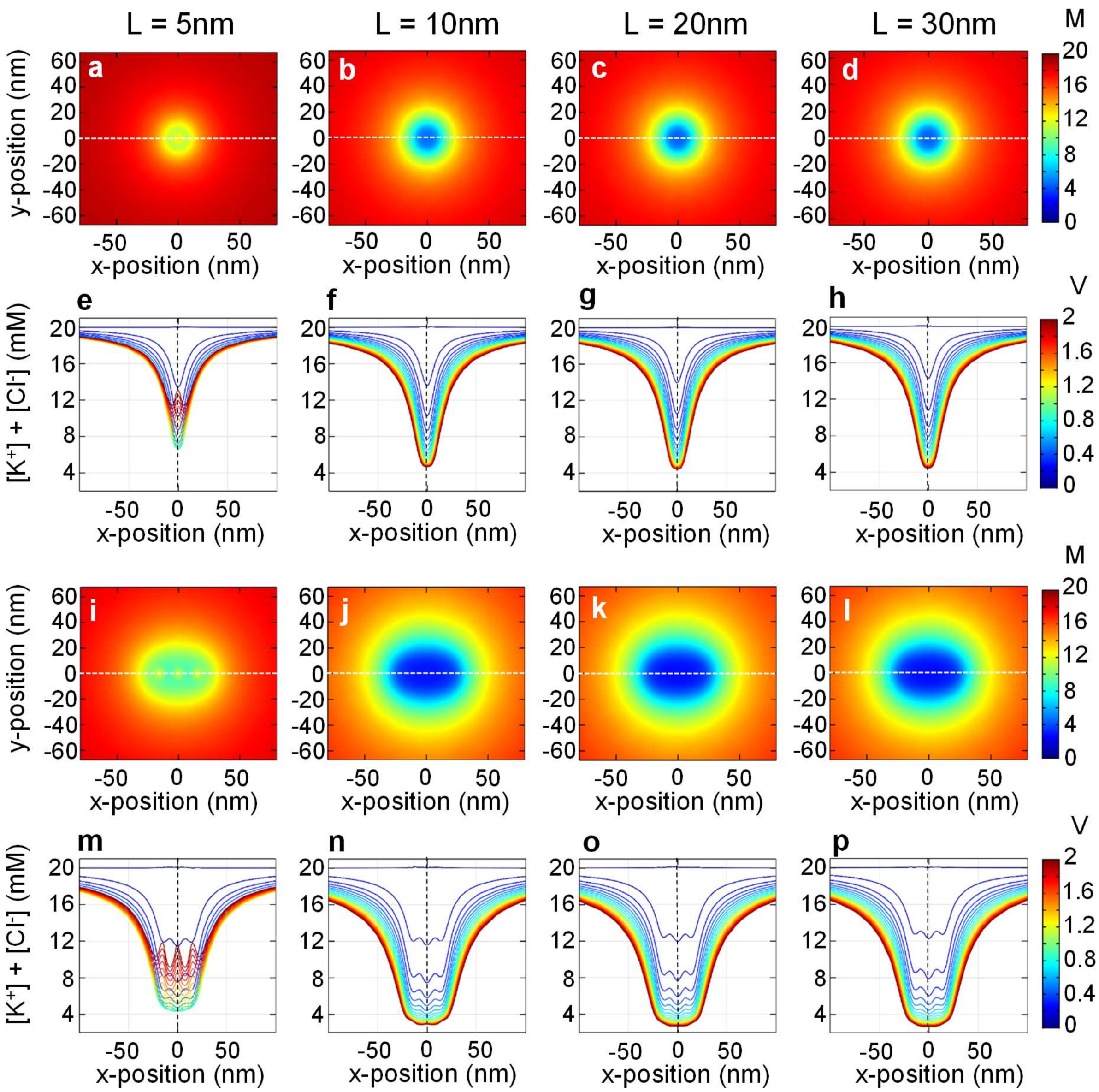

Figure S1. Ionic depletion caused by ion concentration polarization in single nanopores (a-h) and in nanopore arrays with 3 pores (i-p) in 10 mM bulk KCl concentration as a function of pore length and voltage. Results for 5, 10, 20, and 30 nm long pores are shown in subsequent columns from left to right. *All nanopores had a surface charge density on the pore walls of -0.05 C/m^2. (a-d) and (i-l) show surface heat maps at 2 V of the total concentration of K^+ and Cl^- at a distance 5 nm away from the membrane surface for single pores and arrays, respectively. (e-h) and (m-p) show ionic concentrations along the dashed horizontal line in the heat maps as a function of transmembrane potential between 0 V and 2 V for single nanopores and arrays. For all arrays an interpore spacing of 15 nm from center to center was used with the center pore located at (0,0,0).*

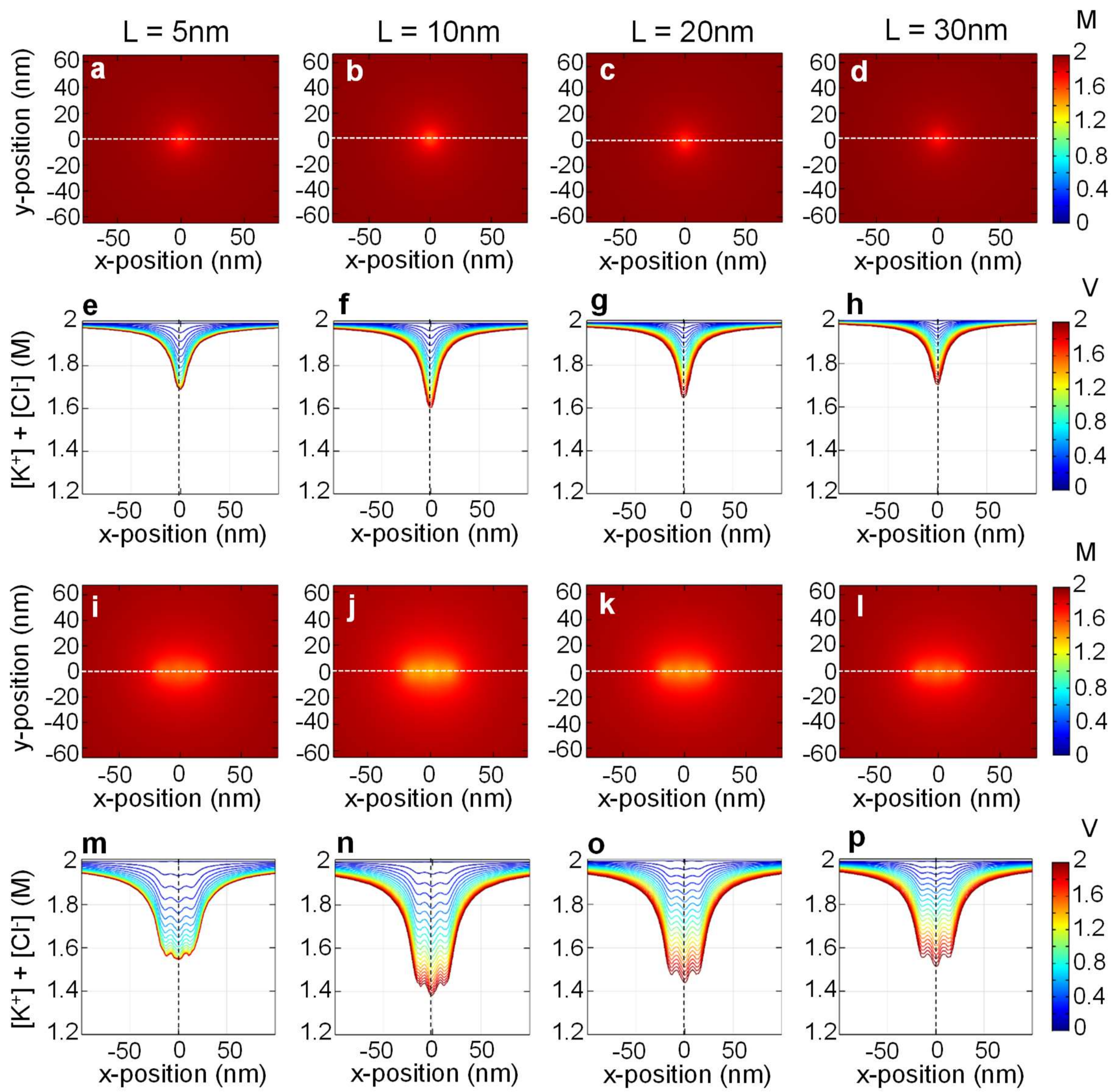

Figure S2. Ionic depletion caused by ion concentration polarization in single nanopores (a-h) and in nanopore arrays with 3 pores (i-p) in 1 M bulk KCl concentration as a function of pore length and voltage. Results for 5, 10, 20, and 30 nm long pores are shown in subsequent columns from left to right. *All nanopores had a surface charge density on the pore walls of -0.05 C/m*^{2}. *(a-d) and (i-l) show surface heat maps at 2 V of the total concentration of* K^+ *and* Cl^- *at a distance 5 nm away from the membrane surface for single pores and arrays, respectively. (e-h) and (m-p) show ionic concentrations along the dashed horizontal line in the heat maps as a function of transmembrane potential between 0 V and 2 V for single nanopores and arrays. For all arrays an interpore spacing of 15 nm from center to center was used with the center pore located at (0,0,0).*

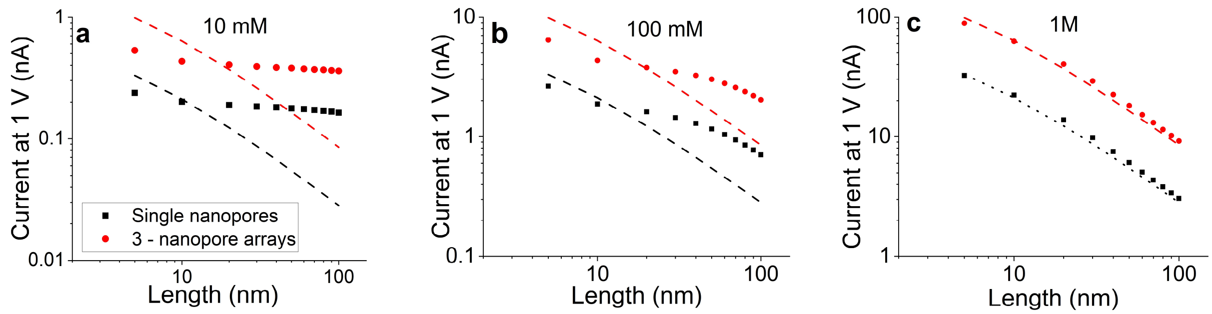

Figure S3. Ion current at 1 V through single nanopores (black symbols) and 3 – nanopore arrays (red symbols) for pore lengths between 5 and 100 nm. *The pores' walls were negatively charged at a density of -0.05 C/m^2. The dotted lines show how the current depends on pore length according to eq. (3) in the main manuscript, assuming each pore is filled with a solution whose conductivity is equal to that of a respective bulk solution: 0.15, 1.5, and 15 S/m for 10 mM, 100 mM, and 1 M, respectively.*

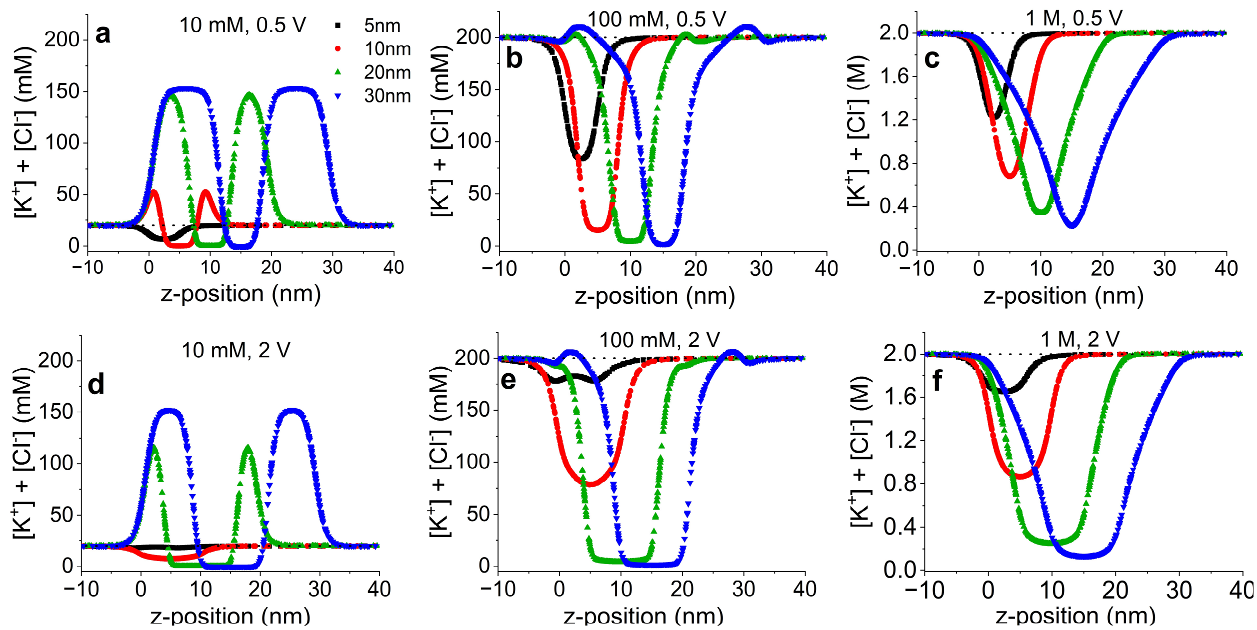

Figure S4. Total ionic concentration along the pore axis for the center pore in 3-nanopore arrays containing ionic diodes, as a function of pore length and salt concentration at 0.5 V (a-c) and at 2 V (d-f). *Blue, green, red, and black symbols indicate pores that are 30 nm, 20 nm, 10 nm, and 5 nm long. Entrance to all pores is at z = 0 nm. The pores contain a junction between two zones with opposite surface charges, -0.05 C/m^2 and 0.05 C/m^2. The two zones have equal lengths. The dotted horizontal line shows total bulk concentration of ions. Distribution of ion concentration for negative voltages is shown in Figure 11 in the main manuscript.*