Supporting Information: Prediction of Alkanolamine pK$_a$ Values by Combined Molecular Dynamics Free Energy Simulations and ab initio Calculations

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Table S1: The raw intrinsic hydration free energies, $\mu_i^{\mathrm{res}(NVT;\infty}(T,\rho[T,P])$, (in kJ·mol^{-1}) of the neutral forms of the 29 alkanolamines of this study from different charge models and from SMD continum solvent simulations at $T = 298.15$ K and $P = 1.0$ bar. Their uncertainties are approximately 0.2 kJ·mol^{-1}.

	RESP				
amine	HF/6-31G*	B3LYP/ 6–311++G(d,p)	MP2–cc–pVTZ+PCM	AM1–BCC	SMD
MEA	-30.79	-27.07	-29.8	-28.93	-31.72
3–AP	-30.52	-26.05	-28.12	-32.35	-26.93
EDA	-38.59	-34.37	-39.50	-35.60	-33.17
PA	-21.33	-18.19	-20.63	-14.06	-15.60
2–MPA	-15.09	-11.30	-14.99	-13.66	-11.44
AMP	-33.36	-30.43	-33.39	-24.6	-29.17
AMPD	-56.48	-51.28	-52.9	-44.82	-43.12
AEPD	-52.16	-49.21	-53.38	-41.19	-37.75
2–AP	-38.11	-33.47	-36.32	-26.72	-31.58
DEA	-47.3	-42.28	-45.91	-43.26	-47.52
2–AEE	-29.74	-26.56	-31.82	-42.44	-40.6
2–DIPA	-14.57	-12.86	-18.3	-11.08	-10.15
DIPA	-45.22	-40.94	-46.61	-38.779	-46.68
MDEA	-40.95	-34.29	-36.15	-39.23	-31.05
n–CHEA	-25.06	-22.23	-26.05	-25.19	-26.53
SAPD	-50.52	-45.27	-47.44	-46.71	-44.61
TBAE	-18.3	-16.45	-21.13	-21.44	-24.77
THMAM	-76.27	-71.97	-68.99	-57.24	-62.09
3–DMAP	-15.28	-13.24	-18.75	-24.01	-16.32
DMIPA	2.62	3.31	1.57	-9.12	-6.06
t-BDEA	-43.84	-39.08	-21.13	-32.33	-31.1
TREA	-5.94	-6.34	-4.03	-7.79	-2.74
1–AP	-32.96	-29.68	-32.52	-27.08	-29.78
MAE	-18.99	-14.99	-15.85	-25.29	-30.23
EAE	-24.09	-20.66	-22.11	-24.32	-17.2
IPAE	-20.47	-17.54	-20.1	-22.52	-19.76
MPAE	-18.13	-15.74	-16.95	-19.3	-11.21
IBAE	-19.45	-15.98	-16.02	-21.23	-27.68
EAMP	-25.71	-19.89	-24.91	-19.26	-16.88

Table S2: The raw intrinsic hydration free energies, $\mu_i^{\mathrm{res}(NVT;\infty}(T,\rho[T,P])$, (in kJ·mol^{-1}) of the protonated (RNH_3^+) forms of the 29 alkanolamines of this study from different charge models and from SMD continuum solvent simulations at $T = 298.15$ K and $P = 1.0$ bar. Their uncertainties are approximately 0.2 kJ·mol^{-1}. The value of the Galvani potential for TIP3P water[S1–S3] (-48.24 kJ·mol^{-1}) should be subtracted from the raw SMD values for comparison purposes.

	RESP				
amine	HF/6–31G*	B3LYP/ 6–311++G(d,p)	MP2–cc–pVTZ+PCM	AM1–BCC	SMD
MEA	-239.86	-237.57	-243.18	-246.93	-290.07
3–AP	-218.05	-216.29	-222.98	-227.37	-269.22
EDA	-225.99	-222.7	-231.07	-233.00	-275.69
PA	-222.14	-218.93	-235.98	-234.01	-286.49
2–MPA	-215.24	-211.47	-229.8	-228.13	-281.14
AMP	-222.05	-216.09	-226.45	-223.6	-270.38
AMPD	-229.95	-221.62	-227.79	-229.16	-264.27
AEPD	-218.22	-212.35	-217.50	-222.35	-257.13
2–AP	-232.91	-229.51	-236.64	-233.86	-278.63
DEA	-213.28	-208.1	-207.33	-213.99	-248.44
2–AEE	-216.08	-213.07	-223.77	-227.13	-262.57
2–DIPA	-158.3	-152.28	-156.27	-153.25	-216.76
DIPA	-198.66	-193.21	-193.19	-190.684	-245.23
MDEA	-199.84	-195.19	-192.56	-191.47	-238.66
n–CHEA	-187.64	-179.66	-189.3	-186.75	-237.47
SAPD	-236.36	-230.24	-234.27	-241.74	-273.28
TBAE	-184.80	-179.84	-187.22	-188.06	-243.31
THMAM	-235.58	-224.43	-225.93	-232.68	-258.88
3–DMAP	-174.24	-173.21	-173.18	-174.78	-227.04
DMIPA	-174.15	-173.01	-179.83	-173.55	-242.86
t–BDEA	-174.28	-166.5	-168.5	-168.45	-229.38
TREA	-164.02	-160.55	-169.56	-162.44	-231.43
1–AP	-232.91	-229.67	-237.16	-238.23	-284.80
MAE	-212.62	-210.71	-213.99	-214.95	-266.18
EAE	-201.41	-200.1	-203.41	-204.07	-256.79
IPAE	-193.42	-188.52	-195.73	-194.72	-250.00
MPAE	-186.9	-180.61	-188.13	-189.32	-241.81
IBAE	-187.77	-183.99	-193.15	-193.77	-248.04
EAMP	-188.24	-182.16	-189.8	-185.25	-241.25

References

(S1) Zhang, H.; Jiang, Y.; Yan, H.; Yin, C.; Tan, T.; van der Spoel, D. Free–energy calculations of ionic hydration consistent with the experimental hydration free energy of the proton. *J. Phys. Chem. Lett.* **2017**, *8*, 2705–2712.

(S2) Lamoureux, G.; Roux, B. Absolute hydration free energy scale for alkali and halide ions established from simulations with a polarizable force field. *J. Phys. Chem. B* **2006**, *110*, 3308–3322.

(S3) Feller, S. E.; Pastor, R. W.; Rojnuckarin, A.; Bogusz, S.; Brooks, B. R. Effect of electrostatic force truncation on interfacial and transport properties of water. *J. Phys. Chem. A* **1996**, *100*, 17011–17020.