Supporting Information for “Bulk and Interfacial Properties of the Decane+Brine System in the Presence of Carbon Dioxide, Methane, and Their Mixture”

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June 22, 2021

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Figure S1: Brine densities from MD simulations, CPA EoS, and experimental measurements (Al Ghafri et al., 2012).

Figure S2: Same as in Fig. 2, but at 443 K and 100 MPa.
**Figure S3:** Same as in Fig. 2, but at 323 K and 20 MPa.

**Figure S4:** Same as in Fig. 2, but at 323 K and 100 MPa.

**Figure S5:** Same as in Fig. 2, but for salt-free system.
Figure S6: Same as in Fig. S5, but at 443 K and 100 MPa.

Figure S7: Same as in Fig. S5, but at 323 K and 20 MPa.

Figure S8: Same as in Fig. S5, but at 323 K and 100 MPa.
Figure S9: Mole fractions of CH\textsubscript{4} and CO\textsubscript{2} in the water-rich phase: (a) CH\textsubscript{4} in decane+brine+CH\textsubscript{4} ($x_{CH_4} = 0.5$), (b) CH\textsubscript{4} in decane+brine+CH\textsubscript{4}+CO\textsubscript{2} ($x_{CH_4} = x_{CO_2} = 0.25$), and (c) CO\textsubscript{2} in decane+brine+CO\textsubscript{2} ($x_{CO_2} = 0.5$), and (d) CO\textsubscript{2} in decane+brine+CH\textsubscript{4}+CO\textsubscript{2} ($x_{CH_4} = x_{CO_2} = 0.25$) systems. The open symbols represent the results from the MD simulations and the estimates obtained using the CPA EoS are shown as lines.
Figure S10: Salt concentration dependence of IFT for (a) decane+brine, (b) decane+brine+CH\(_4\) \((x_{\text{CH}_4} = 0.5)\), (c) decane+brine+CO\(_2\) \((x_{\text{CO}_2} = 0.5)\), and (d) decane+brine+CH\(_4\)+CO\(_2\) \((x_{\text{CH}_4} = x_{\text{CO}_2} = 0.25)\) systems. Lines are a guide to the eyes.
Figure S11: Pressure dependence of decane surface excess for (a) decane+brine, (b) decane+brine+CH$_4$ ($x_{CH_4} = 0.5$), (c) decane+brine+CO$_2$ ($x_{CO_2} = 0.5$), and (d) decane+brine+CH$_4$+CO$_2$ ($x_{CH_4} = x_{CO_2} = 0.25$) systems. The open symbols represent the results from the MD simulations and the estimates obtained using the DGT with CPA EoS are shown as lines.
Figure S12: Same as in Fig. S9, but for surface excesses of CH₄ and CO₂.
Figure S13: Same as in Fig. S11, but for NaCl.
**Figure S14:** Same as in Fig. 3, but for 374 and 403 K.
Figure S15: Saturated densities for (a) decane+brine+CH$_4$ ($x_{\text{CH}_4} = 0.2$), (b) decane+brine+CO$_2$ ($x_{\text{CO}_2} = 0.2$), (c) decane+brine+CH$_4$ ($x_{\text{CH}_4} = 0.8$), and (d) decane+brine+CO$_2$ ($x_{\text{CO}_2} = 0.8$) systems. The estimates obtained using the CPA EoS are shown as lines. The lower set of data represents the decane-rich phase.
Figure S16: Same as in Fig. 6, but for 374 and 403 K.
Figure S17: IFTs of (a) decane+brine+CH$_4$ ($x_{CH_4} = 0.2$), (b) decane+brine+CO$_2$ ($x_{CO_2} = 0.2$), (c) decane+brine+CH$_4$ ($x_{CH_4} = 0.8$), and (d) decane+brine+CO$_2$ ($x_{CO_2} = 0.8$) systems. The estimates obtained using the DGT with CPA EoS are shown as lines.