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Convective dissolution of carbon dioxide in salted water: linear stability analysis and effect of control parameters VANESSA LOODTS, LAURENCE RONGY, ANNE DE WIT, Non Linear Physical Chemistry Unit, Université Libre de Bruxelles (ULB) — We study the convective dissolution of carbon dioxide (CO_2) in salted water theoretically. We perform a linear stability analysis with regard to buoyancy-driven convection of the time-dependent concentration profiles of CO_2 diffusing into the aqueous solution. On the basis of a parameter-free dimensionless model, we predict the time of onset and wavenumber of the instability when the system becomes unstable, i.e. when the growth rate of the instability equals zero. We also define a characteristic growth rate σ^* quantifying the growth of the perturbations in the unstable regime. We find good agreement of σ^* with growth rates of buoyancy-driven fingering available in the literature. We moreover explicit the procedure to compare the dimensionless theoretical prediction with dimensional experimental and numerical data and analyze the influence of parameters controlling implicitly the characteristic length and time scales of the problem. We find that increasing the partial pressure of CO_2, or decreasing the aqueous salt concentration or the temperature destabilize the system, leading to faster growing buoyancy-driven fingers.

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