



**Figure 10.14.** The calculated effect of chemical enhancement of CO<sub>2</sub> gas exchange in the ocean as a function of the gas exchange mass transfer coefficient,  $G_{600}$  (m d<sup>-1</sup>). The air–water  $f_{CO_2}$  gradient is 40% over- or undersaturation for evasion and invasion, respectively. Lines are drawn for different forward rate constants of CO<sub>2</sub> hydration. Short dashed lines indicate CO<sub>2</sub> net flux for no reaction of CO<sub>2</sub> with water. Longer dashed lines were calculated by using laboratory-determined values for the hydration rate of CO<sub>2</sub> (Table 4.6). CO<sub>2</sub> gas exchange rates are chemically enhanced by roughly 1, 3 and 15% for mass transfer coefficients of 4, 10 and 20 m d<sup>-1</sup>, respectively. The solid lines indicate CO<sub>2</sub> exchange fluxes calculated for CO<sub>2</sub> hydration rates increased by 10 times ( $10 \times k_{CO_2}$ ) and 100 times ( $100 \times k_{CO_2}$ ). In order for the chemical reaction to have a significant effect on CO<sub>2</sub> gas transfer in the range of mass transfer coefficients that dominate gas transfer in the ocean,  $G_{600} > 5$  m d<sup>-1</sup>, the rate constant would have to be catalyzed by at least a factor of 10. Redrawn from Emerson (1995).