The alkalinity production process has a dramatically different set of controls, and the resultant maximum alkalinity concentrations are typically one or two orders of magnitude less than the maximum acidity concentrations found in mine environments. The carbonate rocks which produce significant alkalinity or bicarbonate concentrations in groundwater, surface-water, and mine drainage samples (i.e. coal surface mines, stone quarries, and coal and noncoal underground mines) are limestones and dolomites and the principal carbonate minerals are typically calcite (calcium carbonate) and dolomite (calcium-magnesium carbonate).

Very thorough discussions of the chemical reactions of carbonate mineral dissolution and precipitation and associated solubility and chemical equilibria controls are found in Stumm and Morgan (1970), Krauskopf (1967), Garrels and Christ (1965), Freeze and Cherry (1979), Plummer et al. (1978), White (1988), and Langmuir (1997). Rose (1997) calculated the range of bicarbonate concentrations for calcite dissolution in pure water from 83 mg/L at PCO_2 of 10^{-3} to 370 mg/L at PCO_2 of 10^{-1} using the methods (i.e. Case 4) described in Garrels and Christ (1965). Figure 1.1 from White (1988) shows solubility curves for calcite as a function of carbon dioxide partial pressure, and Rose and Cravotta (1998) depict bicarbonate and alkalinity concentration for a similar range of PCO_2, based upon Case 2 of Garrels and Christ (1965, p. 81).

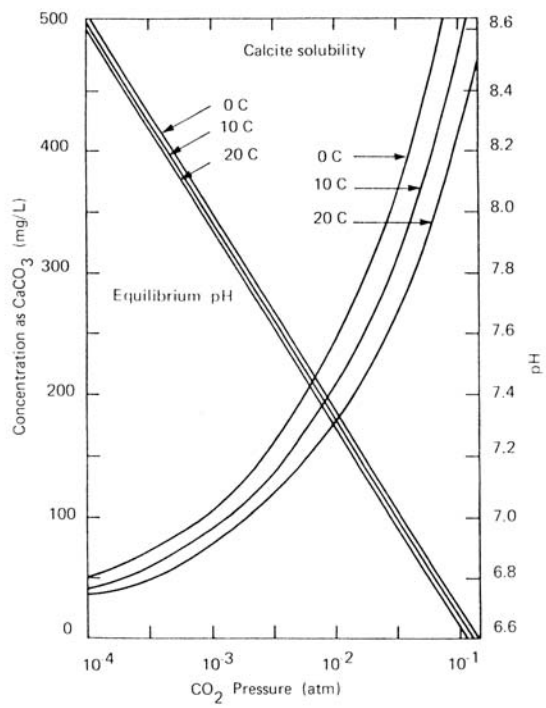

Figure 1.1 Solubility curves for calcite as a function of carbon dioxide partial pressure (from GEOMORPHOLOGY AND HYDROLOGY OF KARST TERRAINS by William B. White. Copyright © 1988 by Oxford Univ. Press, Inc.).