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Solubility of Calcium Phosphates

L.C. Chow

American Dental Association Health Foundation, Paffenbarger Research Center,
National Institute of Standards and Technology, Gaithersburg, Md., USA

Solubility is one of the most important properties of calcium phosphate salts. It is the solubility that determines the direction of many reactions that involve calcium phosphates such as dissolution, precipitation, hydrolysis, and phase transformation. Calcium phosphate solubility also plays a major role in biological processes that involve formation and resorption of hard tissues as well as pathological calcifications. This chapter will focus on concepts that would aid in gaining a better understanding of the solubility behavior of calcium phosphates, rather than provide a survey of the literature, which has been given elsewhere [Elliot, 1994]. Solubility is conventionally described as the amount of a solid that can dissolve into a unit volume of solution. For calcium phosphates, this quantity often changes by several orders of magnitude with changes in the pH and concentrations of acids and bases, such as HCl and NaOH. Thus, on the surface, the solubility may appear to be a complex function of these solution parameters. However, a clearer picture of the solubility properties for calcium phosphates can be gained by understanding the basic principles governing the solid-solution equilibrium.

Gibbs' Components

The composition of a solution may be described in terms of the quantities of independent components defined in Gibbs' phase rule [Gibbs, 1876]. The components may be understood as the minimum number of compounds that are needed to form all of the phases that may be present in a system. In the simplest case, a solution that contains calcium and phosphate ions is