Stability and metastability of arsenian pyrite

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Pyrite with high As content is a common mineral occurring in a range of environments. The physical and chemical controls on stability of pyrite, arsenian pyrite and arsenopyrite (the FeS_2-FeAsS system) are currently poorly understood. In this study we attempt to constrain solubility limits of arsenic in pyrite from textures and data in ore deposits. Arsenian pyrite (2-4 wt.% As) from the Konkera gold deposit (Burkina Faso) has textures indicating decomposition to low As pyrite and arsenopyrite during low grade metamorphism. The textures were probably formed when a reaction front propagated through the arsenian pyrite leaving a fine grained aggregate of low-As pyrite (<0.2 wt.% As), arsenopyrite and gold. Microprobe measurements suggest that the reaction was isochemical. The textures can be interpreted as a dissolution-precipitation process resulting in decomposition of a metastable arsenian pyrite to a stable assemblage. Metamorphosed sulfide deposits tend to contain an assemblage of low As pyrite and arsenopyrite pyrite but high As pyrite (>2wt% As) is most common in deposits in unmetamorphosed hydrothermal deposits where arsenopyrite is a rare phase (e.g. Carlin trend, USA). The combined dataset suggests that the equilibrium solubility of As in pyrite is in the range of 0.2-1 wt.%, and higher concentrations represent a metastable solid solution which can un-mix to low-As pyrite and arsenopyrite during low grade metamorphism. Metastability of hydrothermal arsenian pyrite is possibly related to rapid pyrite growth and may be controlled by surface processes.