Apatite formation from calcite under hydrothermal environment: transforming mechanisms and influencing factors

SHI Cheng[1], LU Xian-cai[1], CAI Yuan-feng[1], HE Hong-ping[2*]

(1. *State Key Laboratory for Mineral Deposit Research, School of Earth Sciences and Engineering, Nanjing University, Nanjing* 210046, *China*;
2. *Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou* 510640, *China*)

Abstract: Apatite widely occurs in organisms and various rocks, and its formation mechanisms change with changing physical and chemical conditions. In this study, Raman spectroscopy and field emission scanning electron microscope with energy spectrometer technology were used to study the phase transition in the replacement of calcite by hydroxyapatite in hydrothermal conditions. Formation mechanisms of hydroxyapatite were also discussed. Results show that hydrogen phosphate ion from the solution replaces carbonic acid ion of calcite first in weakly acid environment and forms dicalcium phosphate dehydrate(DCPD). Some of the DCPD become hydroxyapatite (HAP) progressively through the dehydration and dehydrogenation process; others would dissolve in aqueous solution. However, in alkaline environment, only a small fraction of calcite is replaced by HAP. Therefore, the replacement reactions from calcite to hydroxyapatite are explained by "the coupled dissolution-reprecipitation" mechanism. Under low temperature condition, acid buffer solution promotes the formation of DCPD and alkaline condition, on the other hand facilitates the formation of HAP. High temperature accelerates the replacement of calcite by HAP and no DCPD phase was observed in this condition.

Keywords: Hydroxyapatite; Calcite; Hydrothermal Experiment; Phase Transition; coupled dissolution-reprecipitation mechanism