Experimental study of phosphorus dissolution in liquid CO_2-water system

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Phosphorus (P) is used as essential component of various macromolecules like DNA and RNA, phospholipids that forms cell membrane, and ATP, Acetyl-CoA, and NADPH as energy currency in modern terrestrial life forms[1]. In the biogeochemical P cycle, oceanic content is far less than that on land, due to low solubility of phosphate minerals to seawater[2]. On earth, major mineral containing P is apatite [$Ca_5(PO_4)_3$-(F,Cl,OH)] as over 95% of P in the crust is included[3]. Few studies suggest supply source of P as meteorites or other terrestrial minerals but their contributionto early chemical evolution is still under debate[4]. Under ocean floor near hydrothermal vent sites, pool of liquid carbon dioxide (CO_2) was found[5,6]. Liquid CO_2 has unique hydrophobic property as a solvent, which can dissolve various hydrophobic compounds that are in many cases insoluble to water[7]. It is plausible that similar liquid CO_2 reservoir existed at hadean Earth, due to higher CO_2 concentration in the atmosphere[8] and deeper ocean compared to today. Apatite, insoluble to seawater, is known to dissolve in CO_2 rich brines[9] and may dissolve in liquid CO_2 as well. However, the distribution of phosphorus in CO_2 rich system in deep sea is not known, including those derived from apatite. In this study, distribution of apatite derived phosphorus and phosphorus in saturated water was constructed in liquid CO_2-water system and were analysed.

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