

Phosphorus inactivation by Aluminum in lakes and sediments

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Non-calcareous, phosphorus (P)-rich lake sediments typically release P associated with iron hydroxide (Fe(OH)₃) during the development of hypolimnetic anoxia. Naturally or artificially elevated concentration of aluminum hydroxide (Al(OH)₃) in such sediments can prevent the P release [1, 2], provided the Al(OH)₃ to Fe(OH)₃ ratio is >3 [3], because Al(OH)₃ provides an additional redox-insensitive sorption capacity to sediments. The high Al(OH)₃:Fe(OH)₃ ratios are typical for sediments of (i) atmospherically acidified lakes with elevated terrestrial export of ionic Al (Al_i), (ii) lakes treated with Al salt, and (iii) alpine lakes with high erosion of aluminosilicate soil [3]. High Al(OH)₃ concentrations may occur in sediments of circum-neutral forest lakes, with little Al_i input, but receiving organically-bound Al (Al_o) [4].

Palaeolimnological data on a ~14,000-yr sediment from Plešné Lake (Czech Republic) suggest that photochemical liberation of Al_o [5] has been a significant natural source of Al_i for the lake, and Al(OH)₃ for its sediments throughout the Holocene [4]. The Late Glacial sediment had most P associated with Fe(OH)₃, calcite, or apatite, and would have released P during anoxia. The Holocene sediment had negligible P release during anoxia, because P was immobilized by Al(OH)₃. The P-sorption characteristics of sediment changed due to soil formation in the de-glaciated watershed. Soil organic acids bound and carried Al_o to the lake, where it was liberated by solar radiation. Similar sediment composition of lakes in Maine (USA) [2] suggests that this P-immobilizing process is general.

[1] Kopáček *et al.* (2004) *Limnol. Oceanogr.* **49**, 1202–1213.

[2] Lake *et al.* (2007) *Sci. Total Environ.* **373**, 534–541.

[3] Kopáček *et al.* (2005) *Environ. Sci. Technol.* **39**, 8784–8789. [4] Kopáček *et al.* (2007) *Limnol. Oceanogr.* **52**, 1147–1155. [5] Kopáček *et al.* (2006) *Environ. Sci. Technol.*

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Mineralogy of natural diamond-forming fluids

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Fluids parent to diamonds are elusive and can be directly studied only when trapped in rare diamond inclusions. We present data on the geochemistry and mineralogy of fluids hosted by 20 fibrous diamonds from Kongo. The fluids are in sub-micron inclusions that range in composition from silicic to carbonatitic. X-ray diffractometry is proven to be the most effective tool for an integral mineralogical analysis of the entire volume of included diamonds. Using XRD patterns, compositional trends, FTIR and Raman techniques, we significantly expanded the list of minerals that may precipitate from diamond-forming fluids. Most common phases in the fluid are found to be phlogopite, complex Na-Ca-Mg-Fe carbonates, apatite, KCl brine and gaseous CO₂. Other minerals occurring in lower abundances include hydrated micas and other sheet silicates, carbonate hydrates, Ca-Al-Fe oxide carbonate hydrate, Na chlorate hydrate, and several hydrous aluminosilicates. The majority of the diamonds contains CH₂ groups bonded to sp³-hybridized carbon. We suggest the hydrocarbons are associated with carbonate minerals in inclusions as 1) Diamonds with high CH₂ peaks are lower in SiO₂, K₂O, have higher contents of CaO, MgO and FeO, and higher intensities of IR carbonate peaks; 2) CH₂ peaks are often reported in IR patterns of gem-quality inorganic carbonates. A wide range of hydrous and carbonate minerals found in the fluid is preserved due to high activity of H₂O and CO₂ locked by the host diamond.