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Graphite paradox in Baikal geyserite paleovalley, Russia

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Abstract

Natural graphite, a polygenic mineral, is a product of regional, contact, impact metamorphism, and magmatic or fluid deposition. In fluid-deposited graphite, aqueous C-O-H systems play a special role in determining the characteristics of hydrothermal products by shifting the chemical equilibrium. From this viewpoint, the recently discovered carboniferous mineralization in the Baikal hydrothermalites has attracted increasing interest with regard to graphite crystallization under the influence of low-pressure low-temperature (LPLT) carboniferous H_2O-rich fluids. Herein, we studied graphite mineralization in the geyserites and travertines of the Baikal geyserite paleovalley (Eastern Siberia, Russia) by applying a multitude of mineralogical studies. Optical, scanning, transmission electron, and atomic force microscopy, energy-dispersive spectroscopy, Raman spectroscopy, and carbon isotopic composition analyses of graphite, carbonate carbon, and oxygen in both the hydrothermalites and host rocks were conducted. The obtained results revealed several peculiar features regarding the graphite in geyserites and travertines. We found that Baikal graphite, earlier predicted to be a product of hydrothermalites, generally occurs as a relict graphite of the host metamorphic rocks with partial in situ redeposition. The newly formed LPLT fluid-deposited graphite is characterized by micrometer- and submicrometer-sized idiomorphic crystallites overgrown on the relict metamorphic graphite seeds and between calcite sinter zones during the last stage of travertine formation. The results present additional valuable data for understanding the mechanism, range of the formation conditions, and typomorphism of fluid-deposited graphite with probable crystallization from carbon solution in the C-O-H system at LPLT conditions.

Keywords: Graphite, geyserite, travertine, hydrothermal conditions, C-O-H fluid, fluid deposition, paleovalley, Baikal rift zone