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Graphite Re-Os Dating

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Natural graphite is one among a handful of critical materials used in emerging technologies, such as lithium-ion batteries. In order for the supply of natural graphite to keep a pace with growing demand new graphite deposits will have to be discovered [1]. However, the search and discovery of such occurrences has hitherto been limited by a lack of graphite chronology information pertinent for understanding ore field relationships. Without this direct information, the timing of graphite mineralizing events have been inferred from other minerals in adjoining host rock materials, which may not be part of the same paragenetic assemblage.

Here we showcase recent developments for age dating natural graphite using the Re-Os decay system [2]. We begin by investigating the Re contents for graphites (n = 17) formed in metamorphic, hydrothermal, and meteoritic environments. In all three cases, graphite Re abundances exceed upper continetal crustal (UCC) Re values but are analagous to Re values found in terrestrial sulfides, organic-rich sedimentary rocks, and hydrocarbons.

A subset of these graphites (n =3) were selected for graphite Re-Os dating. These include two hydrothermal graphite samples formed in lower-crustal shear zones (Wollaston-Mudjatik Transition [Gr_{WMT}], Canada]) and tanzanite-tsavorite gemstone deposits (Merelani Hills [Gr_{MH}], Tanzania) and one metamorphic graphite sample formed in the Franciscan subduction zone (Laytonville Quarry [Gr_{LQ}], USA).

High-precision Re-Os graphite dates were obtained (Gr_{WMT} = 1731.52 ± 7.43 Ma; Gr_{MH} = 586.89 ± 2.39 Ma; Gr_{LQ} = 161 Ma]) from all three samples. These graphite Re-Os dates are consistent with the inferred formation ages of graphite mineralization constrained by other techniques. The success of the graphite Re-Os dating method now allows for the possibility of other graphite deposits to be constrained and their formation models tested within a robust temporal framework.

[1] Olson et al. (2016)

[2] Toma et al. (2022)