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Direct Dating of the Mineralization by the Single Grain (U,Th)-He Pyrite Geochronology

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Genetic models which are based on the geodynamical settings are essential for exploration strategy. The age of mineralization is one of the most effective ways to link the hydrothermal process to the geological settings. Routine dating of hydrothermal events is complicated by the lack of proper minerals for geochronological studies.

Pyrite is abundant in most of the Au, Ag, Cu, Pb, Zn, Sn, W, and Mo deposits and is known to be crystallized at different stages of ore formation. Therefore, pyrite geochronology has a range of potential applications, which include dating of ore replacement and remobilization events. However, the wide use of Re-Os, Rb-Sr, Sm-Nd, and Ar-Ar isotope systems for the dating of pyrite is limited by several isotope-geochemical reasons related to low concentrations of parental isotopes.

Recent advances in understanding the He thermal retentivity in pyrite allow us to propose this mineral as a (U,Th)-He geochronometer [1]. Single grain (U,Th)-He pyrite dating was successfully tested on several deposits [2,3].

Herein we would like to present and discuss the capabilities of this technique to study ore processes on the example of several gold deposits located in Russia. Based on >70 measurements of (U,Th)-He pyrite ages from these localities we can conclude that this approach is a powerful tool to study the chronology of hydrothermal impulses within the ore-bearing areas.

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1. Yakubovich et al. *Petrology* **2019**, *27* (1), 59–78.

2. Yakubovich et al. U-Th-He Geochronology of Pyrite from the Uzelga VMS Deposit (South Urals)—New Perspectives for Direct Dating of the Ore-Forming Processes. *Minerals* **2020**, *10* (7), 1–20.

3. Yakubovich et al. U-Th-He Geochronology of Pyrite from Alteration of the Au-Fe-Skarn Novogodnee-Monto Deposit (Polar Urals, Russia)—The Next Step in the Development of a New Approach for Direct Dating of Ore-Forming Processes. *Geosciences* **2021**, *11* (10), 408.