

Precise hematite (U-Th)/He age determinations using a multi-aliquot method

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The (U+Th)/He method is developing as useful chronometer of iron oxide formation, capable of determining the timing of ore deposit formation and transient hydrothermal events associated with faulting, as well as regional climate histories. The application of the technique is hampered by natural diffusive and recoil loss of ⁴He, and the partial loss of U and/or Th during the He analysis process. We have used a multi-aliquot method to obtain precise (U+Th)/He ages of hematite from Cenozoic hydrothermal systems where cogenetic adularia Ar/Ar ages can be determined. The technique relies on the separate measurement of ⁴He and ²³⁸U+²³²Th concentrations in 3-6 aliquots of ~5 mg of homogenized hematite. Average He and (U+Th) concentrations typically vary by ±2-3%, thus sample (U+Th)/He ages are typically ±5%.

Six samples of specular hematite from the Rio Marina mine, Elba yield an average age of 5.26 ± 0.20 Ma (2σ). The isochron age (5.30 ± 0.03 Ma 2σ) is considerably more precise, and demonstrates that the hematites contain no significant trapped non-radiogenic He. These ages are consistent with the K/Ar age of cogenetic adularia (5.32 ± 0.11 Ma; Lippolt et al. 1995) providing a good indication that He loss is insignificant and that (U-Th)/He method is a high precision dating tool for Cenozoic hydrothermal and supergene from hematite.

Reference: Lippolt, H.J., Wernicke, R.S., and Bähr, R., 1995. Paragenetic specularite and adularia (Elba, Italy): Concordant (U+Th)-He and K-Ar ages. *Earth Planet. Sci. Lett.* 132, 43-51.