

Chronology of weathering periods by supergene goethite (U-Th)/He dating in the Oriental High Atlas, Morocco.

MICHÈLE VERHAERT^{1*}, CÉCILE GAUTHERON², ALAIN BERNARD³, AUGUSTIN DEKONINCK¹, YVES MISSENARD², JOHAN YANS¹

¹ University of Namur, ILEE, Belgium (*correspondence: michele-alexandra.verhaert@unamur.be)

² University Paris-Sud Orsay, UMR CNRS-UPS 8148, France

³ Université Libre de Bruxelles, Laboratory of Mineralogy and Applied Geochemistry, Belgium

The application of (U-Th)/He dating to iron oxihydroxides recently renewed the interest in supergene ore deposits chronology. The (U-Th)/He method is based on the accumulation of ⁴He produced during the alpha decay of U and Th that are usually contained in traces in various minerals, and offers the potential to date supergene minerals over a range of timescales, up to hundreds of Ma. Goethite and hematite, especially, are ubiquitous in supergene deposits and precipitate in surface conditions that are favorable for slow He diffusion and thus He retention over geological ages, which makes them ideal candidates for (U-Th)/He dating.

To better understand the development of supergene profiles, we have performed goethite (U-Th)/He dating on samples collected in the Oriental High Atlas (Morocco), in the oxidized Pb-Zn-Cu-V-Fe ore deposits of Jbel Haouanit, Jbel Klakh, and Jbel Rhals. The Jbel Klakh and Jbel Rhals samples respectively yielded reproducible ages of ca. 15-20 and 1.5-2.5 Ma. Jbel Haouanit results show some variations, with ages of ca. 4-5.5 and 10.5-11.5 Ma. We speculate that these variations could be related to the polycrystalline structure of these samples and/or to the continued growth of these minerals through contact with groundwater long after initial precipitation. These new ages correlate with geodynamical events recently defined by Leprêtre et al. (2015) in the High Atlas during the Cenozoic: 1) late Eocene, 2) early to middle Miocene, and 3) Pliocene to present. Our data in the Moroccan High Atlas do confirm that goethite (U-Th)/He dating is a reliable tool to date the weathering processes/periods, and that this method may be useful for dating mineralizations related to recent crustal movements.

References: Leprêtre, Missenard, Saint-Bezar, Barbarand, Delpech, Yans, Dekoninck & Saddiqi (2015), *Journal of African Sciences* 109, 177-194.