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Novel in situ Rb-Sr constraints on the timing of early diagenesis and pre-metamorphic alteration history from the Lubambe-Mingomba deposit, Central African Copperbelt

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Recent advances in laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS/MS) technology now allow for µm-scale in-situ Rb-Sr dating of detrital, authigenic and metamorphic minerals within sedimentary basins providing valuable insights into depositional ages, constraints on diagenetic and isotopic overprinting and timing of deformation. These advances now allow for the rapid and spatially resolved reconstruction of the petrochronological history of complexly altered sedimentary basins.

One such complexly altered sedimentary basin is the Central African Copperbelt (CACB) of Zambia and Democratic Republic of the Congo (DRC) which is characterised by a long-lived fluid flow and alteration history driven by hypersaline brines [>30wt% Ca-K-Na(Cl)] [1]. Previous attempts to resolve depositional ages and timing of diagenesis by targeting silicates in the CACB with conventional Rb-Sr geochronology have largely returned syn- to post-metamorphic cooling ages [2]. Here we apply the in-situ Rb-Sr technique to silicates from early to late Tonian (880-765Ma) sequences at Lubambe-Mingomba (formerly known as Lubambe Extension) Cu-Co orebodies as a pilot study to constrain timing of early diagenesis and better understand pre-kinematic hydrothermal alteration in the CACB.

Petrographically-constrained spot (67µm) analysis targeting primary textures in the cores of fluid-altered K-feldspar clasts yielded well-defined detrital (1.8-1.3 Ga) ages in agreement with ages from local basement complexes. Further characterization of altered-hydrothermal K-feldspars yield early to late Tonian ages (0.76-0.71 Ga) which coincides with interpreted rifting [3] and likely synchronous with diagenetic-hydrothermal alteration. Later hydrothermal K-feldspars yield ages likely synchronous with the onset of basin inversion (0.65-0.63 Ga) and syn- to post-metamorphic (0.53-48 Ga) growth/resetting [3]. Conversely, authigenic phlogopite and illite yield distinctly younger dates (0.46-0.53 Ga) likely reflecting cooling ages and isotopic re-equilibration.

Overall, the data presented here demonstrate the utility of in-situ Rb-Sr geochronology in reliably constraining detrital and early diagenetic age information previously obscured by significant syn-metamorphic overprinting. We also evaluate the potential for using the Rb-Sr method to constrain timing of mineralization from silicate phases that are petrographically concomitant with sulphides.

References:
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[2] Torremans et al., (2018) Solid Earth 9:1011-1033
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