EGU2020-19851, updated on 26 Oct 2020
https://doi.org/10.5194/egusphere-egu2020-19851
EGU General Assembly 2020
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Are protracted timescales of magmatism documented in the Platreef, Bushveld Complex?

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Models for the formation of the Rustenberg Layered Suite of the Bushveld Igneous Complex continue to be debated. The consensus timescale over which magmatism took place has reduced hand in hand with advancements in geochronological techniques and data precision. The most recent studies by double spiked (^{202}Pb-^{205}Pb) zircon CA-ID-TIMS U-Pb have indicated emplacement in less than 1 Myrs [1][2]. Increasing analytical precision has also seemingly permitted individual magmatic layers to be resolved, leading to the "out of sequence sill" emplacement model [2], albeit contested [3].

We present two new high-precision zircon dates obtained from two continuous core intervals collected <4m apart in a single Ni-Cu-PGE rich pyroxenite unit in the Turfspruit section of the Platreef, Northern Limb of the Bushveld Complex [4]. Grobler et al. [5] correlate this pyroxenite with the Merensky Cyclic Unit of the Upper Critical Zone in eastern and western limbs. Assuming the recommended zircon ^{238}U/^{235}U of Hiess et al. [6] without uncertainties propagated as per previous studies e.g. [1][2], the age interpretations of these two samples define a minimum and maximum temporal interval between 1.01 ±0.16 Myrs and 1.28 ±0.22 Myrs that brackets, or overlaps with, the entirety of previous dates from all preceding studies. The pyroxenite is continuous, without intrusive contacts, and the stratigraphically lower sample produces an apparently younger zircon age than the overlying sample. It seems highly unlikely the entire longevity of the Bushveld's magmatic evolution was apparently captured within this 4 m section. Therefore, it now seems highly improbable that the Bushveld was emplaced and cooled in less than 1 Myrs, as the current paradigm states [1].

The older date from the Platreef now aligns the isotopic age relationships with the field observations of the overlying Main Zone, in contrast to the interpretation of Mungall et al. [2]. The new dates alone neither support nor contradicts the "out of sequence" sill emplacement model. Rather they merely indicate that melt related process that crystallised zircon was protracted within narrow vertical intervals, and that future work should acknowledge this potential complexity. It raises questions which age of event(s) introduced or modified sulfides within the ore bearing horizon. This requires greater integration of the geochronological record with ore textures at a

high sampling density.

However, there also remains a substantial, yet previously overlooked caveat to all geochronological interpretations presented thus far; “out of sequence” sills in particular. This caveat is that the variations in the $^{238}U/^{235}U$ between samples over observed magnitudes of variations in zircon [4] could account for any offsets in $^{207}Pb/^{206}Pb$ dates interpreted as real temporal differences. This issue remains to be tested.

References:

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