In situ U-Pb geochronology on garnet and rutile: New age data from the Palaeoarchaean Onverwacht Group, Barberton Greenstone Belt, South Africa.

Valby van Schijndel\textsuperscript{1}, Kathryn Cutts\textsuperscript{2}, Gary Stevens\textsuperscript{3}, Cristiano Lana\textsuperscript{2}, and Thomas Zack\textsuperscript{4}

\textsuperscript{1}University of Potsdam, Institute of Geosciences, Potsdam, Germany (vanschi@uni-potsdam.de)
\textsuperscript{2}Universidade Federal de Ouro Preto, Department of Geology, Ouro Preto, Brazil (kathryn.cutts@gmail.com; cristianodeclana@gmail.com)
\textsuperscript{3}Stellenbosch University, Department of Earth Sciences, Stellenbosch, South Africa
\textsuperscript{4}University of Gothenburg, Department of Earth Sciences, Gothenburg, Sweden

The Barberton Greenstone Belt (BGB) is a well-preserved remnant of Paleo- to Mesoarchean crust. The oldest supracrustal rocks of the BGB consist of the 3.5-3.3 Ga Onverwacht Group. These rocks form a NE-SW trending belt deformed and metamorphosed largely under lower greenschist-facies conditions. In the southern BGB, the Komati Fault separates the structurally uppermost, lower greenschist-facies Onverwacht Group from its stratigraphically lowest components - the Sandspruit and Theespruit Formations (hereafter referred to as Lower Onverwacht Group), which occur south of the Komati Fault and have been metamorphosed under high-pressure amphibolite-facies conditions. The Lower Onverwacht Group rocks occur as a band along the southern edge of the greenstone belt and as septa between several ca. 3.55, 3.45 and 3.23 Ga Tonalite-Trondhjemite-Granodiorite plutons. The Lower Onverwacht Group rocks record a complex history of metamorphism and retrogression. An early phase of amphibolite-facies metamorphism is recorded at ca. 3.44 Ga by monazite in metasediments, whilst the main phase of the regional metamorphism occurred at ca. 3.23 Ga (e.g. Cutts et al., 2014).

The rocks targeted in this study have felsic metavolcanic protoliths and occur as a greenstone remnant within deformed and undeformed phases of 3.45 Ga Trondhjemites. They contain cm-sized garnets and the mineralogy of the samples indicate amphibolite-facies peak metamorphism. The garnets show major element growth zonation from core to rim (\textit{Alm}_{0.63-0.86}\textit{Grs}_{0.15-0.08}\textit{Pyr}_{0.05-0.09}\textit{Sps}_{0.17-0.03}). U-Pb rutile geochronology gives an age at 3.15 Ga and Zr-in-rutile thermometry yields a temperature of ca. 640 °C (at 5 kbar). The rutile grains contain small, pristine zircon inclusions and the rutile is assumed to have grown in equilibrium with both zircon and quartz as buffer phases. The amphibolite-facies assemblage and the Zr-in-rutile temperature indicate that the rutile dates are cooling ages, which are difficult to interpret without information on the age of peak metamorphism of the samples. The objective of this study is to attempt to elucidate the early metamorphic record of these samples by directly dating the large garnet grains using in situ U-Pb laser-ablation inductively-coupled-plasma mass-spectrometry geochronology. Ongoing research shows that low-U garnet is datable by this method (Albert Roper...
et al., 2018). Preliminary results have been obtained from a different Lower Onverwacht Group sample, yielding a 3.45 Ga age for the garnet core and a 3.22 Ga age for the garnet rim (Cutts et al., unpublished data). The results indicate that U-Pb in rutile and in garnet from Archaean greenstones can be used in order to date metamorphic events. This is especially relevant when other potential datable accessory minerals, such as zircon or monazite, are not present.

References
