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Zircon ages and Hf-O isotopes of the Stolzburg and Honingklip plutons in the southern Barberton Granitoid-Greenstone Terrane, South Africa: Implications for tectonic processes

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The Barberton Granitoid-Greenstone Belt (BGGB) is one of the typical localities for early Archaean granitoid-greenstone tectonics, and models of crustal evolution proposed for this region have found widespread applicability in Archaean terranes elsewhere [1]. Two contrasting views were proposed for early Archaean tectonic styles of the BGGB, namely horizontal plate interaction versus vertical movements [2,3,4]. In the former model, the BGGB was suggested to have formed through subduction of the southeastern terrane beneath the northwestern terrane along the inferred Saddleback-Inyoka-Inyoni suture at ca. 3.2 Ga. The occurrence of ca. 3.2 Ga local high-pressure metamorphic rocks in the Badplaas-Stolzburg granitoid domains flanking the greenstone belt has been used to support the subduction model [3]. In the alternative model, the dome-and-keel architecture of the BGGB was interpreted as the result of diapir-driven crustal convection [4]. However, the published emplacement ages (ca. 3.45 Ga) of TTG plutons in the Stolzburg domain are a significant obstacle to the interpretation that the dome-and-keel architecture was the result of greenstones sinking between rising domes of TTG crust at ca. 3.23 Ga, coeval with the regional metamorphism [2,4]. Here, we report an integrated study of zircon U-Pb ages and Hf-O isotopes for the Stolzburg and Honingklip plutons in the Stolzburg domain of the BGGB. Multiple granitoid phases can be identified in the Stolzburg pluton, and two main phases were dated in this study. Granitoids of the older phase have gneissic structure and medium- to coarse-grained texture. Zircons are short-prismatic, display oscillatory zoning in CL images, and have high Th/U ratios and are thus clearly of magmatic origin. SIMS U-Pb dating yielded a weighted mean $^{207}Pb/^{206}Pb$ age of 3442 ± 5 Ma, which is interpreted as the emplacement age of the older phase. Granitoids of the younger phase are weakly deformed and display a fine-grained texture. Zircons are long-prismatic, also show oscillatory zoning in CL images and are of magmatic origin. They provide a weighed mean $^{207}Pb/^{206}Pb$ age of 3226 ± 4 Ma, which reflects the emplacement age of the younger phase. Most zircon grains from the Honingklip pluton exhibit oscillatory zoning in CL images, suggesting single-stage magmatic growth. These zircons define a weighed mean $^{207}Pb/^{206}Pb$ age of 3224 ± 10 Ma. A few grains contain inherited cores with $^{207}Pb/^{206}Pb$ ages of ca. 3460 Ma. The older granitoids of the Stolzburg pluton have mantle-like zircon $\delta^{18}O$ values of +5.4 ± 0.2 ‰ and slightly negative $\varepsilon_{Hf}(t)$ values of -1.0 ± 0.3. The younger granitoids of the Stolzburg and Honingklip plutons have high zircon $\delta^{18}O$ values of +6.6 ± 0.2 ‰ and +7.0 ± 0.3 ‰ as well as negative $\varepsilon_{Hf}(t)$ values of -2.5 ± 0.3 and -2.0 ± 0.3, respectively, which indicate significant crustal reworking of the Stolzburg domain at ca. 3.23 Ga. These multiple episodes of magmatism imply that the Stolzburg domain may have been relatively hot and thus not rigid enough to be subducted at ca. 3.2 Ga. Combined with previous data, we suggest that the ca. 3.2 Ga magmatism occurred simultaneously on both sides of the inferred Saddleback-Inyoka-Inyoni suture, which is inconsistent with the subduction model proposed by Moyen et al. [3].

References:

[1] Anhaeusser CR (2014) J African Earth Sci 100: 684–732
[2] Brown M (2015) Geol Soc Am Bull 127: 1550–1557
[3] Moyen J -F et al. (2006) Nature 442: 559-562
[4] Van Kranendonk MJ (2014) Precambrian Res 254: 19-35