Temporal variation in average zircon saturation temperature over last 4 Gyr

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As a ubiquitous, refractory, readily datable accessory mineral, zircon has become a standard mineral tracer of magma crystallization, crust production, and detrital provenance. However, zircon abundance in the geologic record is a function of zirconium abundance and magma composition, neither of which are necessarily constant over geologic time.

Following on the results of [1], we have examined variations in zircon saturation in average crustal lithologies over the past 4 Gyr through weighted bootstrap resampling of a database of several hundred thousand whole-rock geochemical analyses, using the empirical zircon saturation temperature equations of [2]. The results show that decreasing average extent of mantle melting has lead to increasing Zr content and decreasing M-value for magmas of a given range of silica contents over Earth history. The subsequent increase in average zircon saturation temperature predicts a major increase in the volume of zircon produced for a given volume of crystallized magma over Earth history. Further accentuated by higher expected solidus temperatures for many magmas in the Archean, this change in expected zircon production compounds with preservation bias to weight observed detrital zircon spectra towards the present and significantly complicates inferences of crust production from zircon age distributions. Correcting for zircon productivity should result in more accurate estimates of juvenile crust production.

Additional complications in translating from zircon abundance spectra to crustal volumes are introduced by potential variability in emplacement depth and magma water activity through time, which dramatically affect most silicate mineral solidi but have comparatively little effect on zircon saturation temperature.

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[2] Boehnke, P., Watson, E. B., Trail, D., Harrison, T. M. & Schmitt, A. K. *Chemical Geology* **351,** 324–334 (2013).