A contribution to the Archean Hf record by bulk Lu-Hf single grain analysis of zircon

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The evolution of Earth's crust-mantle system through geologic time has been investigated for many decades using initial isotope ratios of various radio-isotope systems. To circumvent the problem of open-system modification of ancient whole rocks, *in-situ* analyses of individual growth zones in zircon have been developed. This approach yields U-Pb ages and Hf initial isotope compositions for the same spot or at least for the same grain, and thus has the potential to more reliably constrain the differentiation history of the silicate Earth. However, *in-situ* methods produce εHf data of only modest precision (≥1 ε-unit), albeit at high spatial resolution. In particular, inaccurate corrections of Yb isobaric interference commonly generate scatter among calculated initial Hf isotope ratios. This makes it particularly difficult to distinguish among the early terrestrial reservoirs owing to their similar isotope compositions at the time of zircon crystallization.

An alternative approach is to select individual zircon grains without complex age zoning and determine their Hf-isotope composition by MC-ICP-MS after chemical purification of Hf. This yields high precision Hf isotope measurements with uncertainties of better than 0.3 ε-units. In addition, data scatter is drastically reduced as compared to *in-situ* analyses. Thus, the results provide a much higher resolution for differentiation processes recorded by early Archean rocks.

We applied this *bulk* Hf method to single zircon grains from the Archean Bastar Craton, India. Before digestion, the same grains were U-Pb dated with LA-ICP-MS. The oldest sample, with an age of 3.58 Ga, yields εHf = +1.60 ±0.14. Younger samples progressively yield more negative εHf values. In conjunction with a global database, the Hf isotope record indicates that only moderate amounts of continental crust formed during the Paleoarchean. Furthermore, the results highlight the potential for *bulk* single zircon Hf analysis as an alternative to *in-situ* investigations.