An outline of juvenile crust formation and recycling history in the Archaean Western Dharwar craton, from zircon *in situ* U-Pb dating and Hf-isotopic compositions

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The Western Dharwar Craton (WDC), southern India is a classic Archaean granite-greenstone terrain. The existing geochronological and isotopic data bearing upon multiple events of magmatism, greenstone belt development, deformation and metamorphism indicate an evolution between ca. 3.36 and 2.5 Ga, but preclude a clear resolution of crust forming and crustal recycling episodes. Zircon *in situ* analysis was aided by electron microprobe BSE/CL imaging and comprised U-Pb ages, estimation of U, Th, Zr, Hf, Y and Yb abundances and Hf isotopic compositions by a combination of Electron microprobe, LAM-ICPMS and LAM-MC-ICPMS (for methodology, Griffin *et al.* [1]). A large number of zircon grains from samples of: 1) fluvial quartz-arenite from the basal quartz-pebble-conglomerate unit of the Dharwar Supergroup, deposional age ca. 2.9 Ga, 2) low-Al_2O_3 tonalite gneiss from Gorur, dated previously at ca. 3.3 Ga and 3) sands from rivers draining central part of WDC at two locations.

Considering the concordant or nearly-concordant zircon ages, the combined dataset represents a range of protoliths between ca 3.63 and 2.5 Ga. The oldest age of 3634±10 Ma (2σ) corresponds to the mean of two detrital grains from the basal quartzite while rocks of this antiquity are yet unrecognised in the WDC. Initial $^{176}Hf/^{177}Hf$ ratios of these and few other zircons of marginally younger (upto ca. 3.5 Ga) ages approach chondritic composition (ε_{Hf} between +3 and +0.5) suggesting their protoliths may have incorporated older juvenile material with some crustal pre-history. Significant addition of juvenile magmas into the Dharwar crust between ca. 3.36 and 3.2 Ga is emphasized, a direct example being the Gorur tonalite gneiss, which was revisited and dated here at ca. 3346±10 Ma (2σ, ε_{Hf} between +4 and +7). Explanations for the apparent non-involvement of older crust in the genesis of these juvenile magmas remain ambiguous, possible scenarios are discussed in the light of constraints from previous geochronological data. Younger zircons (ca. $\leq$ 3.1 Ga) suggest protoliths that represent an essentially recycled crust.

[1] Griffin *et al.* (2004) *Precambrian Res.* **131**, 231-282.

REE and HFSE geochemical characteristics of pyrites in Yao'an gold deposit in Western Yunnan, China: Tracing ore forming fluid signatures

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The pattern and abundances of rare-earth elements (REE) and high field strength element (HFSE) in a hydrothermal solution could be estimated by combining appropriate experimental data with REE measurements on suitable co-existing minerals. The solubility and the liquid-solid distribution coefficients of rare earth elements are greatly increased by complexing and mobility is probably caused by complexing agents such as Cl, F, and CO_2. Experiments with Cl complexing show preferential mobilization of light rare earth elements and Eu. Complexing by either F or CO_2 has been advocated to explain preferential mobilization of heavy rare earth elements. But the recent research shows that F-rich hydrothermal fluids can still preferential mobilization of light rare earth elements, displayed by lower HFSE-LREE elemental ratios than chondrite.

The Yao'an gold deposit is spatially related to and contemporaneous with the Yao'an alkaline intrusions, located in the NW- NNW trending Ailaoshan- Jinshajiang fault zone, western Yunnan, China. The Yao'an gold deposit formed during two stages, i.e. a sulfide stage and a sulfide - oxide stage. The H, O, S, C stable isotope and REE data suggest that magmatic fluids of the alkaline intrusions caused sulfide stage mineralization of the Yao'an gold deposit. The system evolved from the sulfide stage to the sulfide - oxide stage mineralization by influx of meteoric fluids. The REE and HFSE geochemical characterization of pyrites from the Yao'an gold deposit show that REE abundance of pyrite is relatively high with strong enrichment in LREE, lower HFSE-LREE elemental ratios (Th/La, Hf/Sm, Nb/La), suggesting a Cl-rich ore forming fluid.

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