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Detrital zircon evidence for Mesoarchean continental collision in the Western Dharwar craton (India)

JULIE MALLENS[1], MARTIN GUITREAU[1], MUDLAPPA JAYANANDA[2], ABDELMOUHCINE GANNOUN[1], CLAIRE FONQUERNIE[1], EMMY VOYER[1] AND K.R. AADHISESHAN[2]

[1]Université Clermont Auvergne
[2]University of Hyderabad
Presenting Author: julie.mallens@doctorant.uca.fr

The continental crust is the oldest archive of early Earth differentiation and it almost recorded the entire evolution of our planet. In spite of numerous studies, crustal processes and Earth geodynamics remain hotly debated for crusts older than 2.5 Ga. A recent article on the Western Dharwar craton (WDC) showed that a major supracrustal belt (Holenarsipur) is composed of three independent tectonic blocs in the form of an oceanic plateau, an oceanic arc, and an oceanic crust section [1]. These blocs were assembled close to 3200 Ma which, hence, required horizontal motions to be gathered.

The present contribution aims at testing this horizontal motion hypothesis through the study of detrital zircons from a major sedimentary unit (basal oligomictic meta-conglomerate) that formed at ~3000 Ma and mark the base of the Bababudan supracrustal belt [2]. We analyzed detrital zircon crystals for U-Pb and Lu-Hf isotope systematics, using LA-ICP-MS and LA-MC-ICP-MS, in order to provide parental magma age, source information and, hence, reveal evolutionary patterns which can be discussed in terms of tectonic context [3].

Our new U-Pb and Lu-Hf isotope data for detrital zircons are consistent with available igneous zircon data from the literature and show a two-stage evolution. The first part (3430-3250 Ma) coincides with closed-system evolution of a depleted reservoir similar to an arc or a MORB mantle without long-lived pre-existing crust influence. The second part (3250-3150 Ma) exhibits concurrent sampling of a depleted source similar to arc or MORB mantle, a very depleted (refractory) mantle (time-integrated $^{176}Lu/^{177}Hf$ of 0.056), and an enriched (crustal) source. We interpret this two-stage evolution as evidence for ~200 My juvenile crustal growth followed by continental collision that resulted in “chaotic” sampling of various sources, hence, marking a major geodynamic change in WDC evolution. This collision is supported by the existence of 3150 Ma Chikmagalur (porphyritic) granite which is a crust reworking product on which the studied meta-conglomerate sits unconformably [2].

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[3] Collins *et al.,* (2011), *Nature Geoscience 4*, 333-337.