The Behavior of the U-Pb System and Trace Elements in Zircon During Contact Metamorphism: a case Study from the Kadavur Anorthosite Complex, Southeastern India

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Zircons from quartzites bordering the Kadavur anorthosite complex in southeastern India were studied by laser ablation ICP-MS to assess the behavior of their U-Pb systematics and trace element distributions during contact metamorphism. Cathodoluminescence (CL) imaging shows that the zircons consist of rounded cores surrounded by subhedral to euhedral rims, some of them separated by a mantle. The cores show weak CL and are either structure-less or show faint oscillatory, sector and patchy zoning. The rims are oscillatory zoned and the highly luminescent mantles typically show no internal structure.

The U-Pb data provide a cluster of old ages and two distinct younger populations. The older cluster comprises both concordant and discordant ages that range from 3.4 to 1.9 Ga and is only identified in the cores of zircons. The two younger populations include a group with concordant ages in the range of 990 to 850 Ma (mean of 914$\pm$22 Ma, 2σ) and a group with concordant ages from 830 to 760 Ma (815$\pm$11 Ma). These two populations are mainly found in the mantles and the rims, respectively, but also occur in some cores. The old cores are interpreted as detrital grains and the ages indicate that the sediments have Archean sources in the Western and Eastern Dharwar cratons. Discordant and 990-760 Ma ages found in the cores are interpreted to reflect partial or complete re-equilibration of the U-Pb system. Internal structures indicate that the two younger age populations represent periods of metamorphic zircon growth or complete re-equilibration of the U-Pb system in detrital grains.

Trace element measurements indicate that all zones have steep REE patterns enriched in the HREE. The cores show a large spread in REE concentrations and $(Gd/Yb)_N$, which attests to their detrital origin. The other zones show a narrow range of REE concentrations and $(Gd/Yb)_N$. The fact that the ˜815 Ma cores and re-equilibrated zones have similar REE contents indicates that the event that caused new crystallization or re-equilibration of zircon resulted in resetting of the U-Pb system and REE in preexisting cores.

Titanium-in-zircon thermometry (Ferry and Watson, 2007) yielded a range of 950 to 1150 °C for detrital cores. The mantles and rims yield 1074$\pm$18 °C (2σ) and 1073$\pm$15 °C, respectively. This indicates that the quartzites experienced at least two ultrahigh temperature events, of which the younger event at 815$\pm$11 Ma is more pronounced. This event possibly corresponds to the contact metamorphism and hence emplacement of the anorthosite body. The 914$\pm$22 Ma age population resembles early Neoproterozoic ages from the Eastern Ghats Belt, which have been interpreted to date high temperature metamorphism during Rhodinia assembly. Our study indicates that this event also affected the Eastern Dharwar craton.

References

Ferry JM, and Watson EB (2007) New thermodynamic models and revised calibrations for the Ti-in-zircon and Zr-in-rutile thermometers. Contrib Min Petrol 154: 429-437

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