# Zircon constraints on limited, fluid-deficient eclogitization of the felsic continental crust (North Muya complex, Eastern Siberia)

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Zircon isotope (U-Pb, $\varepsilon_{Hf}(t)$, $\delta^{18}O$) and trace-element composition are conventionally used as recorders and geochemical tracers of metamorphic modification of crustal lithologies. Nonetheless, mineralogical response (i.e., occurrence of high-pressure assemblages) on a whole-rock level as well as a degree of the achieved chemical re-equilibration within single zircon crystals largely depend on fluid regime on the course of prograde-to-peak evolution. In case of low- to medium-temperature felsic rocks and fluid-deficient subsolidus zircon transformation, incomplete zircon re-equilibration should be expected due to predominant dissolution-reprecipitation (*e.g.*, Martin et al., 2008). Here, we examine the behavior of zircon in garnet-free and garnet-bearing felsic (metagranitoid and metasedimentary) rocks, which are juxtaposed with a mafic kyanite eclogite in the Neoproterozoic North Muya HP complex (Siberia) (mainly up to ~650–670°C and 2.5–2.7 GPa). Zircon from a garnet-bearing granitoid, rich in apatite inclusions, preserve the original U-Pb age systematics (with the precursor granite aged at 799±4 Ma), accompanied by retained crystal morphologies, oscillatory zoning, “magmatic” geochemical signatures (high HREE/MREE ratios, negative Eu/Eu*), and narrow range of $\varepsilon_{Hf}(t)$ (+3.1±5.9) and $\delta^{18}O$ (+6.7±8.2‰). Detrital zircon from garnet-free exhibits curvilinear oscillatory zonation due to the initiating thermally-induced recrystallization, recorded in discordance of some U-Pb age estimates (mainly within 846–758 Ma). The $\delta^{18}O$ variations are quite strict (+7.7±9.2‰), whereas the variable and mostly negative $\varepsilon_{Hf}(t)$ values (-7.6±1.5) mainly reflect the heterogeneity of sedimentary sources. In a garnet-two-mica gneiss, primary zircon is preserved only as ~856–776 Ma core domains (up to 15-30% of grain volume), which in some cases experienced partial Pb loss. Most of zircon volume, however, is occupied by heterogeneous, inclusion-rich (primarily quartz, K-Na-micas and epidote, occasional garnet) recrystallization mantle ($\delta^{18}O$ = +13.8±14.6‰, one inherited core with +8.2‰) inclusions, which yield geochemical features of “eclogitic” zircon (flat MREE-to-HREE patterns, absent Eu/Eu*) and the weighted average age of 639±6 Ma. Zircon from both garnet-bearing rocks show thin, bright-CL recrystallization rims with mainly discordant U-Pb estimates and systematic $\delta^{18}O$ decrease by up to 1.6‰, but “eclogitic” trace-element signatures only in a metasedimentary garnet gneiss. We interpret this to reflect a two-stage discharge of metamorphic fluids, which, at a high-pressure stage, were low-volume and internally-sourced, and significant only in a $H_2O$-enriched protolith of a garnet gneiss. Evidence of $^{18}O$-depleted zircon recrystallization rims after both “magmatic” and “eclogitic” zircon, together with Mn enrichment of garnet rims potentially indicate a distinct metamorphic stage, which could result from heating and/or fluid infiltration linked to peak crustal stacking and thickening.

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Martin, L.A.J., Duchêne, S., Deloule, E., Vanderhaeghe, O., 2008. Mobility of trace elements and oxygen in zircon during metamorphism: consequences for geochemical tracing. *Earth and*

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