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Suprasolidus prograde zircon growth in migmatites?

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Empirical studies of zircon in migmatites document features compatible with growth during heating at suprasolidus conditions [1]. However, numerical modelling of zircon behaviour suggests that suprasolidus zircon is expected to grow only during cooling and melt crystallization [2,3]. Here, I combine phase equilibrium modelling coupled with mineral–melt Zr partitioning to reconcile the observations from migmatites with the predictions of previous numerical models of zircon behaviour in anatectic systems. In general, an equilibrium-based model that includes Zr partitioning does not allow prograde suprasolidus zircon growth. However, melting of metapelites at temperatures just above the wet solidus may allow limited zircon growth due the low solubility of zircon in melt coupled with a source of Zr from minor garnet and ilmenite breakdown (**Figure 1a**). Preservation of this zircon requires entrapment in growing peritectic minerals during subsequent heating and further melting. Heating above muscovite exhaustion in metapelites is unlikely to grow zircon due to the progressive increase in zircon solubility as well as an increasing compatibility of Zr in the residual mineral assemblage (**Figure 1b**). The modelled compatibility of Zr in the residue of a metabasite decreases during heating, but an increase in zircon solubility in melt counteracts this; prograde suprasolidus zircon growth in metabasites is unlikely. Infiltration of Zr-rich melt into a migmatite during open-system anatexis provides an additional potential mechanism for prograde suprasolidus zircon growth during high-temperature metamorphism. However, fluid-fluxed melting reactions are unlikely to produce prograde suprasolidus zircon.

[1] Hermann & Rubatto (2003). Journal of Metamorphic Geology, 21(9), 833–852.
[2] Kelsey, Clark & Hand (2008). Journal of Metamorphic Geology, 26(2), 199–212.
[3] Kohn, Corrie & Markley C (2015). American Mineralogist, 100(4), 897–908.

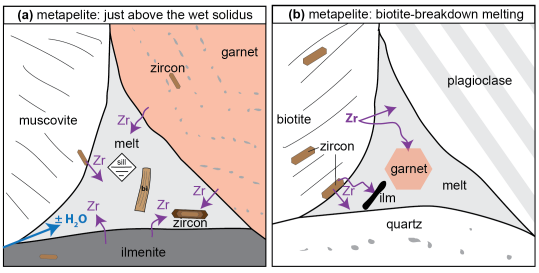

Figure 1. Schematic diagram showing the potential sources and sinks for Zr during heating and partial melting. **(a)** Low-temperature partial melting of a metapelite may result in oversaturated melt (with respect to zircon) and liberation of Zr from garnet and ilmenite breakdown could lead to zircon growth in melt during heating. **(b)** High-temperature melting of a metapelite results in undersaturated melt and the generation of the Zr-rich peritectic minerals garnet and ilmenite. New zircon growth is not expected during biotite-breakdown melting.