ZIRCON SATURATION TEMPERATURES, PRESERVATION OF INHERITED ZIRCON, AND TEMPERATURES OF MAGMA GENERATION: IMPLICATIONS OF A PARADOX

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It is commonly assumed that magmas carrying inherited zircon with magmatic overgrowths were zircon-saturated throughout their histories. Furthermore, it appears likely that zircon fractionation does not affect Zr concentration enough to strongly modify calculated saturation T (TZr; Watson & Harrison, 1983) - hence, TZr's provide estimates of conditions of magma generation. Most TZr's for granitoids with inheritance (including trondhjemites, granodiorites, tonalites) are ~700-800*C. Although reasonable for very felsic magmas, these T's are markedly lower than those considered likely for magma generation. Extensive crustal melting producing mobile magma is thought to require T sufficient for biotite dehydration (~850* or more). Explanations for discrepancy between TZr and likely initial magma T include: (1) Unsatisfactory calibration of the thermometer; (2) depression of Zr by fractional crystallization; (3) persistence of zircon in undersaturated melts; (4) occurrence of biotite dehydration at lower T than suggested by experiments; (5) generation of magma by lower T mechanisms. Although all are plausible, perhaps the most reasonable suggestion is that crystals are entrained and survive in zircon-undersaturated melts. Dissolution rates of zircon permit survival in undersaturated melts for tens of thousands of years (cf. Watson, 1996). If grains are armored by other minerals or if the magma does not remain above TZr for long, inherited zircons may be preserved. An intriguing possibility is that zircons enclosed in biotite survive protracted early stages of melting; with extensive biotite dehydration, zircons are released, melt fraction increases rapidly, and mobilized magma ascends quickly and cools below saturation T.