Shaping the Pb Isotope Compositions of Anatectic Melts by Differential Dissolution of Zircon Versus Monazite

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Abstract: How the dissolution of accessory phases (e.g. zircon, monazite, and apatite) affects the radiogenic isotope (Sr, Nd, Hf, and Pb) compositions of melts derived from metasedimentary sources is one of the outstanding issues in isotope geochemistry (Watson and Harrison, 1984; Zeng et al., 2005). The Mid-Miocene leucogranites along the Himalayan orogenic belt are dominantly derived from fluxing-melting (Group-A) and muscovite dehydration melting (Group-B) of metasedimentary sources (Gao et al., 2017; Zeng and Gao, 2017). As compared with those in Group-B leucogranites, Group-A rocks are characterized by elevated Sr and Ba concentrations, but lower Sr as well as Hf isotope compositions. New Pb isotope data show that at similar age of crystallization, melts derived from fluxing melting are characterized by elevated $^{208}Pb/^{204}Pb$ (>39.56), and Th/U (>3.0), in contrast, dehydration melting ones by lower $^{208}Pb/^{204}Pb$ (<39.46) and Th/U (<2.0). Such a feature could be understood by considering the contrasting behavior of zircon (high U, low Th, and low Th/U and $^{208}Pb/^{204}Pb$ ratios) and monazite (low U, high Th and hence high Th/U and $^{208}Pb/^{204}Pb$ ratios). At similar P-T conditions, presence of free water enhances the dissolution of monazite and in turn elevates the melt's Th/U and $^{208}Pb/^{204}Pb$ isotopic compositions, whereas it has minor effects on the dissolution of zircon grains during partial melting of metasedimentary rocks.

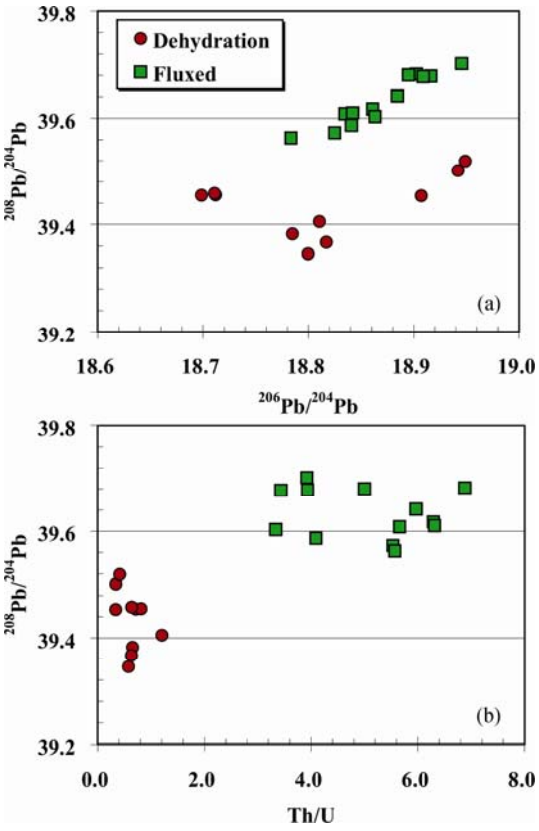

Fig. 1. Co-variation diagrams showing the relationship of (a) $^{208}Pb/^{204}Pb$ and $^{206}Pb/^{204}Pb$ and (b) $^{208}Pb/^{204}Pb$ and Th/U ratios in the Mid-Miocence Himalayan leucogranites.

Key words: leucogranite, Pb isotope, partial melting, accessory phase

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