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LITHIUM ISOTOPIC CONSTRAINTS ON THE ORIGIN OF I- AND A-TYPE GRANITES FROM EAST JUNGGAR (NW CHINA) OF THE CENTRAL ASIAN OROGENIC BELT: IMPLICATIONS FOR LI ISOTOPIC FRACTIONATION DURING CRUSTAL ANATEXIS

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Though Li isotope fractionation during mantle melting and differentiation of basaltic melts have been proved insignificant, Li isotopic systems during crustal processes remain unclear. To study this, we report combined petrological, Nd-Sr and Li isotopic data for the late Paleozoic coexisting I- and A-type granites in the East Junggar orogen of the Central Asian Orogenic Belt. The granites were formed responding to underplating of mafic magmas in the lower crust in a post-collisional, extensional regime, and intruded into the Paleozoic foldbelts that formed due to extensive oceanic subduction-accretion processes.

The I-type granites have equally important calcic hornblende and biotite, and contain minor but widespread mafic microgranular enclaves (MME). They show chemistry typical of calc-alkaline granites, e.g., SiO₂=60–70 % and CaO=1.9–5.0 %, and are characterized by MORB-like Nd-Sr isotopes, with $\epsilon_{Nd}(t)=5.9–6.3$, and $I_{Sr}=0.70355–0.70446$, and the two figures for MMEs are $\sim+6.5$ and $0.70355–0.7041$, respectively. These features, along with the textures and mineral chemistry, suggest the I-type granites formed mainly from partial melting of the deeply-buried Paleozoic metabasites, and subordinately from mixing of post-

collisional mafic magma in the source. The younger alkaline granites include biotite- and hornblende A-types. The biotite A-types are characterized by the occurrence of annite (without hornblende), and the hornblende A-types by sodic hornblende (arfvedsonite) and scarce Fe-rich biotite. The two categories of A-type granites show high SiO_2 (74–78 %), very low MgO, CaO, Al_2O_3 , Ba and Sr, and have Nd isotopic compositions comparable to those of the I-types, but the biotite A-types show Rb, K_2O and Li higher than the hornblende A-types. These features suggest that the biotite A-types originated from melting of an equivalent to the I-type granites, controlled by biotite dehydration melting, and the hornblende A-types from re-melting of the granulitic residue after extraction of the biotite A-types controlled mainly by hornblende dehydration melting.

The I-type granites have Li=35–47 ppm and $\delta^7\text{Li}=+3.0\sim+3.7$ ‰, and the two figures for MME are 52–88 ppm and $+1.4\sim+2.2$ ‰. The biotite A-type granites have Li (54–141 ppm) and $\delta^7\text{Li}$ ($+3.6\sim+4.6$ ‰), which are significantly higher than the hornblende

A-types (50–61 ppm and $+2.6\sim+3.5$ ‰, respectively). Modeling using the Rayleigh dehydration melting model supports the formation of I-type granites by mixing of a metabasite-derived granitic melt with small amounts of mafic magma, and the inferred granite melt is predicted to have $\delta^7\text{Li}=+5$ ‰, suggesting a measurable Li isotopic fractionation during the melting of metabasites. Also, modeling suggests that melting of equivalent to the I-type granites can form a granite melt with Li=70–126 ppm and $\delta^7\text{Li} = +3.7\sim+4.7$ ‰, and re-melting of the granulitic residue at higher temperatures can yield a granite melt with Li=51–78 ppm and $\delta^7\text{Li}=+2.8\sim+3.6$ ‰, which are largely comparable to those of the biotite A-type and hornblende A-type granites, respectively. Our new data suggest that (1) crustal anatexis via dehydration melting of hydrous phases can produce small but notable Li isotopic fractionation, thus Li isotopes of granites cannot be used to directly reflect the source, and (2) A-type granites can be produced by dehydration melting of biotite- and/or hornblende-bearing I-type granites.