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Petrogenesis of high Sr/Y leucogranulites in the Liangcheng area, central-northern margin of the North China Craton



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The leucogranulites occur as stocks in the Liangcheng area in the central-northern margin of the North China Craton. They are relatively homogeneous with some clots of Al-rich mineral (grt, sil) and irregular schlieren of sil-bi-grt-bearing granulites and spl-grt granulites. The leucogranulites are characterized by inequigranular textures and mylonitic deformation. They mainly consist of garnet, mesoperthite, quartz, K-feldspar, plagioclase with minor biotite, sillimanite, spinel, ilmenite and zircon. Large (0.5-2 mm) garnet and mesoperthite porphyroclasts are surrounded by the finer-grained (0.01-0.1 mm) quartzo-feldspathic matrix.

SIMS zircon U-Pb results suggest that the protolith of leucogranulites were emplaced at ~1.95 Ga, subsequently were metamorphosed at ~1.92 Ga. The abundant inherited zircons yield nearly concordant ²⁰⁷Pb/²⁰⁶Pb ages ranging from 1.95 to 2.2 Ga. Different types of zircons (inherited, magmatic and metamorphic zircons) have similar $\delta^{18}\text{O}$ values of 7.2-9.2 ‰, which is lower than that of metamorphic zircons (10.0-12.0 ‰) from surrounding metasediments.

The leucogranulites are characterized by: (1) high SiO₂ (72.7-73.7 wt%), low FeO_t+MgO (0.98-1.66 wt%) and relative high CaO contents (1.34-1.46 wt%) with Na₂O/K₂O > 1.2, weakly peraluminous (A/CNK = 1.05-1.10); (2) low Rb (48-68 ppm) and Rb/Sr (0.07-0.11), high Sr (607-797 ppm), Ba (834-1000 ppm) and Sr/Y (90-202); (3) low REE ($\Sigma\text{REE} = 67\text{-}79$ ppm), moderately fractionated REE patterns ($\text{La}_N/\text{Yb}_N = 21\text{-}37$) without obvious Eu anomalies ($\text{Eu}/\text{Eu}^* = 0.88\text{-}1.20$). Their Zr contents range from 109 to 133 ppm, corresponding to whole rock Zr saturation temperatures of 746-780°C. These data provide maximum estimates of temperature for the magma due to the presence of abundant inherited zircon. The composition of leucogranulites is close to that of eutectic granite at 645°C and 5 kbar, and also comparable to that of those melts produced from H₂O-fluxed melting of muscovite schist at 6 kbar [1][2].

It is inferred that the protolith of leucogranulites were generated by H₂O-fluxed melting of metasediments at 645-746°C and 6 kbar during the prograde metamorphism. The high Sr/Y ratios were probably due to a combination of two factors: 1) H₂O-fluxed melting consumed plagioclase in higher proportion, thus the melts would have elevated Sr concentrations; 2) Garnet could be formed under subsolidus conditions at 4-6 kbar in metapelites, and acted as residual phase during H₂O-fluxed melting, thereby trapping Y and HREE.

References:

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- [2] Patiño Douce A and Harris N (1998) *J Petrol* 39(4): 689-710

