Paper Number: 1163

Melt-crystal interaction during magma mixing: the Zircon U-Pb-Hf-O isotope and mineral microanalysis of granitoids and mafic enclaves in Karamay pluton, West Junggar, NW China

Kang, L., Xiao P.X. and Zhao, H.B.

Key Laboratory for the Study of Focused Magmatism and Giant Ore Deposits, MLR, Xi'an Center of Geological Survey, CGS, Xi'an, 710054, China

---

Currently, similar to partial melting, crystallization separation, assimilation and hybridization, magma mixing has been one of the important petrogenesis processes for magmatite formation [1-3]. The microanalysis of zircons, disequilibrium textures and mineral assemblages of magma mixing rocks and mafic microgranular enclaves (MMEs) in the Karamay pluton of the West Junggar region, were studied and aims to discuss the ages, the nature of the end-member magmas, and the melt-crystal interaction during magma mixing. In-situ U-Pb, Hf and O isotopic analyses in cores, mantles, and rims of zircons in monzonitic granite and MMEs show variable $\delta^{18}O$ values from 4.72‰ to 7.41‰ and 4.84‰ to 7.67‰, respectively. Combined with the morphology and structure of zircons, two classes of zircons in monzonitic granite and MMEs can be distinguished: 1) Crustal-like zircons, characterized by short columnar shape with significant oscillatory zoning, $\delta^{18}O$ weighted means in the cores were respectively 6.56‰ and 6.67‰, and decrease in the mantle and rim; 2) Mantle-like zircons, characterized by long columnar-needle shape, $\delta^{18}O$ weighted means in the cores were respectively 5.32‰, 5.53‰, and increase in the rims. The two types of zircons all developed in the monzonitic granite and MMEs, indicating that some zircons migrated between the host rocks and MMEs. Therefore, excluding the heterogeneous zircons provided a more accurate age, and the reset zircon U-Pb ages (SIMS) of monzonitic granite and MMEs were 313.1±3.9Ma and 312.5±9.8Ma, which are more reliable and consistent. $\varepsilon_{Hf}(t)$ values in different parts of the zircons all had an analogous range, +9.3-+16.0 in the monzonitic granite, +9.2-+13.6 in MMEs, indicating that the diffusion coefficient of the Lu-Hf isotope should be higher than oxygen isotope in the early stage of magma mixing (before and during zircon crystallization). The analysis of electron probe and back scattered images (BSI) of minerals show plagioclase with corrosion zones and bimodal reversed zoning, amphibole with pyroxene reversed zoning, pyroxene with growth zoning in host rocks, and plagioclase phenocryst with corrosion rims and bimodal reversed zoning, amphibole phenocryst with growth zoning and apatite with hollow structure in MMEs. According to zircon Hf-O and plagioclase microanalysis, magma mixing had occurred during the zircon crystallization in the Karamay pluton, and subsequently, hot mafic magma injected into the felsic magma, causing magma mixing at least three times during rock-forming mineral crystallization process. Tracing the mineral sources, zircons, plagioclases, amphiboles and pyroxenes migrated between host granitoids and mafic enclaves due to magma mixing. Zircons Hf-O isotope and mineral microanalysis in granitoids and MMEs reveal that abundant mantle magma were involved in the genesis of the Karamay pluton, and the high $\varepsilon_{Nd}(t)$ values and $\varepsilon_{Hf}(t)$ values of granite in the West Junggar region may have the relationship with magma mixing on the basis of regional geology.

References:

[1] Russell JK (1990) Reviews in Mineralogy and Geochemistry 24: 153-190

[2] Jellinek MA and Kerr RC (1999) Journal of Geophysical Research 104: 7203-7218

[3] Perugini D et al. (2013) Chemical Geology 335: 8-23.