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Application of microprobe-based flank method analysis of Fe^{3+} in garnet of North Qilian eclogite and its geological implication

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Keywords

Microprobe, flank method, ferric iron, garnet, North Qilian eclogite

Abstract

A newly developed microprobe-based methodology (the Flank Method) for $Fe^{3+}/\Sigma Fe$ quantification has been successfully applied to some natural garnets from the North Qilian eclogites by JEOL JXA-8100 microprobe at Peking University. The results demonstrated an obvious discrepancy in comparison with the outcomes by conventional stoichiometric calculations. This methodology allows to measure the $Fe^{3+}/\Sigma Fe$ ratio and perform elemental analyses simultaneously in the same condition. Accurate in-situ measurement of Fe^{3+} content in garnet may bring certain impact on the garnet-based P-T estimation. According to the compositional zonation displayed in the studied eclogitic garnets from North Qilian, a prograde metamorphic *PT* path from 19.5 kbar, 520 ^{o}C to 22 kbar, 600 ^{o}C was reconstructed. More interestingly, the measured $Fe^{3+}/\Sigma Fe$ ratios in garnets decreasing from core to rim may probably imply that the oxygen fugacity (fO_2) declines with the depth of the subduction zone.

1. Introduction

Garnet is an important Fe-bearing mineral in metamorphic rocks. Its compositional zonation that may reveal important geological information (e.g. P-T conditions, oxygen fugacity etc.) [1, 2]. The ferric iron content in garnet is commonly estimated by indirect methods, such as stoichiometric recalculation from microprobe elemental analyses. However, due to inherent analytical precision, the arising uncertainty of $Fe^{3+}/\Sigma Fe$ determination in garnet will lead to further questions about the related P-T estimation and redox-state evaluation [3-7]. A recently developed microprobe-based (in-situ) methodology termed as the Flank Method [8] has been successfully applied to natural garnets for $Fe^{3+}/\Sigma Fe$ determination with very satisfied outcomes [9]. It is a hybrid method measuring both the iron's Lβ/Lα intensity ratios and peak shifts that thus has "dramatically" enhanced the analytical