Light Lithophile Elements (Li, Be and B) determination in amphiboles: a comparison between LA-ICP-SFMS and SIMS

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A combined laser ablation (LA)-ICP-MS and secondary ion mass spectrometry (SIMS) study has been carried out for evaluating the accuracy of the Li, Be and B (Large Lithophile Elements; LLE) determination at trace level in pargasites and kaersutites from high-T lithologies (mainly, mantle ultramafics and alkaline basalts). SIMS analyses were performed with a Cameca IMS 4f using a $^{16}O^-$ primary beam focalised on spots of 15-20 μm in diameter. Analytical conditions were typically 10 nA of beam current and 17 keV of total impact energy. The ions sputtered from polished, gold coated, samples were transferred to the mass spectrometer by the 25 μm optics and energy filtered by applying –100 V offset voltage, with an energy bandwidth by ±25 eV. At these conditions, Ottolini et al. (1993) showed that the matrix effects for Li (and Be) are significantly reduced to less than ±20 relative, with a concomitant improvement of the precision (a few percent at ppm level). Acquisition times were 50 s each for $^{7}Li^+$, $^{9}Be^+$ and $^{11}B^+$, and 20 s for $^{30}Si^+$, which was used as internal standard. Quantification of Li was done with an empirical calibration based on NIST SRM 610 standard, and Macusani rhyolite, Ceran glass and H8 hornblende reference samples. Differently, Be and B quantification was performed with the NIST SRM 610 glass as external standard, without further corrections. The LA-ICP-MS instrument used in this work couples a sector field ICP-MS Element I (ThermoFinnigan), adopting the fast field regulator (fast scanning) of the Element II, with a 266 nm laser microprobe. The LA-ICP-MS analytical method is described in Zanetti et al. (This Volume). The LLE concentrations were found in the range of hundreds of ppb to tens of ppm for Li, hundreds of ppb to ppm for Be, and tens of ppb to ppm for B. As for Li, the agreement between LA-ICP-MS and SIMS is better than 5% at tens of ppm level, whereas it is better than 10% and 30% at ppm and hundreds of ppb level, respectively. Be agreement is within 20%, whereas that of B is better than 15% and 30% at ppm and hundreds of ppb level, respectively.

References

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Gross productivity of the Sagami Bay using Triple Oxygen Isotope

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Introduction

Estimation of gross productivity by triple oxygen isotope (^{16}O, ^{17}O and ^{18}O) method, has been recently developed, would alleviate problems involved in the incubations methods (Luz and Barkan, 2000). Using this technique by collecting bimonthly samples from June to October, we examined the changes in $\Delta^{17}O$ anomaly and estimated primary productivity in the Sagami Bay.

Discussion

The changes in $\Delta^{17}O$ anomaly are positively correlated with chlorophyll *a* concentrations in the mixed layer. The $\Delta^{17}O$ anomaly during the sampling period shows three important features: 1) high $\Delta^{17}O$ anomaly in the mixed layer, corresponds to chlorophyll-*a* concentrations, is resulted by photosynthesis and air-sea exchange, 2) low anomaly in the aphotic zone reflecting respiration in the absence of photosynthesis and, 3) elevated $\Delta^{17}O$ anomaly in the sunlit thermocline driven by photosynthesis proceeding in the absence of gas exchange. Gross production of oxygen in the mixed layer computed using $\Delta^{17}O$ anomaly is higher by 10-40 mmol m^{-2} d^{-1} compared to oxygen incubation in the light and dark bottles. The potential sources of lower estimates by incubation technique could be due to inability to measure O_2 uptake rates in the light bottles and it is assumed to be equal in the light and dark bottles, bottle effect on activity of enzymatic reactions, and changes in physical conditions such as temperature, light intensity on activity of phytoplankton.

Reference

Luz, B., and Barkan, E., (2000), *Science,* **288**, 2028-2031.