Importance of reference materials and of the determination of matrix effects for precise and accurate measurements by SIMS

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SIMS technique (Secondary Ion Mass Spectrometer) has been used for several decades to examine element and isotope compositions at micrometer scale in various geological samples [1]. But SIMS measurements are subject to matrix effect at the time of sputtering process. To overcome these matrix effects in the order to achieve precision and accuracy of the analyses, reference materials are needed. These reference materials must have the same chemical composition and mineralogy of the sample, or at best, must be the closest possible.

We will show different examples of determination of matrix effect for oxygen isotopes: in $CaCO_3$ polymorphs, in different carbonates (magnesite, dolomite, siderite, rhodochrosite and ankerite, [2]), and in a solid-solution, i.e. Fe-Ca-Mg garnets [3,4]. We will highlight the importance of the choice of the reference materials and the determination of possible matrix effect. When all the precautions regarding these effects are taken, a precision better than 0.5 ‰ can be achived, the more complex the correction, the worse precision is reached.

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Differentiating magma sources from conglomerate and breccia clasts, IODP Site U1349, Ori Massif, Shatsky Rise Oceanic Plateau

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Shatsky Rise in the northwestern Pacific is one of the largest (~500,000 km^2) and oldest (145-135 Ma) Large Igneous Province on the oceanic floor. Studies of magnetic lineations and bathymetry showed that Shatsky has an elongated structure with three edifices (Tamu, Ori, Shirshov) progressively decreasing in age and in volume [1]. Integrated major and trace elements and Sr-Nd-Pb-Hf isotopes for the Shatsky Rise basalts show 4 distinct magma types and MORB-like compositions with trends towards the enriched plume(?)-source for Ori and Shirshov Massifs [2-4]. Deciphering deep plume vs. shallow mantle contributions to the Shatsky magmatism remains a fundamental problem.

During the IODP Expedition 324, site U1349A penetrated Ori massif near its summit [5] and recovered volcaniclastic sandstones, volcanic breccia, a clay-rich layer and polymictic volcaniclastic conglomerate (Unit III, ~20 m) between sedimentary layers and igneous basement. The breccia clasts range in size from 2-20 mm and the conglomerate clasts from 2-80 mm. These fragments represent eroded volcanic material originating from locally sourced portions of the Ori Massif.

All clasts are heavily altered picritic and tholeiitic basalts with little or no primary magmatic minerals preserved and significant enrichments in fluid mobile elements (Ca, Na and K). For the fluid immobile element Ti the concentration of TiO_2 ranges from 1.8-4 wt.%, whereas the Shatsky Rise basement lavas have no TiO_2 contents higher than 2.7 wt.%. This implies that the clasts are derived from different lavas with distinct petrogenesis and geochemistry relative to the rest of the basement lavas sampled to date. Thus, at least 5 magma types compose Ori Massif. Trace element and Nd-Hf isotope data on the new High-Ti magma type will allow further investigations into source heterogeneities.

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