EVALUATION OF UNCERTAINTY BUDGETS OF Pb AND U DETERMINATIONS IN GLASSES AND ZIRCON AT HIGH SPATIAL RESOLUTION

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Laser ablation inductively coupled plasma-mass spectrometry (LA-ICP-MS) has been widely used for element and isotope analyses in geological study. Recent research has highlighted that matrix induced laser fractionations between commonly used external reference materials (NIST61x SRMs), natural silicate reference materials (USGS glasses) and zircon are significant at high spatial resolution.[1] Question raised here is if such fractionation effect is the significant uncertainty source to combined uncertainty for the whole trace element analytical procedure. Luo et al (2007)[2] has addressed the uncertainty budget of Co, La and Th trace analysis using LA-ICP-MS. The results indicated that Poisson counting statistics prevailed for the uncertainty budget when the signal was relatively low. However, elements which have significant fractionation effect - such as Pb and U - at higher spatial resolution have not been addressed. Therefore, the objective of this study is to evaluate the uncertainty budget of Pb and U determination and assess the effect of elemental fractionation to their combined uncertainties. Experiment was conducted at 193nm excimer LA-ICP-MS lab at Department of Earth Science, University of New Brunswick. Spot sizes from 45 to 13 micron were chosen for evaluation. Calibration was performed using NIST610 with internal standardization using Ca or Si. NIST 612, NIST 614, USGS glasses and Zircon 91500 were treated as unknowns. Elemental fractionation and the matrix effect arising from 193 nm excimer laser ablation ICP-MS were evaluated in detail in this uncertainty budget study.

References

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The influence of deep water circulation on the distribution of ^{231}Pa and ^{230}Th in the water column and sediments of the Pacific Ocean.

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SESSION 12b:
"Pa and Th distributions in the ocean: controlling mechanisms"

The Atlantic Meridional Overturning Circulation (AMOC) is increasingly recognized as paramount to controlling the broad distribution pattern of sediment ^{231}Pa/^{230}Th in the Atlantic Ocean [1,2]. In contrast, for the Pacific, "boundary scavenging", i.e. the enhanced removal of ^{231}Pa in high particle flux, opal dominated regions, is generally considered as the dominant factor [3,4,5].

We have revisited this apparent dichotomy by developing a two-dimentional Pacific scavenging model to investigate the possible influence of the Pacific Meridional Overturning Circulation (PMOC) on the distribution of sediment ^{231}Pa/^{230}Th. The circulation strength and geometry in the model are based on published field observations [6] and the scavenging parameters are chosen to reproduce the broad features of dissolved ^{231}Pa and ^{230}Th profiles measured in the Pacific Ocean. Boundary scavenging is taken into account by adding a removal term derived from a two-box model following [7]. The sediment ^{231}Pa/^{230}Th generated in the model between 30°N and 30°S is then compared to the existing database.

The results show that both boundary scavenging and overturning circulation play an equally important role in determining the distribution of ^{231}Pa/^{230}Th in Pacific sediments. The former by increasing ^{231}Pa/^{230}Th in zones of enhanced scavenging and the latter by producing distinct vertical and horizontal ^{231}Pa/^{230}Th gradients. As anticipated, the boundary scavenging effect is more prominent in the eastern equatorial Pacific but the influence of circulation in this region can still be recognized in the data. In areas of lower scavenging intensity, measured sediment ^{231}Pa/^{230}Th varies with water depth in accordance with model predictions, suggesting that PMOC strength and geometry are the main controlling factors. This finding suggests that past changes in the strength and geometry of the PMOC could be derived from the distribution of ^{231}Pa/^{230}Th in the low productivity regions of the Pacific.

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