Real-time elemental and isotopic analysis at atmospheric pressure in a laser ablation plasma

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Laser Ablation Molecular Isotopic Spectroscopy (LAMIS)

Would the ability to immediately analyze any sample in the field for elemental and isotope content be of value to the geological community? It is possible and this talk will describe a new technology that offers just that capability. The technology has been named LAMIS for Laser Ablation Molecular Isotopic Spectroscopy. By expanding the capabilities of a classical laser plasma technology known as LIBS (Laser Induced Breakdown Spectroscopy) to emphasize the measurement of molecular emission spectra in addition to elemental, LAMIS provide geologist with a tool for measuring all elements and their isotopes, including light elements like Li, Be, C which are impossible with XRF. The basis of LAMIS is to analyze a tiny amount of the sample using the laser beam. No sample preparation or consumables are needed. We have developed LAMIS to date by establishing its ability to measure B, C, H, D, Sr and other isotopes. We have demonstrated down to percent levels for sensitivity and have experimental plans to meet ppm levels. This talk will describe the previous isotope work that has been reported in LIBS plasmas and show how LAMIS expands those capabilities.

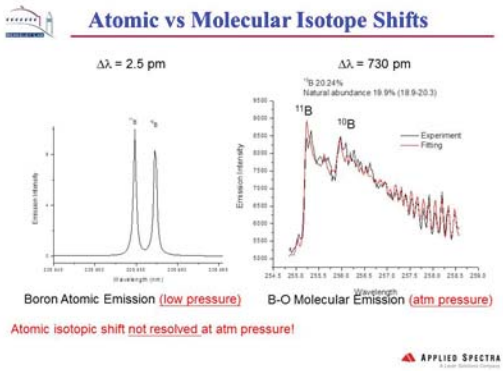

Figure 1: Demonstration of atomic versus molecular isotope emission spectra in laser plasmas

Conclusion

This talk will describe previous isotope work that has been reported in LIBS plasmas and show how LAMIS expands those capabilities.

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Changes in $^{231}Pa/^{230}Th$ signatures in the bottom water of the ocean

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There has recently been much development in the description and modeling of the particulate $^{231}Pa_{xs}/^{230}Th_{xs}$ ratio in the ocean as proxy for the meridional ocean circulation, especially to study the situation in the glacial Atlantic Ocean. Many studies have investigated the effects of ventilation, mass flux and particle composition on $^{231}Pa_{xs}/^{230}Th_{xs}$ ratios. The interpretations as paleoproxy rely usually on the assumption that the isotopic signal stored in the sediment is determined by the composition of suspended or sinking particles when these arrive at the respective water depth. This composition is controlled by exchange with the deep water column [1]. At depths >2500m, Scholten et al. [2] found agreement between $^{231}Pa_{xs}/^{230}Th_{xs}$ ratios in suspended material and surface sediments. Chase et al. [3] observed no difference in activity ratio between surface sediment and a fluff layer present on top of their cores. However, there are several processes that may cause the ratio in surface sediments to differ from the ratio in sinking particles. Bottom currents transport and redistribute the sediment and fractionate grain size [4] and isotopes [5,6]. As a result of this transport and of early diagenetic reactions in the sediment, surface sediments may have a chemical composition and reactivity that is different from sinking particles. We will discuss the possible bias that these processes can give to the signals measured in bottom waters and stored in the sediment.

Whereas Pa/Th ratios have mostly been studied in relation to deep water formation in the North Atlantic, the formation of deep water in the Weddell Sea (Weddell Sea Bottom Water, WSBW) also effects the distribution of ^{230}Th and ^{231}Pa. We will present some new water column data confirming the strong effect of ventilation on the distribution of ^{231}Pa and ^{230}Th in the Atlantic sector of the Southern Ocean. Both nuclides accumulate at intermediate depth in the Weddell Sea while concentrations are appreciably lower in the newly formed Weddell Sea Bottom Water.

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