



Elemental Scientific Inc Technical Note-13

Direct analysis of seawater using the Apex-FAST

The relatively high salt level in seawater makes it necessary to perform dilutions of 10 – 25 fold before analysis of seawater by ICPMS can be carried out. Diluting the sample causes severe contamination issues at the low levels of detection required for the determination of transition elements in seawater. The Apex-FAST system is connected to the ELEMENT-XR (HR-ICP-MS) and adapted with syringe pumps to run at $\mu\text{L min}^{-1}$ flow rates to perform direct analysis of undiluted seawater.

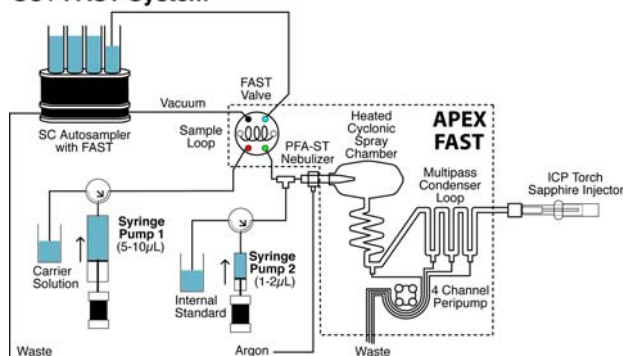
Instrumentation & Sample Intro.

- Thermo ELEMENT-XR
- ESI SC-E2
- ESI PFA-ST Nebulizer
- ESI Apex-FAST
- ESI Syringe Pumps (quartz)

Apex-FAST for direct analysis of seawater

The Apex is combined with a 6 port valve, controlled via SC-E2 auto sampler software and easily integrated with any ICP. The addition of ESI syringe pumps operating at $5\mu\text{L min}^{-1}$ for the carrier and $2\mu\text{L min}^{-1}$ for the internal standard, eliminates the need for sample dilution. Contamination issues are minimized by reducing sample handling, reagent additions and eliminating variability in contamination from sample tubes. The ELEMENT-XR and Apex-FAST are tuned for maximum sensitivity.

SC / FAST System

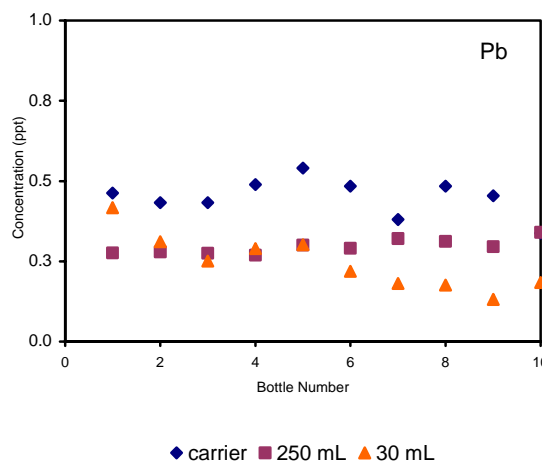


Operating parameters

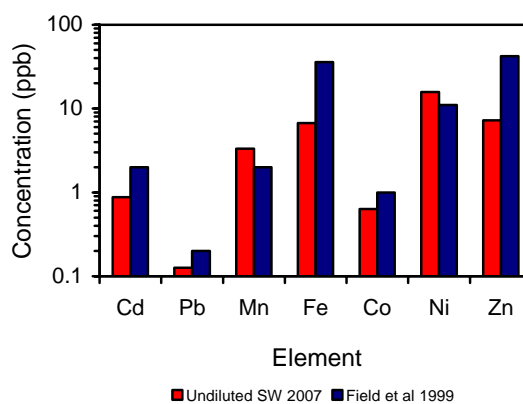
Samples are vacuum loaded into a 0.5mL loop, this relatively large volume to the volume used for measurement also helps to reduce contamination. Once the valve is switched the sample is pushed out of the loop (0.005mL min^{-1}) by the syringe pump through the low dead volume transfer line via the internal standard Tee to the PFA-ST nebulizer on the Apex.

Detection Limits

Pb data is shown for 10 replicates of the carrier solution, 10 replicates from a 250mL bottle and an automated single measurement from 10 different 30mL sample tubes using



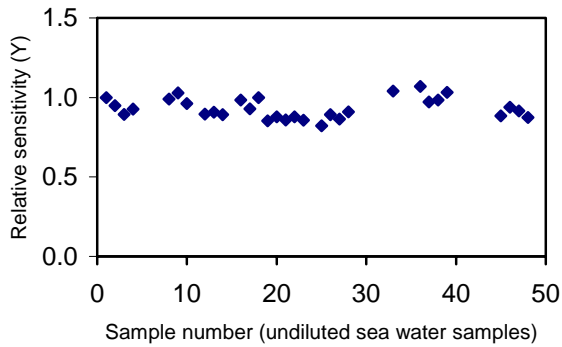
the SC-E2 autosampler. Blanks are low and stable resulting in excellent detection limits for undiluted seawater. Improvements in detection limits are observed over data



collected by Field et al., JAAS 1999.

Stability

A 10mL sample of seawater was spiked with 100µL of concentrated HNO₃ containing 100ppb Y for analysis. The sample was run



approximately 50 times with no wash or rinse steps between each analysis. Excellent precision with minimal drift can be observed.

Accuracy

The Certified Reference Material CASS-4 was analyzed using a single standards addition curve, as can be seen very good agreement is observed between determined and certified values.

