Sample preparation for water analysis

In many ways water is the simplest of all sample types to analyze by ICP-MS. Water is already liquid, so sample preparation is easy. However, natural waters are chemically complex and resulting interferences can also be complex.

Treatment of collected samples

- Samples should be collected in clean plastic bottles, not glass or metal. Samples may be filtered during collection in the field, but you should carefully check that filtered samples are not contaminated by the filters or filter holders, and that the process will work in the field.
- Collected samples should be kept cold and in the dark to prevent microbial activity changing the water chemistry. Nitrogen species and organic acids are the most succeptible to change.
- As soon as possible after collection the samples should be analyzed by ion chromatography, or any other technique for which acidification will ruin the samples. Then, as soon as possible the samples should be acidified with high-purity HNO_3 to bring them to 1% acid by volume. Since the concentrated HNO_3 is about 70%, this means adding about 14 ml of concentrated high-purity HNO_3 per liter of water (1.4 ml for 100 ml, 1.75 ml for 125 ml).

Trace element internal standard solution

In a clean 100 ml volumetric flask add 0.1 ml of each of the following 1000 g/g (ppm) element solutions: Be, Sc, Ga, Y, In, Pr, Re, Bi, Th. Add 7 ml of concentrated high-purity HNO_3, and dilute to volume. The concentration of each internal standard element is 1 ppm. Transfer the solution to a clean storage bottle. Note, you may want to add more Be because of the low sensitivity for low-mass elements.

Blank and standard base solution

To a clean 500 ml volumetric flask add 7 ml of high-purity HNO_3. Dilute to volume. Transfer to a clean storage bottle.

Basic trace element standard

- Because trace elements are by definition at very low concentration, it is usually best to make a trace element standard using two dilutions.
- To a clean 100 ml volumetric flasks, add the amount of the various 1000 μg/g (ppm) single element solutions you need, and add 7 ml of high-purity HNO_3. Dilute to volume and transfer to a clean storage bottle. This is **solution #1** in the table below.

Element	Concentrated single element solutions (ppm)	ml of single element solutions used	Concentration in solution #1 (ppb)	Concentration in 50 ml standard tube (ppb)
Li	1000	0.2	2000	20
B	1000	0.5	5000	50
Al	1000	0.5	5000	50
Mn	1000	1	10000	100
Fe*	1000	5	50000	500

Co	1000	0.05	500	5
Zn	1000	0.2	2000	20
Cu	1000	0.5	5000	50
As	1000	0.5	5000	50
Se	1000	0.5	5000	50
Rb	1000	0.05	500	5
Sr	1000	1	10000	100
Mo	1000	0.01	100	1
Cd	1000	0.02	200	2
Cs	1000	0.01	100	1
Ba	1000	0.5	5000	50
W	1000	0.01	100	1
Pb	1000	0.05	500	5
U	1000	0.05	500	5

*Use 54Fe in DRC mode for analysis.

- The elements listed above are commonly analyzed in natural water solutions in our lab. Elements can be easily added or deleted. Some elements may not be stable in solution for long periods of time (days). Beware of Ag and Hg, as these elements are very difficult to wash out of the ICP-MS sample introduction system and may require a separate run.

Preparing the solutions for analysis

- Add 10 ml of the water samples to their respective 13 ml plastic autosampler test tubes.
- Add 50 ml of the blank solution to 50 ml plastic autosampler tubes: at least one for the blank and one for the standard.
- To the 50 ml standard autosampler tube add 0.5 ml of the standard solution #1.
- Add 0.1 ml of the trace element internal standard solution to each sample tube, and 5 x 0.1 ml to each blank and standard tube.
- Cap the test tubes and shake them to thoroughly mix.

The analysis of some analyzed elements can be improved by using the dynamic reaction cell (DRC). For suggestions on the use of this device, see here. You might also consider doing Ba2+ interference corrections for Zn and Cu.