Direct measurement of uranium in seawater by inductively coupled plasma mass spectrometry

A simple method for direct measurement of uranium (238U) in seawater using triple quadrupole inductively coupled plasma mass spectrometry (ICP-MS) was established. The method provides a good analytical performance with respect to detection limit, accuracy, precision and sample throughput. During the method development and application, several interesting facts were observed: 1) Comparison results for reference material using different quantitation approaches indicate that isotope dilution (using 233U) is the most reliable to achieve accurate 238U measurement. The results obtained for direct 238U measurement in 50-fold diluted seawater samples (n = 112) also underline the difference between isotope dilution and internal (or external) standardization. 2) Appropriate dilution of seawater is important to minimize the matrix effect on the ICP-MS measurement and 20-50 dilution is recommended for natural seawater samples. 3) The sensitivity of ICP-MS was observed to increase in the beginning of sample measurement, and then decrease with the continuous injection of samples, which is believed as a consequence of matrix effect from the seawater to the ionization efficiency in the plasma. 4) When measuring samples taken from large volume of seawater stored in immovable containers for relatively long period (i.e., several months), the uranium concentration and salinity data showed slightly increasing trends with the increase of water depth in the container. Therefore, cautions need to be paid in sampling representativeness when performing 238U measurement for such long-term stored large volume samples.