High-precision isotopic characterization of geochemical materials by MC-ICP-MS (MultiCollector-Inductively Coupled Plasma-Mass Spectrometry)

Sylvain GALLET, Dr
Department of Geosciences, National Taiwan University

Multiple Collector-Inductively Coupled Plasma Mass Spectrometry (MC-ICPMS) has emerged in the last 15 years as a new technique for the measurement of isotopic compositions at high precision and accuracy. The method is now widely applied in cosmo- and geo-chemistry, as well as in nuclear science, or in ocean and environmental studies. The method combines the best part of two well established analytical techniques, borrowing the high efficiency ionization of the ICP source and the electrostatic-magnetic sector of double-focusing mass spectrometers. The simultaneous detection of multiple ions using either Faraday cups and/or ion counters allows for the precise measurement of isotopic ratios, with precision and accuracy that are competitive with TIMS (Thermal Ionization Mass Spectrometry) or even superior in some cases. The ICP source (Ar plasma) is especially useful for elements with high first ionization energy that cannot be easily analyzed by TIMS (e.g, Hafnium), or for the measurement of “non-traditional” stable isotopes.

A ThermoFisher Neptune® MC-ICPMS was installed in 2003 in the Department of Geosciences, National Taiwan University, Taipei (Dr. Shen-Su Sun Memorial Lab). Since that time, various methods have been developed for the determination of isotopic composition of Sr, Nd, Hf, Pb, U-Th. Several modifications to existing chemical procedures (used for TIMS) have been adopted to fit the need of MC-ICPMS. Different introduction systems are used that allow the measurement to be made in wet plasma or dry plasma, thus allowing the elimination of some interferences and/or to largely decrease the sample size required for analysis. The use of such introduction systems is not, however, that simple, as they introduce artificial mass bias that can jeopardize accuracy of isotopic ratio determination.

A general account of the MC-ICPMS method will be exposed, with real-life advices for potential users who may wonder if the method could suit their needs. Results gained from more than three years of measuring common isotope systems will be used to illustrate the outstanding performance of these instruments.