# Advances in resolution and accuracy of *in situ* determination of isotope ratios

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It is widely recognized that the combination of the ICP-Mass spectrometry (ICP-MS) and laser ablation sample introduction technique was one of the most sensitive and versatile analytical technique for the elemental analyses of solid samples [1]. We have developed a new calibration technique for multi-element and isotopic analyses of solid samples using laser ablation-ICP-mass spectrometry coupled with a galvanometric optics. With the galvanometric optics equipped with the femtosecons laser system, two or more sample points could be ablated within very short time interval (~10 msec), and the resulting sample aerosols released from different ablation pits or different solid samples was mixed and homogenized within the sample cell or during the sample transport stages. This suggests that the addition of analytes or second internal elements can be made directly onto the solid samples. In this study, we have measured the REE abundances for two zircon samples (Nancy 91500 and Prešovice) using the standard addition calibration technique using the NIST SRM912. The resulting REE abundance data show excellent agreement with the previously reported values within the analytical uncertainties achieved in this study. Another advantage to use the galvanometric optics is the "integration" of the sample aerosol released from multiple spot. Using the integration technique, the U-Pb age of the zircon sample can be determined from separate 10 ablation pits of small ablation pit sizes (~8 $\mu$m). Finally, we would like to show the analytical capability of the newly developed laser ablation in liquid (LA) technique for elemental and isotopic analysis from small areas [2]. The combination of the ICP-mass spectrometry and the laser ablation technique including the LAL has the potential to become a significant tool for *in-situ* elemental and isotopic analysis of solid samples.

[1] Pisonero, J., Günther, D. (2008) *Mass Spectrometry Reviews,* **27**, 609-623. [2] Okabayashi *et al.* (2011) *J. Anal. At. Spectrom.* DOI: 10.1039/c0ja00200c.

# The high conductivity of iron and thermal evolution of the Earth's core

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The large amount of heat conducted down the isentropic gradient of Earth's outer core contributes nothing to driving convection or re-generation of Earth's magnetic field by dynamo action. The energy for maintaining a geodynamo for at least the past 3.5 gigayears (Gyr) must be supplied in excess of this waste heat, placing tight constraints upon the thermal evolution of the core. Here we measured the electrical resistivity of iron was measured up to 100 GPa at room temperature in a diamond-anvil cell (DAC). The resistivity of hcp-Fe strongly reduced with increasing pressure. A heating experiment was also conducted at 65 GPa in the externally-heated DAC. The observed change in the sample resistance was in good agreement with the prediction by the Bloch-Grüneisen formula, which supports the validity of this formula for hcp-Fe at high pressure. The thermal conductivity of iron is estimated from its resistivity at high pressure and temperature on the basis of the Wiedemann-Franz law. Considering the effect of light alloying element, the conductivity of the uppermost core is in the range of 90-130 W/m/K, significantly higher than previous estimates. Such high thermal conductivity implies a relatively young inner core and a large degree of secular core cooling (~1000 K). The high initial CMB temperature further suggests that a significant portion of the lower mantle would be molten in early history of the Earth [1, 2].

[1] Labrosse *et al.* (2007) *Nature*, **450**, 866-869. [2] Nomura *et al.* (2011) *Nature*, in press.