

Determination of Platinum Group Elements in Geological Samples by Isotope Dilution Inductively Coupled Plasma Mass Spectrometry using Hydrogen in Collision Reaction Interface

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The determination of platinum group elements (PGEs) in mafic and ultramafic rocks including chromites and sulfides, has acquired importance in view of its application as a tool in understanding petrogenetic processes and mantle geochemistry, apart from PGE exploration studies. The distribution of PGEs in different rock types varies from a few ng/g to several mg/g challenging its precise determination by normal ICP-MS methods, which is marred by polyatomic interferences, mass fractionation, sensitivity, reproducibility etc. Sample dissolution and solution preparation also suffers from critical issues related to homogeneity and mineralogical composition of the rocks/ores, contributing sufficient matrix to distort precise PGE determinations. An attempt is made here to develop a new method for determination of Ru, Rh, Pd, Ir and Pt, wherein isotope dilution technique involving cation exchange pretreatment is adopted with ICP-MS using hydrogen in the collision reaction interface (CRI) for selective removal of the interfering argon ions and other plasma matrix ions. Sample preparation consists of its digestion along with PGE spikes (⁹⁹Ru, ¹⁰⁵Pd, ¹⁹¹Ir and ¹⁹⁵Pt obtained from ORNL, Tennessee), in a high pressure asher (HPA-S) with conc.HNO₃ and HCl (5:2) at 300°C and 125 bar pressure for 15 hrs, followed by an off-line separation of major interfering species (eg.Ni,Cu,Zn) using cation-exchange column (AG50w-x8, 200mesh, hydrogen form). The eluted solutions were analyzed by ICP-MS with hydrogen as CRI gas for the determination of PGEs. Rh was determined by external calibration using enriched ¹⁹⁴Pt as internal standard. It was observed that under optimal ICP-MS settings, the signal of PGEs in hydrogen mode is reduced by 2-3 order magnitude (compared to normal mode) with a nominal increase in the resolution of analyte mass spectra, thus possibly allowing greater analyte ion transmission efficiency and reduced space-charge effects. The method has been applied on two international geochemical reference material viz., WMS-1 and Su-1b and a few sulfide bearing samples from Voisey's Bay, Canada, the details of which, including issues related to accuracy and precision, are discussed in detail in this paper.