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Analysis of S, Se and Ag in volcanic glasses by ICP-QQQ-MS

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Many elements, such as S, Se and Ag, are challenging to analyse using traditional quadrupole ICP-MS instruments, because of high backgrounds and/or unresolvable interferences. The Agilent 8800 ICP-QQQ-MS has an octopole reaction system, which separates two quadrupole mass filters. This configuration allows targeted reactions within the reaction cell, and effective removal of most interferences. This major advance in ICP-MS technology reduces the need for complex chemistry prior to sample analysis and the analysis of 'problem' elements using high-resolution instruments. A growing number of laboratories are now able to produce high-quality datasets for elements that traditionally were only possible with high-resolution instruments and the necessary wet chemistry facilities. We developed protocols for analysis of S, Se, and Ag using the ICP-QQQ-MS, because analyses of these elements are invaluable for studying magmatic, volcanic and ore-forming processes. As an initial step we performed standard addition on a range of USGS reference materials for S and Ag to provide calibration values for our measurements. Both S and Se were analysed with O_2 as the reaction gas. For S this reduces the background by five orders of magnitude and gives detection limits of <2 ppb in solution (2 ppm in the rock). Selenium concentrations in volcanic glasses are typically <0.8 ppm. Our long-term Se BHVO-2 data give a precision of 9 % and an accuracy of 3 %, which are comparable to those achieved using ID-HG-ICPMS techniques.

Silver presents a particular analytical challenge, because the Ag content of volcanic glasses is typically <50 ppb and is usually at least 200 times less than the content of the interfering element (Zr). Even with minimal oxide generation the ZrO interference on Ag is impossible to correct for using normal solution ICP-MS analysis. Using NH_3 as a reaction cell gas reduces oxide interferences to a sufficient level such that offline corrections for measured ZrO can be applied. Values for our in-house standards are within 4-10% of ID-HG-ICPMS measurements and analyses of BHVO-2 over a 2-year period give a precision of 10 %.