

Trace Element Characterisation of USGS Reference Materials by HR-ICP-MS and Q-ICP-MS

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An accurate and precise trace-element characterisation of USGS reference materials has been carried out using three different instruments: Nu Instruments AttoM, Thermo Scientific Element 2, and Agilent 7700 Series quadrupole. The six USGS reference materials are: BHVO-2, BCR-2, AGV-2, STM-2, RGM-2, and G-3. This set of samples includes both intrusive and extrusive rocks with compositions ranging from mafic to felsic and encompasses a wide variety of geochemical and trace element characteristics. The 2nd (and 3rd) generation of USGS reference materials was selected for use in this study because it is widely available and more care was taken to avoid contamination during sample preparation. Prior to this study, STM-2 and RGM-2 lacked any thorough, published characterisation and data for G-3 was relatively sparse. By using three instruments with different configurations, this study has produced an effective comparison of the performance of each instrument in response to an array of geologic matrices.

The data reveal that the tested instruments are all capable of producing accurate and precise trace element data over a range of geologic matrices, provided that measures are taken to ensure that each instrument is operated within its dynamic range. In this study, this could be accomplished simply by ensuring proper dilution of samples. However, when matrices are more complex, the use of medium and high resolutions are necessary to reduce the amount of preparative chemistry that is required and the strength of isobaric interferences.

In this study, STM-2 and G-3 present complex geologic matrices. These samples display high concentrations of interference-prone REE's and require intensive, high-pressure and -temperature digestion to remove any refractory mineral phases that might concentrate trace elements. Depending on the instrument, 3 to 8 and 12 to 15 (of 40) elements displayed an RSD >5% for STM-2 and G-3 respectively. Simpler matrices, BHVO-2, BCR-2, and AGV-2, usually displayed RSD's <5%, except in cases of low sample size. Overall, the AttoM allowed for the use of more dilute solutions and, within the concentration range tested, provided similar accuracy and precision in low resolution mode as the Element 2 and 7700 Series quadrupole.