

The future demand for geological reference materials

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Geological RMs (G-1 and W-1) were introduced in 1951 for the purpose of validating the accuracy of silicate rock analysis by dc arc spectrography. Since then the introduction of an array of other spectrographic methods have greatly enhanced research into geological processes. The range of elements that could be determined was expanded and the detection limits for measurement was lowered repeatedly through the years. The development and use of reference materials was critically important in supporting this rapid expansion of geological research. Yet national metrology institutions were largely absent from the development of these materials.

For example, NIST did certify an obsidian (SRM 278) and a basalt (SRM 688), but did not include the rare earth elements, the platinum group elements, and other trace elements of major importance to geoscience research at the time of issue in the certification. Essentially all RMs of importance to the geosciences community since G-1 and W-1 have been prepared and distributed national geological institutions, first by the USGS or the CRPG, rather than by national metrology institutions. The geological institutions are not yet certifying their RMs according to ISO Guides.

The International Association of Geoanalysts (IAG) is now meeting this higher metrological requirement. Since the inception of the IAG certification program in 2003, five powdered silicate rock materials have been issued to meet the demand with respect to calibration, method validation, traceability, etc. for whole rock major and trace element analysis.

The introduction of microanalytical techniques two-three decades ago and the more recent advent of MC-ICP-MS have become new driving forces in geochemical research. The first opened the possibility of performing in-situ elemental composition studies at the μm scale. The second led to the discovery of small isotope composition variations of mass and non-mass dependent processes in "non traditional" stable isotopes (e.g. Fe, Cu, Zn, Mo, W, Hg etc.) through cosmo- and geochemical processes. Coupling the two techniques expands in situ analysis to isotopic studies. These developments have created great demand for (certified) RMs for both isotope ratio and microanalytical measurements for the geochemical community that is not yet being met.

Homogeneity at a μm scale and unmatched matrices of the natural minerals or synthetic doped glasses hamper the progress in certification of RMs for the microanalytical measurement community. A challenge for the production of isotope RMs is to prepare an RM solution with an isotopic composition similar to the natural systems under investigation. Refined cadmium and nickel metals, for example, have fractionated isotopic compositions far above the range observed in natural systems of interest. Yet the calibration RM cannot fulfil its purpose when the uncertainty of its isotopic composition exceeds that of the unknowns being measured against it.

In addition to these current and future challenges, establishing metrological traceability of geological reference materials in the absence of starting points developed by national metrology institutions is a major issue that needs attention in all future certifications.