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New C and S metallic reference materials for SIMS analysis

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Major planetary processes occurred when planets were partially to completely molten, *i.e.,* during their magma ocean stages. This primordial stage encompassed the segregation of a metallic core from the silicate magma ocean, setting the initial distributions of volatile elements (H, C, N, and S) between main planetary reservoirs and modifying rocky planets' original volatile element concentrations and isotopic compositions. High-pressure experiments can quantify elemental and isotopic fractionations during core-mantle differentiation. However, no volatile element reference materials are available that are adapted to local micro-analyses by secondary ion mass spectrometry (SIMS) in experimental metals and silicate glasses, respective analogs of core-forming metals and magma oceans.

To address this lack of standards, we synthesized a series of 56 metallic reference materials comprising four FeNi(±Si) compositions ($Fe_{95}Ni_5$, $Fe_{90}Ni_{10}$, $Fe_{80}Ni_{20}$, or $Fe_{80}Ni_{15}Si_5$) with C, N, and S contents varying from 100 ppm to 4 wt.%. These materials were synthesized in the metallurgy laboratory at the Institute Jean Lamour (Nancy, France) by the "melt-spinning" method, which guarantees that the metal alloys are very efficiently quenched at ~10^6 K/sec. The samples are pieces of ~100-µm-thick ribbons with homogeneous Fe, Ni, Si, C, and/or S contents. Carbon and sulfur contents were analyzed at the Service d'Analyse des Roches et Minéraux at the CRPG. Samples' S contents and $d^{34}S$ values were determined by multicollector inductively coupled plasma mass spectrometry (ThermoScientific Neptune). Characterizations of C, N, and S contents and isotopic compositions by isotope ratio mass spectrometry are ongoing.

Preliminary SIMS results do not show any effect of the FeNi(±Si) composition on measurements of C and S contents and isotopic compositions, suggesting that there is no matrix effect on concentration determinations nor on instrumental mass fractionation. These new reference materials will soon become available to the CRPG's SIMS facility for C, N, and S analyses of not only experimental samples, but also terrestrial and extra-terrestrial samples, and will later be shared with other laboratories worldwide.