Neutron Irradiation Noble Gas Mass Spectrometric technique for quantifying Cl, Br and I in terrestrial and extra-terrestrial rock samples

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The evaluation of heavy halogens (Cl, Br and I) in magmatic glass samples and meteorites provides key information on the origin and the recycling of the major volatile elements. However, their low concentrations in most materials of interest have left them in the shadow of other elements, which can be measured with standard techniques. For example, Cl and Br can be estimated by Instrumental Neutron Activation Analyses but the technique requires several hundreds of mg-sized samples. An alternative technique exists as an extension of the ^{40}Ar /^{39}Ar technique[1, 2]. In order to measure the abundances of Cl, K, Br, I, Ca, Ba and U, splits of samples are exposed to a high neutron fluence. This produces nucleogenic noble gas isotopes in abundances proportional to those of the parent elements.

This technique (Neutron Irradiation Noble Gas Mass Spectrometric – NI-NGMS technique) found a revival in 2000's in the Manchester Laboratory[3, 4, 5]. A recent paper by Kendrick[6] summarized in detail the basic concept of the technique. This author introduced scapolite as a potential standard for halogens, instead of the classic meteorite standard (Shallowater or Bjurböle), for the first time. In a more recent paper, Kendrick *et al*.[7] decreased the values of the scapolite standards by 22% and 26% for the Br and I, respectively. If proved correct, this revision has an impact on all publications for almost 50 years using the NI-NGMS technique. We have measured different standard materials (meteorite, quartz 2320, scapolite) and used an internal correction applied to the sample itself based on barium concentrations ("barium correction"). The implications of these corrections will be discussed, with a focus on reconciling discrepencies in standard measurements to improve this sensitive technique for halogen analysis which is widely applicable to a variety of geologic materials.

[1] Turner (1965), *JGR* **70**, 5433-5445. [2] Böhlke & Irwin, *GCA* **56**, 187-201. [3] Johnson *et al* (2000), *GCA* **64**, 717-732. [4] Kendrick *et al* (2001), *Chem. Geol.* **177**, 351-370. [5] Burgess *et al* (2002), *EPSL* **197**, 193-203. [6] Kendrick (2012), *Chem. Geol,* **292-293**, 116-216. [7] Kendrick *et al* (2013), *GCA* **123**, 150-165.