The isotopic composition of the Martian atmosphere recorded in the Tissint meteorite

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Since the first measurements of the abundances and isotopic compositions of volatile elements in the Martian atmosphere by the Viking (NASA) mission [1], analyses of gases contained in glassy material in Martian meteorites (SNC) have been essential to estimate the elemental and isotopic composition of the Martian atmosphere [2]. Recent analyses by the mass spectrometer on board the Curiosity rover (Mars Science Laboratory mission) definitively confirmed the Martian origin of SNC meteorites and provided additional data to compare Earth and Mars atmosphere [3].

The new Martian meteorite Tissint, collected in 2011 shortly after its observed fall in Morocco, is a shergottite that contains pockets and veins of glassy material formed during the impact that ejected portions of the Martian crust in space. These glassy parts contain trapped Martian atmospheric gases [4,5].

We have analyzed noble gases (Ne, Ar, Kr and Xe) and nitrogen in mg-sized melt-rich and bulk fragments of the Tissint meteorite in order to (i) further characterize the isotopic composition of Martian atmospheric argon and nitrogen and to make a comparison with values determined in-situ [1,3] (ii) to decipher the origin of Martian Xe and to establish a comparison with terrestrial xenon.

Taking a $\delta^{15}N$ of 634 ± 60 ‰ [4] for Martian atmospheric N_2, and correcting ^{40}Ar for in-situ radiogenic ingrowth, Ar-N_2 correlations demonstrate that the Martian atmosphere has a $^{40}Ar/^{36}Ar$ ratio of 1982 ± 344. This value has a comparable precision and is very similar to the one determined in-situ by the mass spectrometer on board the Curiosity rover [3]. It also suggests that the argon atmospheric ratio around 3000 measured by the Viking mission [1] was overestimated.

We will also present new data on the isotopic composition of Martian atmospheric xenon.

[1] Owen *et al.* (1977), *J. Geophys. Res.* **82**, 4635-4638. [2] Bogard *et al.* (2001), *Chronology and Evolution of Mars* **96**, 425-458. [3] Mahaffy *et al.*, *Science* **341**, 263-266. [4] Chennaoui Aoudjehane *et al.* (2012), *Science* **338**, 785-788. [5] Wieler *et al.* (2016), *Meteoritics* **51**, 407-428.