Testing the late accretion hypothesis with high-precision Mo isotope measurements by N-TIMS

MATHIEU TOUBOUL[1], CAROLINE FITOUSSI[1], JONATHAN O'NEIL[2]

[1]Laboratoire de Géologie de Lyon, ENS-Lyon, Lyon, France
[2] Dept. of Earth and Envir. Sci., Univ. of Ottawa, Canada

The late accretion hypothesis, i.e. the ~0.5% addition of extraterrestrial materials to the Earth's mantle after core formation, is the most commonly accepted scenario for explaining the high concents of highly siderophile elements (HSE) and their chondritic relative abundances in the present-day mantle [1]. The isotopes of Mo, a moderately siderophile element (MSE), can potentially be use as a new tracer of mantle heterogeneities produced as a result of late accretion. The rationale for such an approach is based upon (1) the observation that most extraterrestrial materials have different Mo isotope composition than the present-day accessible Earth's mantle. Therefore, late accretion is expected to have changed the Mo isotopic composition of the Earth's mantle. (2) the evidence (from W isotopes [e.g., 2, 3]) for the preservation of early heterogeneities in the Earth's mantle.

This change is predicted to be small (less than 20 ppm) but is now detectable using our new multidynamic high-precision method for Mo isotope measurements by Negative Thermal Ionization Mass Spectrometry (N-TIMS). This new method allows to reach external reproductibility below 10 ppm on all Mo isotope ratios, which is more precise than previous studies [4, 5].

Here, high-precision Mo isotope data using our new N-TIMS method will be presented for mafic and ultramic rocks from the Nuvvuagittuq Greenstone Belt (Canada, ≥3.8 Ga). These samples are targetted because they show ^{182}W excess relative to modern mantle-derived rocks [6], which may reflect a fingerprint of changes in the composition of the Earth's mantle related to late accretion. Alternatively, this ^{182}W excess could reflect the radiogenic signature of a mantle reservoir formed less 60 Ma after the start of the Solar system. These different scenarios will be tested in the light of our new Mo isotope data.

[1] Walker, (2009) *Chemie. der Erde* **69**, 101-125 [2] Touboul et al., (2012) *Science* **335**, 1065-1069. [3] Willbold et al. (2011) *Nature* **477**, 195-199. [4] Worsham et al., (2016) *IJMS* **407**, 51-61. [5] Nagaï and Yokoyama (2016) *JAAS* **31**, 948-960. [6] Touboul et al., (2014) *Chem. Geol.* **383**, 63-75.