Experimental determination of Nitrogen solubility in metal melts

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Nitrogen (N) belongs to the most important elements on Earth, as it is one of the key constituents of our atmosphere and forms the basis of life. However, the geochemistry of N, i.e. its distribution and isotopic fractionation between Earth's reservoirs is not well constrained at present.

Our ultimate goal is to experimentally determine N solubility in metal melts as relevant for core segregation during the accretion of planetesimals or the Earth. For this purpose, the nitrogen solubility in metallic liquid was investigated at 1400 °C and 1 to 3.5 GPa using a piston cylinder apparatus. First results show that the applied double capsule technique, using a metallic outer and non-metallic inner capsule, is not conservative with respect to N, as only one portion of the starting bulk nitrogen is recovered in the metal and a few gas bubbles after the experiment. The rest is likely to be stored in the porosity of the inner graphite capsule and/or has diffused through the outer noble metal capsule due to its high metal affinity [1] which show perfectly flat plateaus of N-concentrations across the entire capsule thickness. N in the metal was analysed by an elemental analyser, however, the low amount of sample material and the N yield in the high pressure experiments required the establishment of new analytical routines. Despite these experimental and analytical difficulties, we were able to determine the N solubility in Fe-dominated metal melt from 1.1 wt% at 1 GPa increasing to 1.3 wt% at 3 GPa. These concentrations extrapolated to higher pressures would potentially allow storing all the N initially accreted into the Earth in the core. Nevertheless, only N partitioning between metal and silicate melts under oxygen fugacities relevant for the early Earth (IW to IW-4) will allow to assess how much N may effectively be contained in the core.

[1] Libourel et al., (2003) *Geochim. Cosmochim. Acta* **67**, 4123-4135