Nitrogen solubility in transition zone and lower mantle minerals

T. YOSHIOKA[1]*, M. WIEDENBECK[2], S. SHCHEKA[1] AND H. KEPPLER[1]

[1]Bayerisches Geoinstitut, D-95440 Bayreuth, Germany (*correspondence: takahiro.yoshioka@uni-bayreuth.de)

[2]Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Telegrafenberg, D-14473 Potsdam, Germany

Earth's atmosphere is made predominantly of nitrogen. Marty [1] suggested that nitrogen in the silicate Earth is depleted by one order of magnitude relative to other volatiles such as carbon, water, neon and argon. Busigny *et al*. [2] showed that the total input flux of nitrogen into the Earth's interior is more than three times higher than the output flux. These observations imply that in the past nitrogen in Earth's surface reservoirs has been transferred into the mantle and that the deep nitrogen cycle has evolved over geologic time. Therefore, the "missing" nitrogen might be stored in either the mantle or core.

Although Li *et al*. [3] quantified nitrogen solubility in upper mantle minerals, the potential of nitrogen storage in the transition zone and lower mantle reamins unclear. We synthesised key transition zone and lower mantle minerals (wadsleyite, ringwoodite, bridgmanite and Ca-perovskite) from oxide mixture or glasses using Pt and PtRh capsules. We included with the mixtures both a nitrogen-source (^{15}N-doped NH_4NO_3) and metalic iron, used to buffer the oxygen fugacity close to the Fe-FeO buffer, so as to be consistent with the reducing conditions of the deep mantle. Nitrogen content in the minerals were quantified by SIMS. Our results reveal that wadsleyite can contain ~150 μg/g nitrogen while coexisting olivine contains only ~30 μg/g, suggesting a $D_N^{wadsleyite/olivine}$ of about 5. These data imply that the deep, reduced mantle may be a major reservoir for terrestrial nitrogen; it is by no means certain the majority of the nitrogen on our planet resides in the atmosphere. Depending on the evolution of the deep nitrogen cycle over geologic time, it is quite plausible that atmospheric pressure may have fluctuated over the course of Earth's history.

We will present further data from other minerals and will also contstrain the effect of pressure and temperature in wadsleyite and ringwoodite to clarify the deep nitrogen cycle.

[1] Marrty (2012) *EPSL*, **313-314**, 56-66. [2] Busigny *et al*. (2011) *Geochim. Cosmochim. Acta*, **75**, 7502-7521. [3] Li *et al*. (2013) *EPSL*, **377-387**, 311-323.