P–V–T equation of state of sodium majorite up to 21 GPa and 1673 K

A. M. DYMSHITS [1]*, K. D. LITASOV [1], A. SHATSKIY [1], I.S. SHARYGIN [1], E. OHTANI [2], A. SUZUKI [2] AND K. FUNAKOSHI[3]

[1] Sobolev Institute of Geology and Mineralogy, Novosibirsk 630090, Russia (*a.dymshits@gmail.com)
[2] Tohoku University, Sendai 980-8578, Japan
[3] SPring-8, Japan Synchrotron Radiation Research Institute, Kouto, Hyogo 678-5198, Japan

Garnet is one of the most abundant minerals in the upper mantle and transition zone and comprises about 40% by volume for peridotitic and up to 70% for basaltic or eclogitic lithologies [1]. With increasing pressure garnet becomes progressively enriched in Si and Na, which can be expressed as sodium majorite (Na-maj) component [2].

The *P-V-T* equation of state (EoS) for Na-maj at pressures to 21 GPa and temperatures to 1673 K was obtained by *in situ* X-ray diffraction experiments and a multi-anvil apparatus at “SPring-8” synchrotron facility. Fitting the entire *P–V–T* dataset using a high-temperature Birch–Murnaghan EoS at a fixed $K'_{0,300}$ = 4 yielded V_0 = 1474.7 (8) Å^3, $K_{0,300}$ = 185 (2) GPa, $(\partial K_{0,T}/\partial T)_P$ = -0.028 (4) (GPa K^{-1}) and a = 3.17 (14) × 10^5 K^1, b = 0.41 (21) × 10^8 K^2, where $\alpha = a + bT$ is the volumetric thermal expansion coefficient. Fitting the present data to the Mie-Gruneisen-Debye EoS with Debye temperature fixed at θ_0 = 890 K yielded Gruneisen parameter, γ_0 = 1.31 and 1.33 at q = 1.0 and 1.18, respectively.

The new data on the Na-maj were compared with previous data on majorite type garnets. The entire dataset enabled us to examine the thermoelastic properties of important mantle garnets and these data will have further applications for modelling *PT*-conditions in the transition zone of the Earth’s mantle using ultradeep mineral assemblages.

[1] Irifune & Ringwood (1987) *Earth Planet. Sci. Lett.* **86**, 365-376. [2] Gasparik (1989) *Cont. Min. Petr.* **102**, 389-405.

Laser spectroscopic *in situ* measurements of D/H in water vapor onboard a passenger aircraft

C. DYROFF[1]*, E. CHRISTNER[1] AND S. SANATI[1]

[1]Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research, PO Box 3640, 76021 Karlsruhe, Germany (* correspondence: christoph.dyroff@kit.edu)

Water (H_2O) is a key species in Earths atmosphere due to its large radiative feedback and transport of latent heat. For a better understanding, and to improve global climate models, it is vital to study the global hydrological cycle.

Isotope ratio measurements of H_2O can provide additional information to H_2O measurements alone, as they are an indicator of the transport pathways (evaporation, condensation, ice formation) of atmospheric H_2O.

We are presently deploying an in-situ diode-laser spectrometer [1] aboard the CARIBIC passenger aircraft [2]. On flights mostly in the northern hemisphere with occasional crossings of the tropics en route to southern Africa we have obtained the first in-situ meridional cross section of δD at the cruising altitude of the CARIBIC aircraft (Fig. 1). A positive gradient of ~150 ‰ from mid latitudes towards the tropics indicates an increased contribution of convective transport of near-surface H_2O vapor at 10–12 km altitude. Our findings are supported by back-trajectory calculations, and agree well with satellite-borne observations [3].

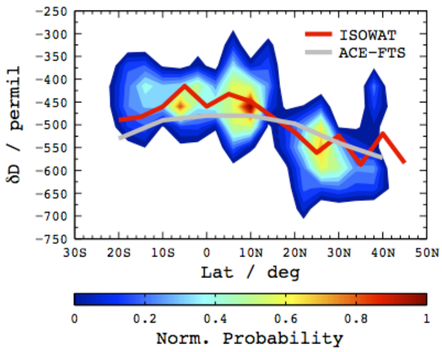

Figure 1: Meridional cross section of δD showing increased convectional transport of H_2O in the tropics. Red line: mean ISOWAT. Green line: ACE-FTS annual mean.

[1] Dyroff *et al.*. (2010) *Appl. Phys. B* **98**, 537-548. [2] Brenninkmeijer *et al.*. (2007), *Atmos. Chem. Phys.* **7**, 4953-4976. [3] Randel *et al.*. (2012) *J. Geophys. Res.* **117**, D06303.

DOI: 10.1180/minmag.2013.077.5.4