Water and 410-km Seismic Discontinuity: Experimental results of water effect on α-β phase transition in $(Mg,Fe)_2SiO_4$ system

J. CHEN[1], T. INOUE[2], H. YURIMOTO[3] AND D. J. WEIDNER[1]

Mineral Physics Institute, State University of New York at Stony Brook, Stony Brook, NY 11794-2100, USA. (Jiuhua.Chen@sunysb.edu)
Department of Earth Sciences, Ehime University, Matsuyama, Japan. (inoue@sci.ehime-u.ac.jp)
Department of Earth and Planetary Sciences, Tokyo Institute of Technology, Tokyo, Japan.

The phase boundary between San Carlos olivine and its high pressure phase, wadsleyite, have been studied comparatively in dry and water saturated condition. By comparing saturated and dry samples from the same experimental run, we determine that both boundaries of the two-phase coexisting loop shift towards lower pressure or lower iron content, and the pressure width of the loop decreases to 0.3 GPa under saturated conditions at 1473K. Thus, the presence of water in the Earth's mantle will sharpen the 410-kilometer seismic discontinuity, shallow the depth of the discontinuity, and reduce the velocity jump across the discontinuity.

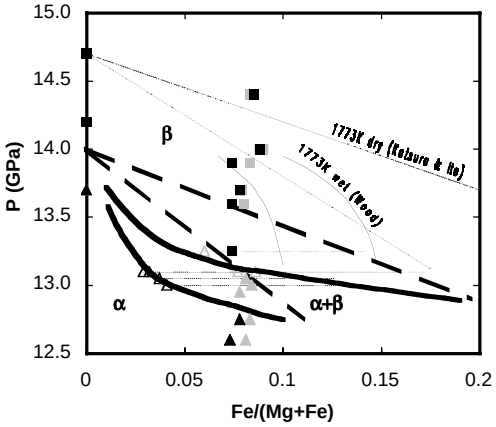

Figure 1. The α+β region of phase diagram for Mg_2SiO_4-Fe_2SiO_4 at 1473 K. Black and grey symbols represent the experimental data under wet and dry conditions, respectively. Triangles and squares represent the data of α and β phases, respectively. Solid symbols indicate a single phase, and open symbols indicate that the α and β phases (linked by broken lines) coexist. Bold solid and dash lines indicate the loop boundaries under wet and dry conditions, respectively. For comparison, the calculated loop boundaries for water undersaturation condition [Wood, 1995] at 1773 K together with experimental loop boundaries under dry condition [Katsura and Ito, 1989] are also superposed in the figure as hair solid and dash lines, respectively.

Pitfalls of Ti Isotopic Measurement by Multi-Collecting-ICP-MS

HSIN-WEI CHEN AND TYPHOON LEE

Inst. Earth Sci., Academia Sinica, Taipei, TAIWAN
Dept. Geo-Sci., Nat'l Taiwan Univ., Taipei, TAIWAN
haart@earth.sinica.edu.tw, typhoon@gate.sinica.edu.tw

Meteoritic Ti isotopes carry a uniquely rich record of the formation of our solar system as well as its chemical elements. Around source stars for solar matter, the highly refractory Ti-mineral acted as nucleation seeds for pre-solar grains. In early solar system solids, Ti isotopic anomalies were not only extremely large (up to 10 %) but also ubiquitous, present in almost all CAI and in many bulk carbonaceous meteorites. Moreover, Ti isotopes also show significant mass fractionation in many CAIs (up to 0.13%/amu) and this effect is different for different parts of the same CAI suggesting the interplay of local condensation, evaporation, or diffusion. The high Ti abundance (>1%) in many refractory minerals (Ti-cpx, hibonite, perovskite, etc.) makes it a tempting target for *in situ* micro-beam isotopic analysis. In preparation for Ti micro-analysis using LA-MC-ICP-MS when our laser ablation system (New Wave, 213 nm) arrives, we have been testing how well our MC-ICP-MS (Nu Plasma) can be used to detect Ti isotopic anomaly and fractionation. A Merck CertiPUR Ti standard solution was diluted to 50 ppb and fed into the plasma torch through an Aridus desolvation nebulizer. It consistently yields a 25 pico-Amp Ti-48 signal implying an ion yield of 1/4000, about five times higher than TIMS running TiO^+. We found that instrumental mass fractionation was sensitive to conditions near the opening of the skimmer cone. When that is well maintained, the measured raw ratios were reproducible to ±0.1%/amu. However, the ICP-MS ratios were fractionated relative to the TIMS results by 3.5% per amu favouring heavy isotopes. After correcting for fractionation by normalizing to $^{46}Ti/^{48}Ti$ =0.108548, we found that our $^{47}Ti/^{48}Ti$ and $^{49}Ti/^{48}Ti$ ratios deviate from the TIMS values by only –2.5 and 2.0ε thus almost within our external 2 sigma errors. However, $^{50}Ti/^{48}Ti$ showed a large deviation of 20±3ε indicating major interference at 50 amu. Careful study of the background mass spectrum demonstrates that background peaks at 51 (>V-51) and 53 amu (>Cr-53) were so small that V-50 and Cr-50 cannot be the problem. We discovered that 20% of the offset was probably from $^{36}Ar^{14}N$ because there is a substantial peak at 54 amu ($^{40}Ar^{14}N$) whose intensity grows with nitrogen leak rate. The remaining fractional deviation stayed the same when we switched to the 100 ppb Ti solution indicating that the effect scales with Ti. So we suspect that TiH_2 is the culprit.

References

Fahey A.J., Goswami J.N., McKeegan K.D. and Zinner E., (1987), Geochim. Cosmochim. Acta 51, 329-350.
Niederer F.R., Papanastassiou D.A., Wasserburg G.J., (1981), Geochim. Cosmochim. Acta 45, 1017-1031.