# The effect of iron spin transition on electrical conductivity of perovskite and magnesiowüstite

KENJI OHTA[1], SUZUE ONODA[2], KEI HIROSE[1] AND KATSUYA SHIMIZU[2]

[1]Department of Earth and Planetary Sciences, Tokyo Instutute of Technology, Meguro, Tokyo, Japan (k-ohta@geo.titech.ac.jp; kei@geo.titech.ac.jp)

[2]Center for Quantum Science and Technology under Extreme Conditions, Osaka University, Toyonaka, Osaka, Japan (onoda@djebel.mp.es.osaka-u.ac.jp; shimizu@cqst.osaka-u.ac.jp)

The electrical conductivity is one of the observable physical properties of the Earth's mantle. The pyrolitic lower mantle mainly consists of Al-bearing (Mg,Fe)$SiO_3$ perovskite and (Mg,Fe)O magnesiowüstite, and the electrical conduction occurs through these two iron-bearing phases. The electrical conductivity profile in the lower mantle has been estimated by extrapolating the data from 40 GPa [Shankland *et al.*, 1993]. Recently, Badro *et al*. [2003, 2004] discovered a pressure-induced electronic spin transition of iron in both magnesiowüstite and perovskite. The spin transition of iron may have significant effect on electrical conductivity, but it has not been examined yet.

Here we measured the electrical conductivity of $Mg_{0.81}Fe_{0.19}O$ magnesiowüstite and $Mg_{0.91}Fe_{0.09}SiO_3$ perovskite at high pressures up to 135 GPa and 300 K in a diamond-anvil cell (DAC). The results demonstrate that the electrical conductivity of magnesiowüstite increases with increasing pressure to about 60 GPa and exhibits anomalous behavior at higher pressures; it conversely decreases to around 80 GPa and again increases very mildly with pressure to 130 GPa. Perovskite shows similar profile to that of magnesiowüstite; it increases to 60-70 GPa and decreases to 80 GPa, then again increases mildly with pressure up to 135 GPa.

This observed reduction in electrical conductivity may be explained by the high-spin to low-spin transition of iron in magnesiowüstite and perovskite. A smaller pressure effect on the electrical conductivity of magnesiowüstite above 80 GPa suggests that a dominant conduction mechanism changes by the electronic spin transition. The electrical conductivity of perovskite becomes higher than that of magnesiowüstite above 90 GPa. Therefore, perovskite can be a main conductor, at least in the deep lower mantle. The electrical conductivity below 2000-km depth in the mantle may be much smaller than previous estimates due to the effect of electronic iron spin transition.

## References

Shankland, T.J., Peyronneau, J., and Porier, J.P. (1993), *Nature* **366**, 453-455.

Badro, J., *et al.* (2003), *Science* **300**, 789-791.

Badro, J., *et al.* (2004), *Science* **305**, 383-386.

# Geochemistry and TEM observation of graphite in 3.8 Ga metasedimentary rocks in Isua Supracrustal Belt

Y. OHTOMO AND T. KAKEGAWA

Institute of Mineralogy, Petrology, and Economic Geology, Graduate School of Science, Tohoku University, Sendai, Japan (otomoyou@ganko.tohoku.ac.jp)

The remnant of oldest life was reported only from one outcrop at the 3.8Ga Isua Spracrustal Belt (ISB), West Greenland [1], although graphite-bearing rocks are located at several spots in the Isua area. New outcrops of graphitic schist, which graphitic contents are up to 8.8 wt %, were found through the course of this study. The graphitic schist is interbedded with banded iron formation and extended for approximately 500m from NW to SE. Major and trace element were determined on graphitic schist samples. Carbon isotope compositions of graphite were determined using the laser micro probe system. TEM analyses were also performed on the extracted graphite samples.

CI chondrite-normalized REE patterns of the new graphitic schist are similar to other Archean shales or banded iron formation. Therefore, new graphitic schist has characteristics of marine clastic to chemical sediments.

Carbon isotope compositions of graphite were determined on 50 samples. Their compositions range from –22.4 per mil to –13.2 per mil. The carbon isotope compositions change systematically, correlated to geological occurrence. Lightest carbon isotope composition was found in the most western area where complicated nano-scale textures of graphite were observed by TEM. The heaviest carbon isotope composition was found in the most eastern area. This carbon isotope shift is probably due to the more metasomatic effect compared to the western samples. Considering those all geochemical data, graphite in new graphite schist also gives another evidence of 3.8Ga marine biota.

## References

[1] Rosing, M. T. (1999) *Science* **283**, 674-676.