

Chemical Composition Dependence of the Dehydration Reactions of Serpentinites

Shuichiro Gemba[1]; Michihiko Nakamura[1]

[1] Inst. Mineral. Petrol. Econ. Geol., Tohoku Univ.

Backgrounds

Recently, dehydration instability of serpentinite has been considered as a mechanism of earthquakes in subducting slabs and mantle wedges. Although serpentinites have wide range of bulk-rock compositions and serpentine solid solution composition is variable, their detailed stabilities have not been determined. In the case of large earthquakes, the fault plane would extend over the area with wide serpentinite stability. This means that the stability might control the propagation of the fault plain. The volume change of the reaction and dehydration kinetics such as rate and grain size of the reaction products are also important to understand the earthquake generation mechanism.

The primary purpose of this study is to determine the detailed stability of serpentine (antigorite) with various chemical compositions, especially with Fe/Mg ratio.

Experimental procedure

The serpentinitized peridotites were collected for the starting materials from three ultramafic bodies: MM, FW, and KT. The MM was collected from a serpentinitized hartzburgite in Marumori, Miyagi. The FW from Fujiwara serpentinitized dunite in the Sambagawa metamorphic belt, and KT, Korotoki serpentinitized wherlite in the Mikabu green rocks in Ehime. The serpentine in KT is Fe-poor, whereas that in FW is Fe-rich. Serpentine in MM has intermediate Fe/Mg ratio. The high-pressure experiments were performed in an end-loaded piston cylinder apparatus at 550-750 deg.C and 1.2GPa for ca.6700-9800 min. The rock powders with controlled grain sizes as well as cored rocks were used as starting materials. The run products were analyzed with EPMA and Raman spectroscopy at Tohoku Univ.

Results

In the runs using MM as a starting material, it was observed that serpentine was stable at 550 deg.C, and that small amount of serpentine broke down to talc at 600 deg.C. At 650 and 700 deg.C, serpentine completely reacted and olivine and talc were formed. At 750 deg.C, orthopyroxene, olivine, and small amount of clinopyroxene appeared and no hydrous mineral was stable. The dehydration run products show a porous texture. In the experiments using FW and KT, serpentine was stable at 600 deg.C, and small part of serpentine broke down to form olivine at 650 deg.C. Serpentine completely reacted and olivine and talc were formed at 700 deg.C. The preliminary experiments so far show that MM dehydrates at relatively lower temperature than FW and KT.

Discussion

It was suggested that differences of bulk chemical compositions and mineral assemblages might affect of the stability field of serpentine. The dehydration would occur at a certain temperature (and pressure) range if heterogeneities of chemical composition exist in the subducting slab and mantle wedge. It was also observed that grain size of the starting materials and dehydration run products are correlated with each other. When permeability of dehydration products is discussed, this must be taken into consideration.