Geodynamics Seminar

第376回ジオダイナミクスセミナー

A pyrolitic lower mantle with $(Mg,Fe^{3+})(Si,Al^{3+})O_3$ perovskite

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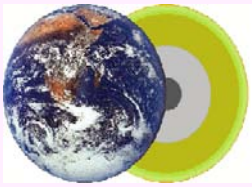
主催：愛媛大学地球深部ダイナミクス研究センター
日時：2/21（金）午後 4時30分～
場所：総合研究棟Ⅰ 4F 共通会議室



EHIME UNIVERSITY GRC GEODYNAMICS RESEARCH CENTER

Abstract

To better understand the Earth's lower mantle (LM), thermodynamic properties (TDPs) of LM minerals should be illustrated clearly. We have so far reported the TDPs of Fe (and Al)-bearing MgO, $MgSiO_3$ perovskite (Pv) and post perovskite by using the internally consistent LSDA+*U* method and the lattice dynamics method. In this work, two spin states, the high (HS) and low spin (LS) state, and several possible distribution configurations are considered in the LM pressure range. For Fe incorporated in Pv, only Fe^{3+} at the Si site undergoes a HS to LS transition. However, this is suppressed by Al incorporation, because Al^{3+} prefers the Si site and attracts HS Fe^{3+} at the adjacent Mg site forming Fe-Al pair. Pv with geophysically relevant 6.25% Fe^{2+} or Fe^{3+}-Al pair is found vibrationally stable. Incorporation of these elements increases the Pv volume a little but gives marginal effects on the TDPs.

Simulated densities, adiabatic bulk moduli, and bulk sound velocities of possible LM mineral aggregations show that a composition close to pyrolite with $(Mg,Fe^{3+})(Si,Al^{3+})O_3$ Pv is accountable for the reference Earth model, while Fe^{2+}-bearing Pv instead gives unigorable disagreements in deeper part. Neither Si-richer nor Si-poorer composition improves the disagreements. This indicates that Fe in LM perovskite should predominantly be ferric acquiring the HS state, and pyrolitic composition with $(Mg,Fe^{3+})(Si,Al^{3+})O_3$ Pv is a reasonable LM model.

詳細は当センターホームページ： http://www.ehime-u.ac.jp/~grc/をご覧ください
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