American Mineralogist, Volume 104, pages 64–72, 2019

Stability of the hydrous phases of Al-rich phase D and Al-rich phase H in deep subducted oceanic crust

Xingcheng Liu[1,2,*], Kyoko N. Matsukage[2,3,*], Yu Nishihara[4], Toshihiro Suzuki[2], and Eiichi Takahashi[1,2]

[1]State Key Laboratory of Isotope Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Wushan, Guangzhou 510640, P.R. China
[2]Magma Factory, Department of Earth and Planetary Sciences, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguroku, Tokyo, 152-8551, Japan
[3]Center for Fundamental Education, Teikyo University of Science, 2525 Yatsuzawa, Uenohara City, Yamanashi, 409-0193, Japan
[4]Geodynamics Research Center, Ehime University, 2-5 Bunkyo-cho, Matsuyama City, Ehime 790-8577, Japan

Abstract

To understand the stability of hydrous phases in mafic oceanic crust under deep subduction conditions, high-pressure and high-temperature experiments were conducted on two hydrous basalts using a Kawai-type multi-anvil apparatus at 17–26 GPa and 800–1200 °C. In contrast to previous studies on hydrous basalt that reported no hydrous phases in this pressure range, we found one or two hydrous phases in all run products at or below 1000 °C. Three hydrous phases, including Fe-Ti oxyhydroxide, Al-rich phase D and Al-rich phase H, were present at the investigated *P-T* conditions. At $T \leq 1000$ °C, Fe-Ti oxyhydroxide is stable at 17 GPa, Al-rich phase D is stable at 18–23 GPa, and Al-rich phase H is stable at 25–26 GPa. Our results, in combination with published data on the stability of hydrous phases at lower pressures, suggest that a continuous chain of hydrous phases may exist in subducting cold oceanic crust (≤1000 °C): lawsonite (0–8 GPa), Fe-Ti oxyhydroxide (8–17 GPa), Al-rich phase D (18–23 GPa), and Al-rich phase H (>23 GPa). Therefore, in cold subduction zones, mafic oceanic crust, in addition to peridotite, may also carry a substantial amount of water into the mantle transition zone and the lower mantle.

Keywords: Water, mantle transition zone, lower mantle, cold subduction, hydrous phases, basaltic crust