American Mineralogist, Volume 92, pages 546–552, 2007

Clinoenstatite exsolution in diopsidic augite of Dabieshan: Garnet peridotite from depth of 300 km

XIANG-WEN LIU,[1] ZHEN-MIN JIN,[2] AND HARRY W. GREEN II[3,*]

[1]State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Wuhan 430074, China
[2]Department of Earth Sciences, China University of Geosciences, Wuhan 430074, China
[3]Institute of Geophysics and Planetary Physics and Department of Earth Sciences, University of California, Riverside, California 92521, U.S.A.

ABSTRACT

Clinoenstatite exsolution lamellae have been discovered in clinopyroxene grains of garnet peridotite from the Bixiling massif of the ultrahigh-pressure metamorphic (UHPM) terrane in the Dabie Mountains, China. Using transmission electron microscopy, we show here that although the lamellae are low clinoenstatite (Lclen) with $P2_1/c$ space-group symmetry, they contain nanometer-scale antiphase domains indicating that the originally precipitating phase had $C2/c$ space-group symmetry. The lamellae are oriented parallel to [010] and ~18° to [001] of the host—approximately parallel to (401). Both the very cold exhumation path of the Dabie UHPM terrane and the orientation of the lamellae preclude the possibility that the originally precipitating phase could have been high-temperature clinoenstatite (HTclen). We conclude that the lamellae precipitated as high-pressure clinoenstatite (HPclen) and subsequently inverted to Lclen. Analysis of the incomplete high-pressure crystallographic data available for compositions approximating those of the lamellae and host suggests a minimum pressure of precipitation of ~9 GPa for Dabie and about 12 GPa for similar exsolution previously observed in the Alpe Arami peridotite, Switzerland. The Bixiling complex is a crustal cumulate, hence this result extends the minimum depth of subduction of continental rocks in the Dabie/SuLu orogen to ~300 km ($P > 9$ GPa).

Keywords: High-pressure clinoenstatite, deep subduction, exsolution, Dabieshan, ultrahigh-pressure metamorphihsm