

Watching mantle through a deep hole: unusual minerals discovered in the Chinese Continental Scientific Drillhole (CCSD)

Jingsui Yang[1]; Wenji Bai[1]; Zhongmin Zhang[1]; Zhiqin Xu[1]

[1] KLCD

www.ccsd.org.cn

The Dabie-Sulu UHP metamorphic belt in the east of China is one of the most exciting geologic discoveries in the last 20 years. In this belt, high-grade continental crustal rocks contain both diamond and coesite, clear evidence of crustal subduction to depths more than 150 km. This belt formed by collision between the North China and Yangtze Blocks in the Mesozoic between about 240 and 220 Ma. In order to investigate the deep structure of this unusual orogenic belt, the Institute of Geology of the Chinese Academy of Geological Sciences and the International Continental Drilling Program (ICDP) have undertaken a deep drilling project (Chinese Continental Scientific Drilling Project or CCSD), which aims to: (1) To determine the 3-dimensional structure, composition and geophysical character of this convergent plate boundary; (2) To investigate the nature and timing of the UHP metamorphism; (3) To investigate the crustal dynamics and crust-mantle interaction involved in the formation and exhumation of the UHP rocks; (4) To study the processes of fluid circulation and mineralization in the crust and upper mantle; (5) To establish a long-term, natural laboratory for the study of crustal dynamics and the evolution of deep continental crust. The drilling started on June 25, 2001 and ended at the depth 5118.20 m on January 23, 2005. The drilling was very successful with core recovery of over 85%. Petrologic study shows that the cores consist of about 1300 m eclogite, about 100 m garnet peridotite, and various gneissic rocks, and can be further subdivided into about 50 lithologic types.

Cutting materials of garnet peridotite between 603.2 and 683.5 m from the Hole were collected during hole-enlarging for mineral separation. Minerals were separated by various regular methods and picked up by hand under microscope. The separated minerals were identified by SEM-EDS, microprobe, Laser Raman, EDXR (Synchrotron X-ray Diffraction) etc. Preliminary distinguished minerals from mineral separations include: silicates, oxide, sulfide, carbonide, native element, metal alloy etc, about 50-60 types in total. Some minerals have been identified, including moissanite, wustite, native Fe, native Cr, native Ni, native Au, native Cu, native Al, taenite, kamacite, Ni-Fe-Cr alloy, Ni-Fe alloy, Fe-Cr alloy, Si-Fe alloy (Fe₃Si₇), Co-Ni alloy, etc. Some of them are new minerals in natural occurrence according to their structure and composition. Silicate minerals include olivine, pyroxene, garnet, rutile, phlogopite, and some alteration minerals. Most of these minerals are attached together with other minerals or included in other minerals, suggesting that they are natural minerals. Some of them are spheroid in shape, e.g., badeleyite, native Fe, taenite, Fe-Ni alloy, magnetite etc, suggesting that they have been liquid and have undergone high temperature melting, but they are not the production of crystal differentiation from melt. These minerals probably were formed by the mixture of mantle materials with core materials from deep. The mineral group of peridotite from CCSD Main Hole is compatible with the mantle mineral group from the Luobusha ophiolite in Tibet, as well as those from the Alpine type ophiolite in South Ural. However, lack of PGE minerals from the peridotite in CCSD Main Hole is the important difference between the others, which suggests that the mantle rocks in different localities were different in their origin.

The CCSD project is providing exciting new information on continent-continent collision, deep subduction of continental crust and the nature of UHP metamorphism. The drilling has been completed and drill core samples and data will be made available through the International Continental Drilling Program. Individuals interested in obtaining data and samples should contact the Project Director, Zhiqin Xu (E-mail: sudechen@ccsd.org.cn).