ボヘミア山塊Moldanubian帯Nové Dvory地域に産するエクロジャイトレンズの単一露頭から見い出されたザクロ石組成累帯構造の多様性とその意味

Deciphering a diverse garnet zoning pattern observed in a single eclogite lens in Nové Dvory, Moldanubian Zone of the Bohemian Massif

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There is an argument on the origins of the Nové Dvory eclogite which experienced over 4GPa and 1000 ^{o}C (Nakamura et al., 2004). It occurs as intercalated lenses in an ultrahigh-pressure (*UHP*) peridotite block surrounded by the country gneiss. Medaris et al. (1998) invoked the high-pressure melt origin of the eclogite based on a geochemical study. Nakamura et al. (2004), however, proposed the subduction origin of the eclogite inferred from a garnet which increases XGrs and decreases XMg toward the rim in a kyanite-SiO2 phase-bearing eclogite. Changes in XMg and XGrs of garnet are commonly utilized as indicators of temperature (*T*) and pressure (*P*), respectively. These assumptions are applicable to eclogites with low-variant and appropriate mineral assemblages. However, it is unlikely to be applied to eclogites with high variant systems. Recently, Faryad et al. (2013) and Nakamura et al. (2013) identified more variety of garnet zoning patterns in bi-mineralic eclogites in Nové Dvory. It made a new argument on the *P-T* history of the eclogite. This study reports further diverse zoning patterns of garnet identified in the Nové Dvory eclogite, and deciphers their formation process by taking into account of the above mentioned factors.
The study eclogites (ND120 and ND0207) are bi-mineralic type collected at one outcrop in Nové Dvory. They are dominated and modally layered by garnet and omphacite. Accessory rutile and apatite are observed. Garnet and omphacite are partially decomposed to amphibole, diopside, spinel, and plagioclase at the margin in various degrees. X-ray mappings show that garnets have individual core compositions and identical rim compositions among each modal layer. Omphacite inclusions are observed only in the inner rim of garnet. In ND120, three kinds of layers are identified, and they contain garnet with Fe-rich core (XMg = 0.30, XGrs = 0.22), Mg-rich-core (XMg = 0.65, XGrs = 0.22), and Ca-rich core (XMg = 0.55, XGrs = 0.25), respectively. The compositions of garnet rims are similar as XMg = 0.50 and XGrs = 0.22. In ND0207, two kinds of layers were identified, and they contain garnet with Mg-rich core (XMg = 0.69 XGrs = 0.21), and Ca-rich core (XMg = 0.52 XGrs = 0.37), respectively. The compositions of garnet rims are similar as XMg = ca. 0.60 and XGrs = ca. 0.30. In both samples, omphacites tend to be Mg-richer and Na-poorer when it appears near or in garnet with Mg-richer core. Because both increase and decrease in XMg (ND120) and XGrs (ND0207) of garnet are observed in hand specimen samples, these parameters cannot be utilized as *P-T* indicators.
The garnet rim contains omphacite, and is indicated to be developed under eclogite-facies. Yasumoto & Hirajima (2015) identified F-bearing pargasites in garnet from a Nové Dvory eclogite, which is stable up to ca. 3GPa at 800^{o}C. It also suggests the eclogite was formed through subduction. In the study samples, omphacite inclusions are not observed in the garnet core. This infers some cores formed under amphibolite-facies conditions. The chemical variation of garnet cores (i.e., Fe-rich, Mg-rich, and Ca-rich cores in ND120) and omphacites in the study samples are considered to be strongly controlled by local effective bulk compositions of their located layers. In contrast, similarity of the garnet rim compositions can be explained by the coincidence of effective bulk compositions of each layer. Drive force of changes in effective bulk compositions can be *T*

increase along subduction or water liberated from decomposition of amphibole. Note garnet with Ca-rich core in ND120 has a Fe^{3+}-enriched omphacite-free mantle (XMg = 0.52, XGrs = 0.22, XAdr = 0.03) while the core and the rim are free from Fe^{3+}. This Fe^{3+} in the garnet mantle can be inherited from decomposed amphibole.

キーワード：eclogite、UHP、open system
Keywords: ultrahigh-pressure, garnet, fluid

Discovery of H_2O inclusions in Kokchetav metamorphic diamond; diamond crystallization during metasomatism in UHP conditions

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Metamorphic diamond was first reported from the Kumdy-Kol area of the Kokchetav Massif (Sobolev & Shatsky, 1990). Kokchetav diamond occurs in dolomite marbles, gneisses, and garnet-clinopyroxene rock with various features of morphology and occurrence. The coarsest crystal (> 100 μm across) of metamorphic diamond occurs in garnet-clinopyroxene rock, compared to diamond in dolomite marble and gneisses (average size: 10 μm across after Schertl & Sobolev, 2013). We report H_2O inclusions and carbonate inclusions in coarse-grained cubic diamond in this rock.
The garnet-clinopyroxene rock collected at the Kumdy-Kol area is composed of garnet layers and clinopyroxene layers with minor amounts of rutile. Due to the simple main constituents, this rock looks like low-P skarn. Diamond occurs as inclusions in garnet and clinopyroxene, and interstitial phases in their boundary. Recently, the same rock type but diamond-free one was described; this diamond-free garnet-clinopyroxene rock contains supersilicic titanite as evidence of UHP conditions (Sakamaki & Ogasawara, 2014).
Cubic diamond grains (approximately 100 μm across) chemically separated from the rock was examined by micro-Fourier transform Infrared spectroscopy (micro-FTIR) spectroscopy in transmission mode. IR spectra of diamond were obtained by using a KBr pellet as an IR transparent window in N_2 gas atmosphere. Obtained transmission IR spectra show CO_3^{2-} bands at 1455 cm^{-1} (weak), clear CH bands at 3107 cm^{-1} (strong), broad H_2O bands at 3428 cm^{-1} (strong), and sharp OH bands at 3555 cm^{-1} (strong) were identified. These bands are caused by carbonate inclusions, H_2O fluid inclusions, hydrogen in diamond matrices, and a hydrous silicate mineral, respectively. These IR absorption bands are similar to those from garnet-clinopyroxenite from the same area in De Corte et al. (1998). Strong IR absorption bands by C-N bonds at 1282 cm^{-1} (A center, very strong), 1180 cm^{-1} (B center, very weak), and 1133 cm^{-1} (C center, weak) are also detected.
High concentrations of water as structural OH and submicron-sized H_2O fluid inclusions in garnet and clinopyroxene coexisting with diamond were detected; 0 (dry) to OH: 1727 ppm and H_2O: 1592 ppm in garnet and total water ($OH+H_2O$): 721 to 4515 ppm in clinopyroxene. Water (OH and H_2O) distribution in the host rock is very heterogeneous grain by grain.
The skarn-like constituents, H_2O fluid inclusions in diamond, host garnet and clinopyroxene, and high OH contents in host garnet and clinopyroxene indicate that the diamond and its host rock formed under H_2O-rich fluid environments such as metasomatism at UHP conditions. The heterogeneous water distribution in the host rock results from a spatial and temporal heterogeneities of H_2O fluid conditions during UHP metasomatism.

キーワード：Kokchetav Massif、Diamond、H2O fluid inclusion、micro-FTIR
Keywords: Kokchetav Massif, Diamond, H2O fluid inclusion, micro-FTIR

走査型電子顕微鏡後方散乱電子回折法を用いた三波川変成帯エクロジャイトの結晶方位解析
Crystallographic preferred orientation analysis of Sanbagawa eclogites using a Scanning Electron Microscope EBSD method

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Sanbagawa metamorphic belt in Japan is characterized by the high-pressure and low-temperature (HP/LT) intermediate type belt which extends from northeast Kanto through the Kii peninsula, passing through central Shikoku until Kyushu in the southwest. The belt is mainly composed of basic, quartzose, pelitic-psammitic schists with several eclogite and ultramafic bodies.
In this paper, we present our study conducted on three three eclogite samples collected from the Iratsu eclogite body. Samples Sb-1 and Sb-3 represent hornblende eclogite whereas Sb-2 represents the quartz-bearing eclogite. From each eclogite samples thin sections in 3D were prepared (i.e. XY-direction, XZ-direction, and YZ-direction). The samples were then studied(1) petrographical under the optical microscope for textural and mineralogical features, (2) chemical features (elemental maps), and (3) Physical features (crystallographic preferred orientations). (1) Petrographically, Sb-1 and Sb-3 are mainly composed of light green omphacite (Omp), pinkish red garnet (Grt), dark green secondary hornblende (Hbl), and actinolite (Act) with pale yellow or colorless epidote (Ep). The samples exhibited granoblastic texture in which Grt was embedded in clustered imp and hHbl. Most of the Omp grains have been retrogressed to Hbl and Act. Garnet porphyroblasts have numerous cracks. Sample Sb-2 was composed of Grt, Omp, secondary Hbl, Ep with abundant quartz. Garnet porphyroblasts have identical features to those observed in Sb-1 and Sb-3, however in this sample they are heavily fractured. In this sample too, Omp grains have secondary Hbl along their rims.(2) Based on chemical elemental mapping (using XGT), all the three samples exhibited Fe-rich Grt with some amount of Mn-component, Ca-rich Omp and Hbl. (3) For physical features, we measured selected areas in each samples for crystallographic preferred orientations (CPO) using Backscattered electron backscattered diffraction (EBSD) method. EBSD maps were collected and from representative phases (Grt, Omp, Hbl, Act) CPOs were presented in pole figures which were constructed along a-axis [100], b-axis [010], and c-axis [001], respectively. The data obtained show that Grt did not show any specific pattern of orientation, hence behaved like rigid body whereas Omp and Hbl/Act display the strongest CPO along [001]-axes, typical for the L-type fabric, representing subduction-related deformation rheology at mantle depth. Hornblende and Act, are secondary after Omp, hence did not modify the CPO during the retrogression stages.

Seismicity and Tectonics of the Black Sea

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The Black Sea, a complex basin between the Arabian, Anatolian and Eurasian plates is a feature of special interest for understanding the geologic history of the region. It was formed as a “back-arc” basin over the subduction zone during the closing of the Tethys Ocean. In the past few decades, the Black Sea has been the subject of intense geological and geophysical studies, including deep seismic sounding and reflection profiling for scientific and petroleum exploration purposes. The Black Sea consists of two basins, Eastern and Western Black Sea, seperated by NW-SE tending topographic ridges. The deepest part of the basins have oceanic crust below a thick cover of sediments at a depth of about 10 km. The margins and the ridges have continental crusts.
In this paper, we present the seismic and fault mechanisms of earthquakes in and around the margins of the Black Sea. Although seismic activity is spare in the basin relative to the surrounding region of the Caucauses and Turkey, the broad-band seismic networks established in surrounding countries, especially in Turkey since 2005, have provided the capability for the detection, location and source mechanism studies of earthquakes in the Black Sea basins. The data shows that; There are a significant number of earthquakes in the Black Sea, mostly of magnitude Mw=4.0 or smaller.
The seismicity increases toward the margins, with the largest events at the margins. The focal mechanisms indicate primarily N-S compression with some E-W component. The mechanism are consistent with the GPS observations, where Westward motion of the Anatolian Plate and N-S deformation of the Caucuses take up most of the motion of the Arabian Plate and only small motions (about 1 mm per year) are transmitted through the Pontides and the Black Sea is being compressed in N-S direction.
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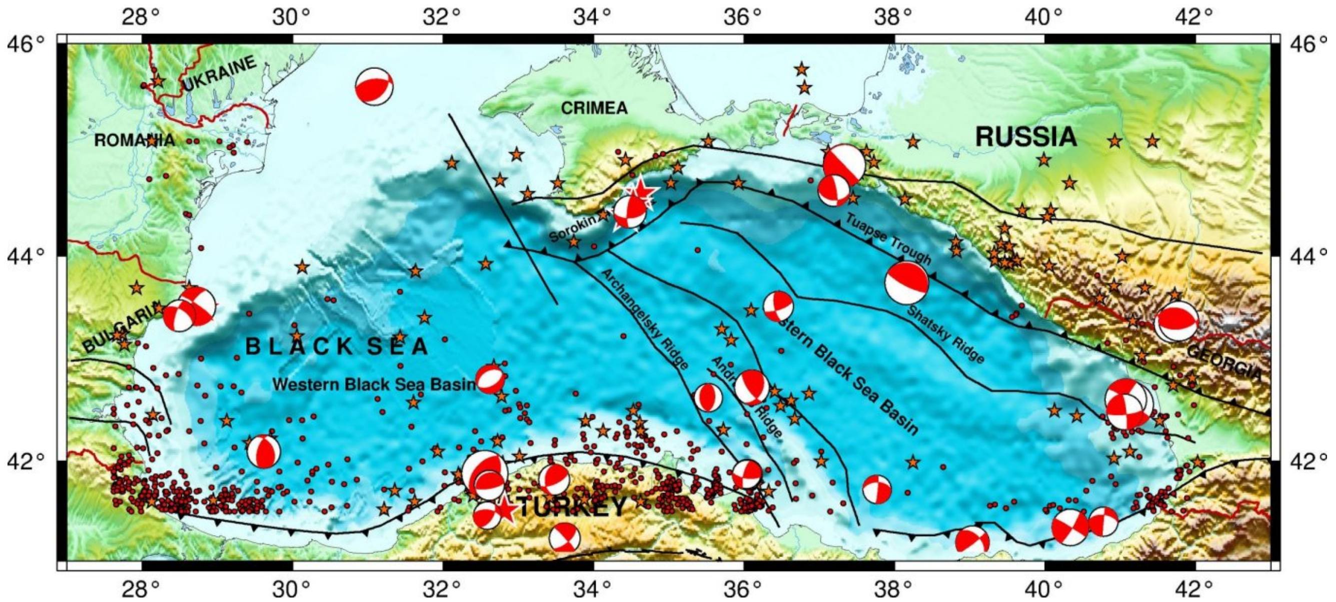
Keywords: Black Sea, oceanic crust, seismicity, fault mechanisms, GPS deformation


UKRAINE
ROMANIA
CRIMEA
RUSSIA
BULGARIA
BLACK SEA
Western Black Sea Basin
Sorokin
Archangelsky Ridge
Tuapse Trough
Shatsky Ridge
Western Black Sea Basin
GEORGIA
TURKEY
28° 30° 32° 34° 36° 38° 40° 42°
46° 44° 42°

