GR-LHERZOLITES INTO NARROW SHEAR ZONES OF SERPENTINITES FROM RHODOPE MASSIF, BULGARIA

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ABSTRACT

Eclogites and eclogitized serpentinites are present in a dismembered and metamorphosed ophiolitic association from the Rhodope Massif in South Bulgaria. The ophiolitic association which is widespread throughout the entire massif, marks a stable stratigraphic level in the well stratified Precambrian metamorphic basement. The latter is divided into two supergroups: lower - Prarhodopian - polymetamorphic infracrustal gneiss complex and upper - Rhodopian - a transgressive supracrustal complex, containing the ophiolites. It is considered that the ophiolites represent ocean crust fragments, obducted over the active margin of an ancient continent. They were covered by pelite- carbonate sediments of Riphean age and later folded and metamorphosed together with the gneisses of the basement. Synmetamorphic fold structures are typical for this stage. Linear and dome anticlines are observed, their cores containing gneisses of the Prarhodopian Supergroup. Both the Rhodopian Supergroup and the Ophiolitic Association in it, occupy close to tight subvertical, inclined and recumbent synclines between positive gneiss fold structures. The primary ophiolite components of basic volcanites, gabbros, gabbro-norites and serpentinized peridotites underwent a continuous metamorphic and structural evolution and as result talc-chlorite-actinolite schists, pyroxenites, eclogites, various amphibolites and metasomatic gabbro-diorites were formed. Eclogites are displayed along local shear zones (Kozhoukharova, 1988). They are most often observed in the deepest and most highly compressed synclines and are usually situated at the lithological contacts of rocks with different rheological properties. Eclogitized serpentinites are found only in the intensively folded Avren syncline, Eastern Rhodopes. Its southern part is pinched between two anticlines and is deformed by isoclinal folds, steeply inclined to west. The core of the syncline contains amphibolites and marbles. Numerous small serpentinite bodies are emplaced between the rock layers. Some of them are eclogitized at the contacts and the serpentine is replaced by enstatite, diopside, olivine, dolomite with sporadic presence of small garnet grains. One of the serpentinite bodies is of special interest for the discussion of eclogitization processes. It is a large lenticular body 3 km long and 400-600 m wide, lying between rigid garnet-bearing gneisses. At the periphery of the body serpentinites possess a banded structure, demonstrated by alternation of dark green unaltered serpentine stripes with light beige-rose, thin (1-2 cm) garnet-lherzolite bands. The garnet-lherzolite zones are always in conformity with the boundaries of the body, as well as the general stratification and metamorphic schistosity of the country rocks. The zones gradually disappear towards the central parts of the serpentinite body. At first the garnet disappears and further also - the pyroxenes. The serpentinites have no traces of eclogitization inside of the body.The garnet bearing lherzolite bands consist of: garnet ($Prp_{50-56}Alm_{27-29}Grs_{16-18}Sps_{1-2}$), enstatite ($En_{84-86}Fs_{14-15}$), diopside ($Wo_{49-51}En_{46-47}Fs_{4-5}$), olivine ($Fo_{88}Fa_{12}$) and spinel (Cr pleonaste). Usually the bands have a zonal structure. Their central parts are occupied by garnet, followed by strips consisting mainly of enstatite, diopside, olivine and spinel. A transitional zone of cryptocrystalline talc-chlorite aggregate is formed between the eclogite minerals and serpentinite. The myrmekite-like symplectites are built up of: a. diopside and spinel; b. diopside, enstatite and spinel; c. diopside, spinel and magnetite; d. diopside and actinolite. They are very characteristic reaction products in the transitional zone. Similar layered metaperidotites are also found in North Greece at the Kimi village (Mposkos and Wawrzenitz, 1995).Garnet-free lherzolites from the more internal zones as well as from another small body consist of enstatite ($En_{90}Fs_{10}$), diopside ($En_{47-50}Wo_{46-50}Fs_{3-4}$), olivine ($Fo_{89-90}Fa_{10-11}$) and spinel-picotite. The Al-content in ortho-and clinopyroxenes from garnet-lherzolites is higher (enstatite 0.12-0.18; diopside 0.11-0.14 apfu) than that from garnet-free lherzolites (enstatite 0.04-0.07; diopside 0.02-0.07 pfu) - evidence for increasing t crystallization temperature in garnet-lherzolite peripheral bands. The P-T conditions of mineral crystallization for garnet-lherzolites estimated by several garnet-pyroxene geothermobarometers vary within the range: T = 640-740ºC; P = 12-15 kbar and for garnet-free lherzolites: T = 500-623ºC; P = 10-12 kbar. At the same time the background regional metamorphism of the country rocks is typically medium pressure amphibolite facies, constrained by serpentine stability to 580-600ºC. A similar strongly expressed spatial anisotropy of the thermodynamic parameters is peculiar to the tribological systems. The genesis of garnet and garnet-free lherzolites is considered as crustal eclogitization of previously serpentinized ultrabasites, due to its deformation during syn-metamorphic folding of the metamorphic basement. Then, narrow shear zones were formed at the periphery of the serpentinite bodies, where interlaminar slip took place. As a result, temperature and pressure increased, the serpentine was dehydrated and replaced by talc, chlorite, ortho-and clinopyroxenes, olivine, spinel and garnet. Some authors (Wintsch, 1985) have proposed an increasing of temperature to 1000ºC in such zones. The arguments for the orogenic syn-metamorphic origin of the garnet-lherzolites from the Avren region, Rhodope massif will be sumarised again: 1) The Ophiolitic Association in the Rhodope massif is an integral part of the Precambrian basement with a wide areal distribution and constant stratigraphic position. It is overlain by a well-stratified rock succession with quite well-preserved primary sequence and normal lithological contacts. It does not mark any late Caledonian-Herzynian or Alpine subduction zones; 2) Garnet-lherzolites are found only in the most intensive folded metamorphic terraines in the Rhodope massif; 3) The formations of garnet-lherzolites mostly in the peripher-

al zones, at lithological contacts of the serpentinite bodies, entirely concordant with general stratification and metamorphic schistosity is evidence for a syn-metamorphic genesis and excludes the probability that these were exotic relict magmatic products; 4) The mineral association of garnet-lherzolites is post-serpentinization one. Everywhere the eclogite minerals replace the serpentine, but themselves are not deformed and altered.

This example indicates the possibility to obtain eclogite P-T condition in the confined space of local shear zones, and at the same time for the differential development of the metamorphic processes during orogenesis.

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