Lithos 108 (2009) 37–71

Contents lists available at ScienceDirect

Lithos

journal homepage: www.elsevier.com/locate/lithos

Mantle peridotites from the Dinaridic ophiolite belt and the Vardar zone western belt, central Balkan: A petrological comparison

B.A. Bazylev [a,*], A. Popević [b], S. Karamata [b], N.N. Kononkova [a], S.G. Simakin [c], J. Olujić [d], L. Vujnović [d], E. Memović [e]

[a] Vernadsky Institute of Geochemistry and Analytical chemistry RAS, Moscow, Russia
[b] Serbian Academy of Sciences and Arts, Belgrade, Serbia
[c] Institute of Microelectronics and Informatics RAS, Yaroslavl', Russia
[d] Geological Institute of Republic of Srpska, Zvornik, Bosnia and Herzegovina
[e] Technical Faculty, Kosovska Mitrovica, Serbia

ARTICLE INFO

Article history:
Received 30 November 2007
Accepted 19 September 2008
Available online 21 October 2008

Keywords:
Subcontinental lithospheric mantle
Abyssal peridotite
Back-arc peridotite
Dinarides
Vardar zone

ABSTRACT

The nearly parallel Dinaridic ophiolite belt and the Vardar zone western belt are assumed to be the remnants of two distinct oceanic basins, constituting different parts of the Tethys Ocean that separated the Gondwana and Eurasia continents during Mesozoic time. These belts comprise numerous large peridotite massifs and small bodies whose petrology was poorly known. This paper presents a large set of internally consistent analytical data for peridotites, including primary mineralogy, major-element chemistry and clinopyroxene geochemistry for massifs of both the ophiolitic belts. We propose, discuss and apply a set of mineralogical, geochemical and petrologic criteria that allow a recognition of the probable geodynamic setting of formation of the ultramafic massifs.

Ultramafic massifs of the Vardar zone western belt gradually change in composition northwards from depleted spinel lherzolites (Banjska massif) to depleted harzburgites (Maljen massif); these bodies originated in the same geodynamic setting, probably a back-arc spreading center. By contrast, the Dinaridic belt ultramafic massifs include several different types that formed in different geodynamic environments. Orogenic lherzolites, interpreted as subcontinental peridotites (Kozara, Čavka, Borja, Sjenički Ozren and Bistrica massifs) are dominated by fertile spinel and plagioclase lherzolites with subordinate amounts of depleted spinel lherzolite, spinel harzburgite, rare dunite and very rare vein garnet clinopyroxenite. The inferred subcontinental peridotites of these massifs are not co-magmatic with neighboring basalts and cannot be considered as members of a single ophiolitic assemblage. Massifs of two other types are less common in the Dinaridic ophiolite belt. These are composed of spinel lherzolite–harzburgite (Zlatibor and possibly Bosanski Ozren massifs) and depleted harzburgite (Tuzinje and Brezovica massifs); both probably originated in a suprasubduction environment. The available data suggest that the studied ultramafic rocks formed in two different oceanic basins, probably marginal seas. We also suggest that the orogenic lherzolites that dominate the central-northern part of the Dinaridic ophiolite belt formed as a result of continental lithosphere extension after closure of the Dinaride oceanic basin and were later tectonically incorporated into the ophiolitic mélange.

1. Introduction

Reconstruction of the geodynamic evolution of a fold belt is a complex geological problem and various methods (e.g. stratigraphical, palaeontological, geochronological, geochemical and petrological) are widely used to achieve this. The recognition of the geodynamic settings in which spinel peridotites occur in fold belts is a key part of this global problem. Specifically, this is a vital issue in the Central Balkan region where large ophiolitic massifs are mainly composed of ultramafic rocks. Mineralogical, petrological and geochemical criteria are needed for the correct reconstruction of the probable geodynamic setting of formation. Such criteria can be developed based on studies of peridotites formed in the known geodynamic settings (e.g. modern Mid-Ocean Ridge (MOR) peridotites, back-arc peridotites and forearc peridotites). Also, helpful insights can come from petrological modelling of partial melting and the subsolidus evolution of mantle peridotites in different geodynamic settings. However, representative analytical data are clearly required to apply these criteria.

Recently published analytical data for a number of the Eastern Mediterranean ultramafic massifs (Lugović et al., 1991; Beccaluva et al., 1994; Bizimis et al., 2000; Dijkstra et al., 2001; Bazylev et al.,

* Corresponding author. Fax: +7 495 9382054.
E-mail address: bazylev@geokhi.ru (B.A. Bazylev).

0024-4937/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.lithos.2008.09.011

2003; Barth et al., 2003, 2008), along with data on associated mafic rocks, indicate the formation of the majority of the ophiolite massifs in this region in suprasubduction settings (Robertson, 2002; Dilek et al., 2008, and references therein). However, some ophiolite massifs of the western belt of the Albanides (Beccaluva et al., 1994; Robertson, 2002), of the Hellenides (Dijkstra et al., 2001; Barth et al., 2003, 2008) and of the northern Dinarides (Lugović et al., 1991) are thought to have formed in a mid-ocean ridge (MOR) setting.

Peridotites from the ophiolitic massifs of Serbia and Bosnia remain the least studied in the Eastern Mediterranean. Analytical data including the major-element chemistry (Lugović et al., 1991; Pamić et al., 2002; Bazylev et al., 2003) and the geochemistry (Lugović et al., 1991) of bulk rocks are available only for a few massifs. Representative data on the primary mineralogy of ultramafic rocks was published only for the Brezovica massif (Bazylev et al., 2003). Because of this, previous attempts to compare peridotites from different ophiolite belts in the region (Popević, 1971; Maksimović and Majer, 1981; Pamić et al., 2002) and to interpret peridotite petrology within the scope of regional geology and geodynamics (Robertson and Karamata, 1994; Karamata et al., 2000a; Robertson, 2002) were hindered by lack of data.

The first goal of this paper is to present an internally consistent and representative set of analytical data (mineralogical, petrochemical, geochemical) for peridotites from a number of massifs and localities from both Dinaridic ophiolite belt and the Vardar zone western belt. The second aim is to set out and discuss some petrologic–geochemical criteria for recognition of the geodynamic setting of formation of the peridotites. The third and final aim of the paper is to highlight particular petrologic and geodynamic features of peridotites from the two ophiolite belts, to compare them and to discuss the available data in the scope of regional geodynamics and petrology.

2. The regional geology and geodynamics framework

One of the branches of the Alpine-Himalayan orogenic belt extends from the Alps southeastwards to the Dinarides in Croatia, Bosnia and Serbia, and then southwards through the Albanides and Hellenides, and beyond (Khain, 2001). Within the Dinarides, a number of sub-parallel belts, interpreted as ophiolite belts, have been recognized (Karamata and Krstić, 1996; Karamata et al., 2000a, and references therein) (Fig. 1). The southwestern one is commonly referred to as the Dinaridic ophiolite belt *sensu stricto* (DB); the central one is known as the Vardar zone western belt (VZWB), and the northeastern one as the main Vardar zone. All of these belts are mainly composed of ophiolitic mélange. This includes terrigenous sedimentary rocks, minor cherts and limestones, together with basalts, diabases, various gabbros and ultramafic rocks (Karamata, Krstić, 1996; Dimitrijević et al., 2000; Pamić et al., 2002). The ophiolitic rocks range from small blocks, to bodies of variable sizes, to large massifs within the mélange, and large massifs thrust over the ophiolitic mélange. Within the large ultramafic massifs of all of these belts, the ultramafics do not usually display primary contacts with gabbroic and basaltic rocks, although there are

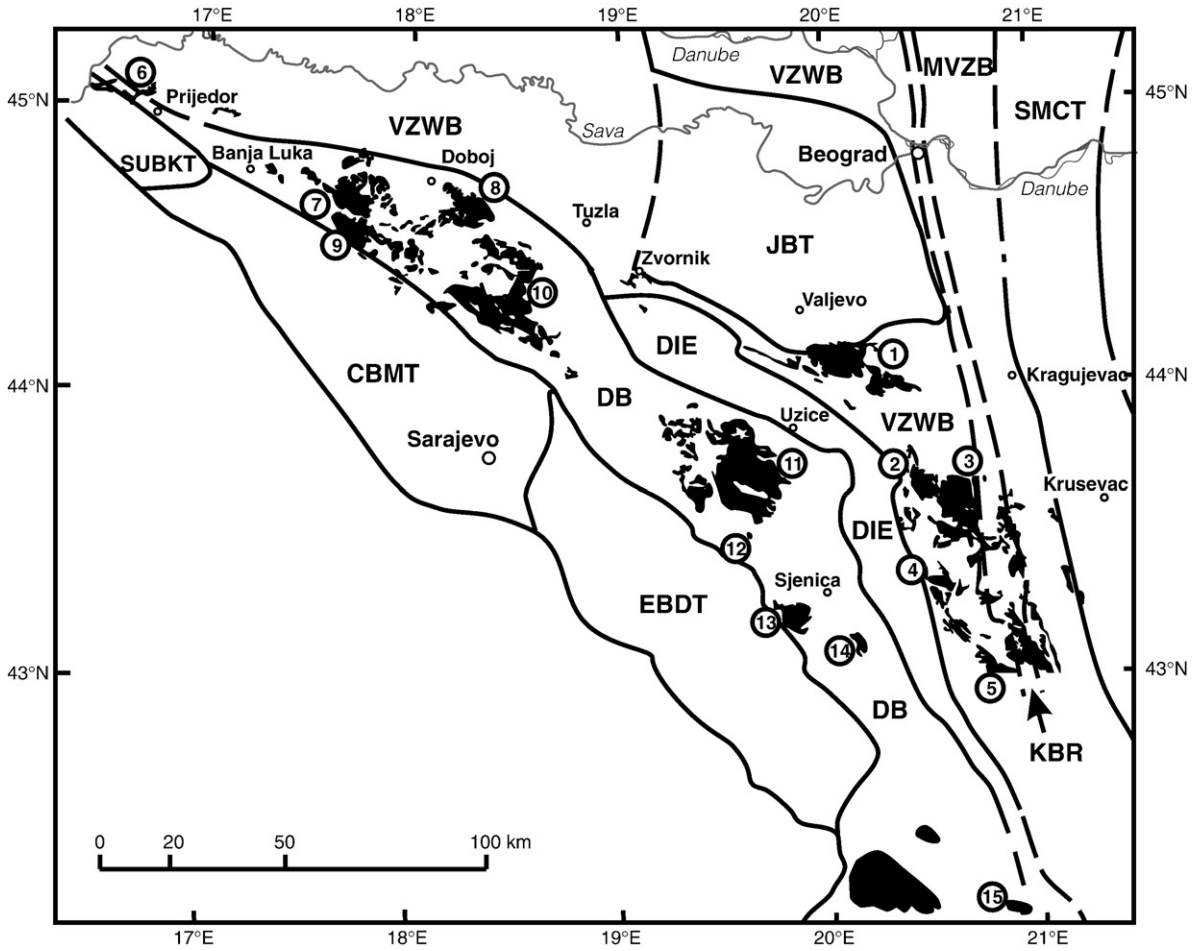

Fig. 1. Position of the studied peridotite massifs in the geodynamic framework of the region. The ophiolite belts and neighbouring terranes (Karamata et al., 2005): DB — the Dinaridic ophiolite belt, VZWB — the Vardar zone western belt, MVZB — the main Vardar zone belt, DIE — the Drina-Ivanjica terrane/element, KBR — the Kopaonik block and ridge, JBT — the Jadar block terrane, SMCT — the Serbo-Macedonian composite terrane, EBDT — the East Bosnian–Durmitor terrane, CBMT — the Central Bosnian mountains terrane, SUBKT — Sana–Una–Banija–Kordun terrane. The ultramafic massifs, complexes and bodies: 1 — Maljen, 2 — Troglav, 3 — Stolovi, 4 — Trnava, 5 — Banjska, 6 — Kozara, 7 — Čavka, 8 — Bosanski Ozren, 9 — Borja, 10 — Konjuh, 11 — Zlatibor, 12 — Bistrica, 13 — Sjenički Ozren, 14 — Tuzinje, 15 — Brezovica.