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PSEUDOSPINFEX OLIVINES FROM GÓRY SOWIE BLOCK AND JORDANÓW-GOGOŁÓW SERPENTINITE MASSIF (SW POLAND)

Abstract: Pseudospinifex olivine was found in metaperidotites from Jordanów-Gogołów Serpentine Massif and Góry Sowie Block. This olivine variety suggests that metaperidotites were formed at HP-MT metamorphic conditions. Occurrence of pseudospinifex olivine records deep sinking of ultramafic bodies into subduction zone and subsequent rapid exhumation with exhumation rate ca. 10 km/Ma.

Keywords: pseudospinifex olivine, HP metamorphism, subduction zone, Sudety Mts.

INTRODUCTION

Olivines displaying platy habit developed perpendicularly to [001] are commonly labeled as spinifex or pseudospinifex depending on its origin. Spinifex olivine are commonly formed as a result of undercooling of komatiite-type rocks (*e.g.* Faure *et al.* 2003, Arndt *et al.*, 2004). Pseudospinifex olivines were found in metaperidotites that had experienced high pressure (HP) metamorphism and were identified as products of antigorite breakdown at $T > 640^{\circ}\text{C}$ & $P > 1.6$ GPa, (*i.e.* Trommsdorff *et al.* 1998; Puga *et al.* 1999).

The objective of this paper is to document the HP metamorphic events as exemplified by occurrence of pseudospinifex olivines within Jordanów-Gogołów Serpentine Massif (JGSM, Sudetic ophiolite) and Góry Sowie Block (GSB) ultrabasic rocks. Our results can be used as potential tool that can delineate the geodynamic setting of the pseudospinifex-bearing rocks from JGSM and GSB.

GEOLOGICAL SETTING

The JGSM and the GSB are situated at the northeastern border of the Bohemian massif. JGSM is composed of highly serpentinized peridotite mantle tectonites and ultramafic cumulate interpreted as dismembered ophiolite sequence of the Sudetic ophiolite (*e.g.* Majerowicz 1979; Dubińska, Gunia 1997). The mantle tectonite sequence of Sudetic ophiolite also comprises Braszowice-Brzeźnica and Szklary massifs adjacent to GSB (Fig. 1). Small ultrabasic bodies also occur within GSB gneisses (Gunia 1997).

JGSM ultrabasic rocks are typically completely serpentinized; the serpentinite varieties are represented by pseudomorphic varieties often ascribed to LT-LP ocean floor

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metamorphism; the pseudomorphic serpentinites are frequently obliterated by antigorite and a late monoclinic amphibole close to tremolite in composition (*e.g.* Dubińska 1995; Dubińska *et al.* 2002). Scarce JGSM ultrabasic rocks containing relict olivine document UHP metamorphism, starting from 410-km discontinuity mantle zone up to surface (Dubińska *et al.* in press), analogous to subduction/eduction model of Brueckner, van Roermund (2004). GSB ultrabasic rocks clearly record metamorphic retrogression starting from eclogite facies conditions via amphibolite to subgreenschist facies metamorphism (Dubińska *et al.* 2002).

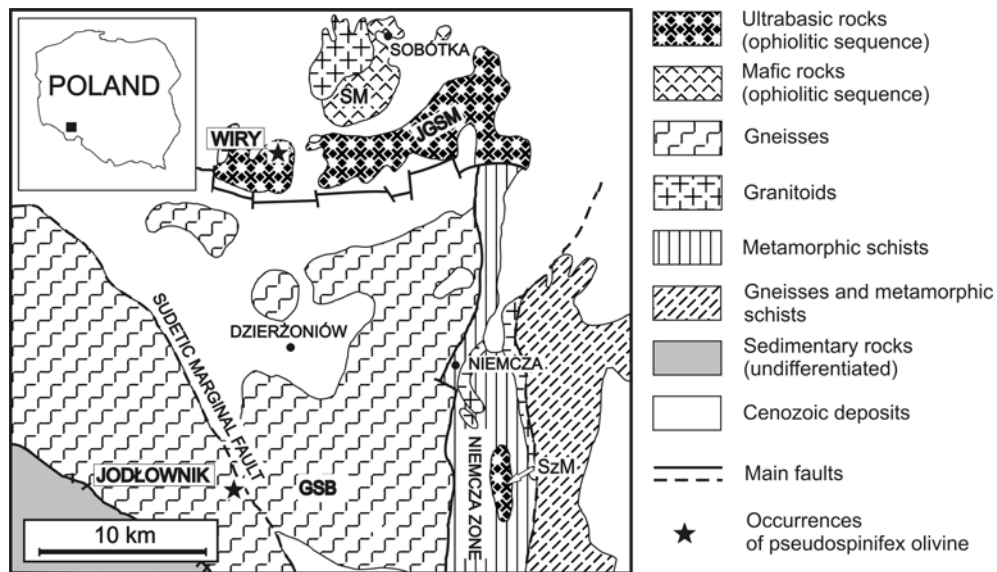


Fig. 1. Simplified geological sketch of the studied area. BBM – Braszowice-Brzeźnica serpentinite Massif, GSB – Góry Sowie Block, JGSM – Jordanów-Gogołów Serpentinite Massif, NRM – Nowa Ruda gabbroic Massif, SM – Ślęza gabbroic Massif, SzM – Szklary ultrabasic Massif.

RESULTS AND DISCUSSION

The samples were studied using conventional petrographic and XRD methods. Mineral chemical compositions were determined by electron microprobe (CAMECA SX100).

Ultrabasic rocks from JGSM and GSB containing pseudospinifex olivines are very scarce. Authors selected seven pseudospinifex olivine bearing samples: four samples from JGSM metabasic rocks (Wiry Mine) and three samples from GSB (Jodłownik, Fig. 1).

Studied pseudospinifex olivines occur together with talk, monoclinic amphibole, serpentine-group minerals (lizardite, late product of serpentinization), Mg-chlorite, calcite, magnesite, ferrichromite, and magnetite (Fig. 2). Crystal habit of the studied olivine corresponds to similar olivine described from metaperidotite from Nevado Filábride Complex (Trommsdorf *et al.* 1998; Ruiz Cruz *et al.* 1999).

Pseudospinifex olivine from Wiry mine are homogeneous in composition (average Fo 0.900 ± 0.002 mol. %, Fo = forsterite). Crystal habit and composition of the Wiry olivine are close to Nevado Filábride olivine considered as products of antigorite breakdown (see for details Trommsdorf *et al.* 1998; Ruiz Cruz *et al.* 1999).

The pseudospinifex olivine from Jodłownik is inhomogeneous. Fo content in the core is similar to the Wiry olivine; the rims of the Jodłownik olivine plates are Fe-enriched (0.85-0.89 Fo, Fig. 2D and Fig. 3A). Fo content of granoblastic olivines from Jodłownik ranges from 0.84 to 0.88 and is close to Fe-enriched rims of pseudospinifex (Fig. 3A). Moreover, the Fe-enriched rims of Jodłownik pseudospinifex olivines are close in composition to Fe-rich zones of JGSM olivines can be ascribed to peridotite melting analogously to interpretation Kushiro, Watter (1998), and Gaetani, Watson (2000).

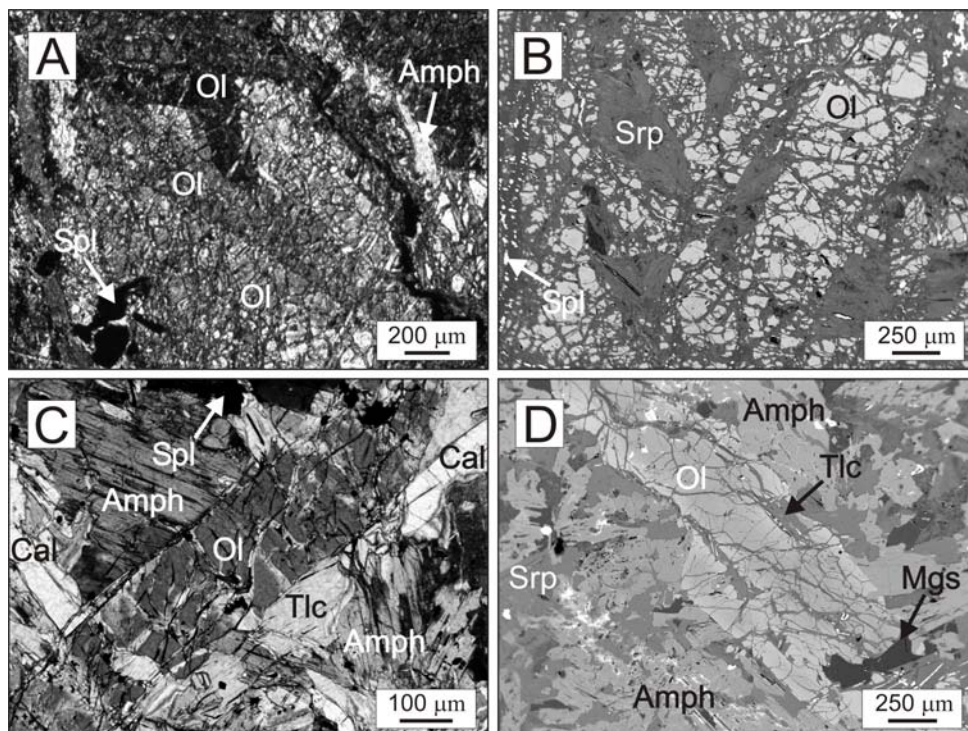


Fig. 2. Photomicrographs and BSE images of the studied pseudospinifex olivines. A – photomicrographs of the peridotite from Wiry mine (JGSM, sample Wi51), B – BSE image of partially serpentinized ultramafic rock (JGSM, sample Wi56), C – photomicrographs of the peridotite from Jodłownik (GSB, sample GS75), D – BSE image of the ultramafic rock containing inhomogeneous pseudospinifex olivine, intergrown with retrograde mineral assemblages (GSB, sample GS75). Amph – monoclinic amphibole, Cal – calcite, Mgs – magnesite, Ol – olivine, Spl – spinel group minerals, Srp – serpentine group minerals, Tlc – talc.

Minor element (Ni, Mn) contents in both Wiry and Jodłownik olivines are significantly diversified (Fig. 3A, 3B). The scatter of analyses is larger than fields proposed by Trommsdorff *et al.* (1998). The scatter can be tentatively explained as a result of fast olivine crystallization and/or interaction with a metastable melt formed during decompression.

Occurrence of pseudospinifex olivine in the studied GSB and JGSM rocks records HP metamorphism of ultramafic rocks and subsequent rapid exhumation. JGSM ultramafic rocks, including pseudospinifex olivine bearing variety, are overgrown by late monoclinic amphibole, its composition, close to tremolite, suggests a posterior greenschist facies metamorphism overprinting rapidly exhumed JGSM ultramafic rocks.

The Al- and Na-rich amphiboles from SGB ultramafic xenoliths document isothermal retrogression path starting from eclogite facies (see for details Bylina *et al.* 2001; Dubińska *et al.* 2002). The HP-MT metamorphism recorded by the pseudospinifex olivines unequivocally documents an earlier deep sinking of ultramafic bodies and subsequent extreme rapid exhumation (eduction) with emerging rate ~ 10 km/Ma (Carswell *et al.* 2003).

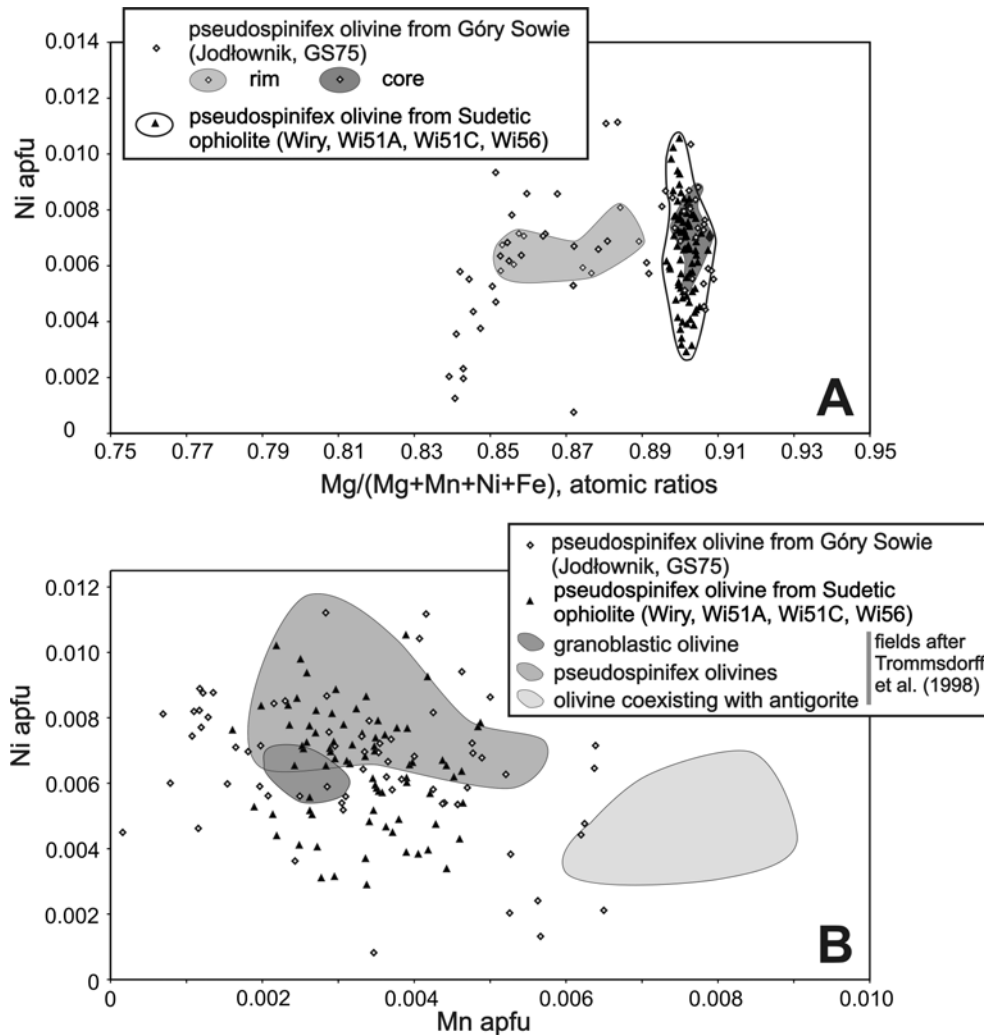


Fig. 3. Chemistry of the studied olivines. A - Mg/(Mg+Mn+Ni+Fe) vs. Ni diagram; B - Mn vs. Ni diagram of the studied olivines compared with different varieties of metamorphic olivine described by Trommsdorff *et al.* (1998)

Acknowledgements. The authors express their sincere thanks to Dr. Piotr Dzierżanowski for help with EPMA analysis. Financial support was provided by UW IGMiP BW and ING PAS (4.3/2005) internal grants.

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