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#### FIRST SUDETIC OCCURRENCE OF JADEITE IN METABASALTS

**Abstract:** The Lower Carboniferous wildflysch from the Jędrzychowice region (the westernmost part of the Kaczawa Complex), include numerous exotics, among which the blueschist blocks and pebbles have been recognized. The blueschists are: (1) jadeite-lawsonite- and (2) jadeite-free, aragonite-glaucophane-bearing rocks. The blocks and pebbles of the jadeite-bearing blueschists are cropped-out at the top and slopes of the hill located 1 km to the north of Jędrzychowice village. Jadeite recognized there is the pure Na-Al clinopyroxene, preserved as the main (up to 30 vol% of modal composition) mineral of the blueschist facies assemblage that was equilibrated at pressure 10-11 kbar and temperature lower than 330°C.

**Keywords:** jadeite, alkali basalt, blueschists, wildflysch, Sudetes.

#### INTRODUCTION

Pure jadeite (Jd) is the sodium-aluminium clinopyroxene, the chemical formula of which ( $\text{NaAlSi}_2\text{O}_6$ ) excludes presence on the M1 side of the Cr [kosmochlor (Ko) molecule], Sc [jervisite (Je) molecule], and  $\text{Fe}^{3+}$  [aegirine (Ae) molecule] accessory constituents, that are the main cations, which define the listed end-members of sodium pyroxenes (Morimoto et al. 1988). These forbidden subcomponents can be completed by Ti (Radvanec et al. 1998), or by vacancies and Ca (on the M2 side), extrapolated to the Ca-Escola (CaEs) molecule (Escola 1921; Bruno et al. 2002). Among the sodic pyroxenes both jadeite and aegirine show extensive solid solution additionally with the Ca-Mg-Fe pyroxenes [Wo, En Fs – “quadrilateral” components (Q)]. In the Jd-Ae-Q classification (Morimoto et al. 1988) jadeite is defined up to 20 mol% of the Q and up to 50 mol% of the Ae components.

Jadeite is considered to be index mineral of high pressure and low temperature metamorphism realized within subduction zone. This mineral is the high pressure product of the univariant reaction albite = jadeite + quartz (Holland 1980, Ghent 1988) or is the high to ultra-high pressure product of dehydration of glaucophane or paragonite (e.g. Biino, de Capitani 1995).

For the first time in the Central European Variscides, jadeite have been documented by Muszyński & Kryza (1993) in the SE segment of the Kaczawa Complex (Bolków and Świerzawa units). These authors have found some relics of nearly pure jadeite (Jd = 93-98 mol%) and aegirine (Jd = 15-35 mol%) in the acide

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metavolcanic rocks of trachyte composition. In the basic metavolcanic/subvolcanic rocks from Sudetes jadeite have not been earlier recognized.

#### GEOGRAPHIC AND REGIONAL SETTING

The jadeite bearing blueschists have been found in the region closed to the western border of Poland, 3 km northward of Zgorzelec, about 1 km to the north of Jędrzychowice village (Fig. 1), where the W-E trending morphological undulations are cut by the N-S trending railway. The highest hill of this region, located to the east from the railway cutting, is built up of the wildflysch including the jadeite blueschist blocks, which range in size from 20 to 100 m in diameter. The pebbles of the jadeite blueschists up to 0.5 m in diameter can be found in abundance on the northern slope of this hill.

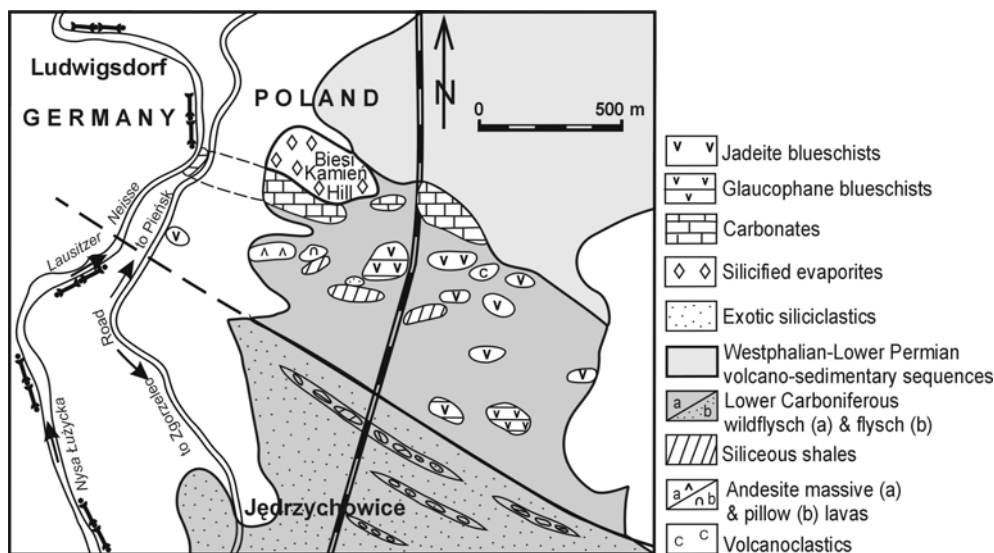


Fig. 1. Geological sketch-map of the Jędrzychowice rock-unit.

In the regional sens, the discovered occurrence of the jadeite blueschists is situated within the Lower Carboniferous, Jędrzychowice/Ludwigsdorf wildflysch-to-flysch succession (Wajsprych & Achramowicz 2003). Within the wildflysch sequence the blueschists and the other exotics are mantled by turbidites which display no evidence of metamorphic alteration. The Jędrzychowice/Ludwigsdorf unit is interpreted to have been formed in collisional settings during the final stages of Variscan orogeny.

#### GEOCHEMISTRY OF JADEITE BLUESCHISTS

All samples of the analysed jadeite blueschists display a high similarity in their chemical composition. The low contents of silica ( $\text{SiO}_2$  in the range of 44 – 48 wt%) and high contents of the alkali elements ( $\text{Na}_2\text{O} + \text{K}_2\text{O}$  ranges from 5.0 to 6.5 wt% with  $\text{Na}_2\text{O} > \text{K}_2\text{O}$ ) suggest basanite – trachybasanite composition of the protolithic

lavas of these blueschists. The ratio Nb/Y versus Zr/TiO (Winchester, Floyd 1977) defines the parental rocks of the jadeite blueschists as alkali basalts. The Y-Zr/4-2Nb (Meschede 1986) trace elements contents precise these lavas as the within plate alkali basalts. Based on the Ta/Yb – Th/Yb rations (Pearce 1983) it is concluded that these lavas were extracted from enriched mantle source (within plate basalts) and have no signs of crustal contamination. Since, an oceanic plateau component should be considered.

#### CRYSTALLINE VARIETY OF JADEITE

A few characteristic forms of jadeite are evidenced. The most common are subradial fibrous-to-prismatic aggregates of jadeite (Fig. 2a) which are very similar to those known from the Franciscan Complex (e.g. Radvanec et al. 1998). Such the

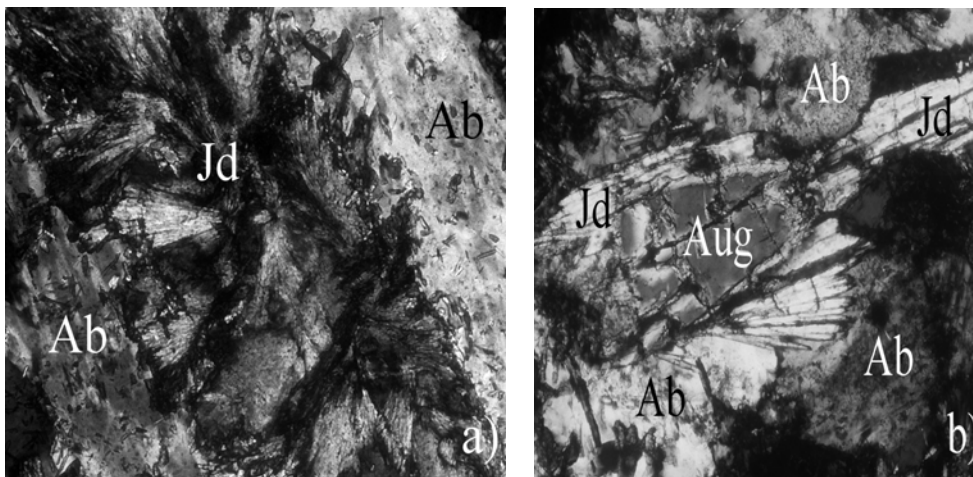


Fig.2. Typical forms of jadeite from the Jędrzychowice blueschists.

aggregates, differently oriented, together with quartz form mineral replacements of the former albitic grains. The full rosettes of prismatic jadeite that developed around apatite are evidenced too (see Wajspych, Achramowicz 2003: Fig. 4B). Another type of a shape of jadeite form the mesh-like, fibrous aggregates. They are composed of very fine, 0.05-0.20 mm long crystals of jadeite that are chaotically arranged at a periphery of the albitic grains. Jadeite is also present in a form of subhedral crystals mantling igneous pyroxene. The main crystallographic elements of such jadeite crusts are oriented in accordance with those of augite crystals (Fig. 2b). The large (up to 30 mm long), euhedral crystals of jadeite were observed in the Jędrzychowice blueschists.

#### CHEMICAL COMPOSITION OF JADEITE

The Na-Al clinopyroxene recognized in the blueschists from the Jędrzychowice rock-unit indicates that the chemical composition is very closed ( $Jd_{98.99}Aeg_{1.0}Q_1$ ) to pure jadeite. It is worth to be noted that ideally pure ( $Jd_{100}$ ) jadeite is commonly

observed. The measured Na<sub>2</sub>O varies in the range of 14.50-15.50 wt% and corresponds to 0.98-1.0 Na atoms per formula unit calculated on the basis of 6 oxide atoms. The content of Al<sub>2</sub>O<sub>3</sub> in the range of 24.97-25.40 wt% gives 0.98-1.0 Al atoms p.f.u. The main additional subcomponents of jadeite indicate low contents; e.g. FeO is measured in the range of 0.13-0.90 wt%, CaO (0.8-0.19 wt%), MnO (0.04-0.09 wt%), and Cr (0.0-0.6 wt%). Some observed regularities in zonal changes of jadeite contents from core ((Jd<sub>98-99</sub> Aeg<sub>1-0</sub> Q<sub>1</sub>) to rim (Jd<sub>100</sub>) is connected with decreasing of Fe and Ca and increasing of Mn and Cr.

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