Characterization and geodynamic implications of contrasting metamorphic evolution in juxtaposed high-pressure units of the Western Erzgebirge (Saxony, Germany)

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Abstract: The Western Erzgebirge consists of a sequence of three tectonometamorphic nappe units with contrasting P-T histories that became juxtaposed during and after exhumation. From the tectonically lowermost to the uppermost these units are the Mica-Schist/Eclogite Unit, the Garnet-Phyllite Unit and the Phyllite Unit. These three units form concentric zones around the core of an antiform composed of the two tectonically lowermost units of the Erzgebirge, the Red-and-Grey-Gneiss Unit and the overlying Gneiss/Eclogite Unit. Samples from the Mica-Schist/Eclogite Unit and the Garnet-Phyllite Unit of the Western Erzgebirge have been investigated in detail, in order to elucidate the geodynamic history of the region. Different generations of mineral assemblages can be correlated with metamorphic pressure-temperature conditions as well as with the development of the rock fabric. Conventional thermobarometry as well as calculations based on an internally consistent thermodynamic data set suggest that the lowermost Mica-Schist/Eclogite Unit formed under high-pressure, intermediate-temperature conditions. Based on preserved relic mineral assemblages, minimum pressures of 12 kbar at temperatures of 470–560 °C were obtained for different types of mica schist and orthogneiss. A second stage of equilibration occurred during the formation of the main foliation under conditions of about 7–8 kbar and 500–630 °C. A late stage of equilibration is indicated under conditions of 450–500 °C and 2–3 kbar during the third deformational event. Well-defined P-T conditions of equilibration at approximately 470 °C and 9 kbar were obtained for the Garnet-Phyllite Unit. P-T paths of the Mica-Schist/Eclogite Unit and the Garnet-Phyllite Unit are clockwise, with maximum pressures preceding the thermal climax. P-T conditions for the Phyllite Unit are poorly constrained, but pressures of approximately 2 kbar are indicated. The quartz microtexture suggests temperatures in excess of 300 °C for this unit. These results reflect a complex metamorphic history within a tectonic framework characterized by compression due to Variscan continent-continent collision, followed by a multistage extensional event.

Key-words: Western Erzgebirge, pressure-temperature path, thermobarometry, Variscan continent-continent collision, exhumation by crustal extension.

Introduction

The Erzgebirge is located on the border between Germany and the Czech Republic (Fig. 1). In geological terms, it is situated at the northwestern border of the Bohemian Massif, which represents a central, predominantly metamorphosed part of the Mid-European Variscides. It forms a large-scale antiformal structure consisting of several units with a predominantly subhorizontal penetra-