The Wechsel Gneiss Complex of Eastern Alps: A Cambrian continental arc and its Early Proterozoic hinterland

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Abstract: The Lower Austroalpine Wechsel Gneiss and Wechsel Phyllite units are known to have been overprinted by Devonian and Late Cretaceous metamorphism within greenschist facies conditions. For the first time, new U–Pb zircon reveal evidence for two stages of continental arc-like magmatism at 500–520 Ma and 550–570 Ma. We speculate on potential relationships of the continental arc-type magmatism and potential oceanic lithosphere (Speik complex) of Proto-Tethyan affinity, which is also preserved in the Austroalpine nappe complex. Abundant, nearly uniform 2.1 Ga-age signature of detrital zircons in metasediments (paragneiss, quartzite) calls for Lower Proterozoic continental crust in the nearby source showing the close relationship to northern Gondwana prominent in West Africa and Amazonia.

Introduction

As known since a long time, the Austroalpine nappe complex of Eastern Alps and Western Carpathians contains two major basement units, which collided during the Variscan orogeny (e.g., Neubauer & Frisch 1993). These include (1) a nearly unmetamorphic Gondwana-derived fossil-rich unit, which represents an Ordovician back-arc unit and a Devonian passive margin (Neubauer & Sassi 1993); and (2) an amphibolite-grade metamorphic unit, which was fully affected by Variscan amphibolite-grade metamorphism including Devonian, early Variscan high-pressure metamorphism, and which is considered representing, in major portions, a poorly dated magmatic arc system with intermediary and acidic orthogneisses. Among these, the Lower Austroalpine Wechsel Gneiss unit of the Wechsel window shows Devonian pressure-dominated metamorphism in upper greenschist (Müller et al. 1999).

Regional geological setting

The basement within the Wechsel window comprises three units from base to top (Fig. 1): (1) the Monotonous Wechsel Gneiss unit, (2) the Variegated Wechsel Gneiss Unit, and (3) the Wechsel Phyllite unit. In the field, albite porphyroblasts represent the most pronounced feature of both Monotonous and Variegated Wechsel Gneiss units (Neubauer & Frisch 1993). The nature of the boundary between Wechsel Gneiss Units and Wechsel Phyllite Unit, tectonic or primary, remains unclear. In the variegated and Monotonous Wechsel Gneiss Units, Müller et al. (1999) found evidence for a Devonian high-pressure dominated metamorphism

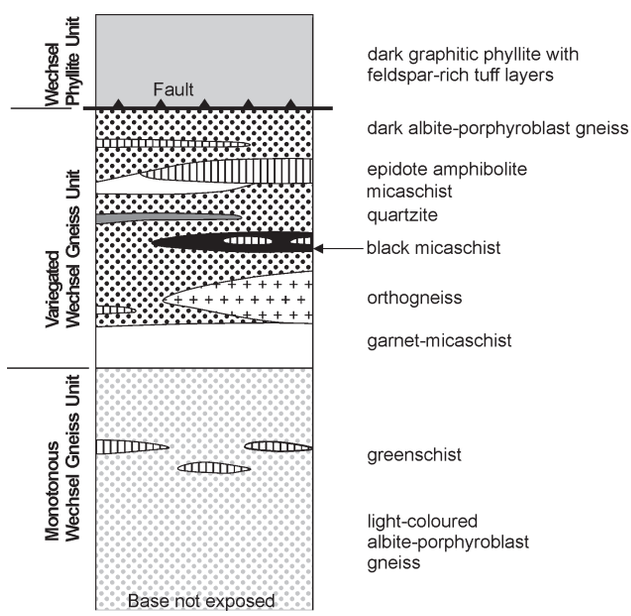

Fig. 1. Lithostratigraphic section of basement units within the Wechsel window, For explanation, see text.

and a low-grade (<350 °C) metamorphic overprint (70–80 Ma), the latter directly related to Early Alpidic nappe stacking of the deep structural level contemporaneous with Gosau basin at top of the Upper Austroalpine within the Austroalpine nappe complex.

Results

Protolith ages of the Variegated Wechsel Gneiss Complex

The Variegated Wechsel Gneiss Unit contains magmatic rocks (hornblende-gneiss, greenschist, acidic orthogneiss) with U–Pb zircon ages between 500 and 523 Ma. In paragneisses and quartzite, the detritus is dominated by several age groups that include euhedral zircons of ca. 490–500 Ma, 550 Ma and detrital components of ca. 1.9–3.2 Ga, with a pronounced maximum of ca. 2.1 Ga. In one samples only, the detritus is dominated by Devonian–Carboniferous ages (380–300 Ma) and its significance remains unclear.

Protolith ages of the Wechsel Phyllite Unit

The Wechsel Phyllite Unit includes feldspar-rich tuffs, which gives latest Neoproterozoic ages (e.g., 556.5± 2.3 Ma and 556.5±9.7 Ma), whereas other samples bear a significant detrital component with dominant age populations of 450–550 Ma and 2.5–2.9 Ma

Discussion

In consequence, the new age data gives evidence for two stages of continental arc-like magmatism at 500–520 Ma and 550–570 Ma. We speculate on potential relationships of the continental arc-type magmatism and potential oceanic lithosphere (Speik complex) of Proto-Tethyan affinity, which is also preserved in the Austroalpine nappe complex (Neubauer 2002 and references therein). We argue, therefore, for long-lasing Late Neoproterozoic to Cambrian subduction of potentially Proto-Tethyan origin along margins of Gondwana.

The abundant, nearly uniform 2.1 Ga-age signatures calls for Lower Proterozoic continental crust in the nearby source showing the close relationship to northern Gondwana prominent in West Africa and Amazonia (Stephan et al. 2018).

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