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Pan-African collision, slab break-off and Rheic ocean opening imprinted in Pre-Variscan complexes of the Western Tatra Mountains, Western Carpathians (Poland/Slovakia).

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The Rheic Ocean started to develop from the rifting of Avalonia from Gondwana during the Silurian and was closed during the Variscan Orogeny. Despite this generally accepted geodynamic scenario, there are still some disagreements about the role of the mantle plume in the Gondwana breakup, and the exact timing of the opening and closure of the Rheic Ocean in different parts of Europe. Age and geochemical data from the Central Western Carpathians (Poland) can help to unravel some open questions.

Core mountains of the Central Western Carpathians are thought to represent Variscan Europe, dominated by Variscan granitoid intrusions [1] and interpreted in terms of the development and closure of the Tornquist and Rheic Oceans. The metamorphic envelope to the Variscan granitoids, migmatized to different extent at c. 360 Ma [2] represents the Pre-Variscan complex, dominated by metapelites, but also containing the orthogneisses, metadiorites, eclogites and amphibolites. Cambrian orthogneisses, dated at 534±16 Ma [3] represent a subduction-related granitoid suite, connected to the Pan-African Orogeny at the northern margin of Gondwana. Metadiorites with rare high Ba (960-3346 ppm) and Sr (775-1001 ppm) geochemical characteristics and lower crustal isotopic signatures (I_{Sr}^{500} = 0.704-0.705; (ε_{Nd}^{500} = -2.1 – -3.0) show a range of protolith ages from 528 Ma to 495 Ma, probably resulting from long-term heating. Two suites of amphibolites with modified MORB-like geochemistry [4] and Nd isotopic characteristics (ε_{Nd}^{360} =+6.5 – -0.68 and 3.8-4.3; T_{DM} = 0.83-0.88 and 0.64-0.65) show zircon core ages of 499±5 Ma and 512 ±5 Ma. Zircon cores show also typical mantle $\delta^{18}O_{VSMOW}$ values in the range of 4.7-6.3‰. Eclogites and garnet-amphibolites, showing MORB geochemical and Nd isotopic characteristics (ε_{Nd}^{360} = 5.0–6.7), with T_{DM} = 0.5–0.6 Ga, show the zircon U-Pb age of ca 350 Ma, being a result of Varsican collision and closure of the Rheic Ocean. A similar age was obtained from amphibolite metamorphic zircon rims (ca 345 Ma), sharing also high $\delta^{18}O_{VSMOW}$ values in the range of 7.7–8.4‰ .

All Lower Paleozoic rocks are interpreted in terms of the fragmentation of the northern margin of Gondwana developed after the Pan-African collision. It was a result of delamination of subducted slab, asthenosphere upwelling and further partial melting of the lower crust. The HiBaSr dioritic intrusions with A-type characteristics were formed as a consequence. Further plume (?) development led to the rifting and the Rheic Ocean opening starting at ca 512 Ma. The closure of the Rheic Ocean as a consequence of Variscan collision is marked by the zircon ages of 350-345 Ma, contemporaneous with granitoid magmatism [1].

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