The age of a former ocean in the Münchberg massif

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In the nappe pile of the Münchberg massif, remnants of a former ocean floor occur within the Prasinit-Phyllit-Serie. This greenschist-facies series consists of predominantly (quartz)-phyllite and greenschist facies MORB-type basalts, with intercalated serpentinite bodies. It crops out mainly along the SE border of the Münchberg massif. The protolith ages of the series are largely unknown. Based on acritarchs, Reitz and Höll (1988) suggested a Neoproterozoic sedimentation age. The metamorphic evolution culminated at 360 – 370 Ma (K-Ar white mica; Kreuzer et al. 1989).

Associated with the serpentinite and greenschist are small bodies of metagabbro. We separated zircon from such a metagabbro (locality S' Blauer Fels, near Götzmannsgrün) to obtain age information about the protolith. U-Pb TIMS data for five multigrain zircon fractions result in a discordia upper intercept age of 404 $\pm$ 10 Ma, but also indicate (sub)recent Pb-loss. Cathodoluminescence (CL) investigations show homogeneous core zones with oscillatory zoning, overgrowths with low CL intensity (high U-content) and high CL intensity (low U-content) as well as irregular appearing zones in the individual grains (interpretable as healed fractures and annealed zones). In-situ U-Pb age determination by laser ablation SF-ICP-MS yields a mean concordia age of 400 $\pm$ 2.2 Ma for the core zones, a mean concordia age of 390 $\pm$ 4 Ma for the overgrowths, and a weighted average Pb-Pb age of 397 $\pm$ 7 Ma for all data, which is identical to the TIMS-based age estimate. Zircon cores and rims have the same Hf-isotope composition, which among the 37 spot analyses show only minor variation. The initial ε(Hf) is +12 $\pm$1.5 (2SD), indicating a depleted mantle source. We interpret the age of the zircon as the magmatic crystallisation age of a mid-ocean-ridge gabbro. Formation of the zircons by a metasomatic event is unlikely considering the ε(Hf) values, which do not indicate a significant crustal contribution. Further, the sample does not show signs of metasomatism.

The combined data indicate a rather short time interval of only $\approx$ 40 Ma for the whole process of formation of the ocean floor (intrusion of gabbros, extrusion of basalts), metamorphism, nappe tectonics, and exhumation. Metamorphism of the high-pressure rocks of the Münchberg massif, structurally on top of the Prasinit-Phyllit-Serie, occurred at ˜395-380 Ma (Stosch and Lugmair 1990), thus only slightly after formation of the ocean floor rocks.

References

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