

A large Permian plutonic system crosscutting different Austroalpine basement units: implications for Permian and Cretaceous tectonics of Eastern Alps

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In some high-grade metamorphic basement units of the Austroalpine mega-unit, temperature-dominated Permian metamorphism is well established as well as the formation of numerous small pegmatites and rare metagabbro bodies. As no sourcing pluton was found up to now, these pegmatites were recently considered to have formed as a result of anatectic metamorphism (Knoll *et al.*, 2018). Based on new U-Pb zircon dating results, we show, for the first time, that a large Permian granitic plutonic system occurs in the footwall units of the pegmatites, which could be considered as the host magma body for pegmatite intrusions. In ascending order of basement units, studied granitic orthogneisses include the foliated Humpelgraben granite-gneiss in the upper part of the Gleinalm “Core” Complex with a ²⁰⁶Pb/²³⁸U average age of 271.0 ± 2.2 Ma. The sheet-like Gleinalm augengneiss stretches over 55 km and forms the structurally highest lithology of the Gleinalm “Core” Complex. The westernmost sample from the Gleinalm augengneiss yields a ²⁰⁶Pb/²³⁸U average age of 272.5 ± 5.0 Ma, whereas the ages of two samples further east are significantly younger (260.8 ± 2.0 Ma, 261.5 ± 2.2 Ma). The Gmeinalm augengneiss has its origin in the Gleinalm augengneiss and crosscuts the ophiolitic Speik Complex and reaches the base of the overlying Rappolt-Almhaus Complex (Neubauer, 1989). It yields a weighted mean ²⁰⁶Pb/²³⁸U age of 256.9 ± 2.2 Ma, which is similar to previously reported ages from pegmatites within the Rappolt-Almhaus Complex in the structurally upward extension of this body but also with pegmatite ages in the overlying eclogite-bearing Koriden Complex as well as in the southern part of the overlying Plankogel Complex (Knoll *et al.*, 2018; Neubauer *et al.*, 2022). Together, the new data reveals the existence of a still well-preserved, although structurally disrupted, Permian plutonic system, which was considered as part of three major Early Alpine (Cretaceous) nappes. As the northern margin of the Gleinalm “Core” Complex is covered by low-grade metamorphic Permian–Triassic strata, the Gleinalm Permian plutonic system is independent from the similar-aged Permian Grogneiss of the Raabalen Complex with its cover, which include Permian volcanics. The results also indicate much more Permian magmatism in the Austroalpine mega-unit of Alps as envisaged before. The new results also imply the need of a new tectonostratigraphy and a new model for the Cretaceous subduction and exhumation.

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REFERENCES

- Knoll, T., Schuster, R., Huet, B., Mali, H., Onuk, P., Horschinegg, M. *et al.* 2018. Spodumene Pegmatites and Related Leucogranites from the Austroalpine Unit (Eastern Alps, Central Europe): Field Relations, Petrography, Geochemistry, and Geochronology. *Canadian Mineralogist* 56, 489–528.
- Neubauer, F. 1989. A plutonic source for pegmatites in the Austroalpine basement of the Gleinalm region (Eastern Alps). *Neues Jahrbuch für Geologie und Paläontologie* (10), 615–624.
- Neubauer, F., Liu, Y.-J., Dong, Y.P., Chang, R.-H., Genser, J., Yuan, S.-H. 2022. Pre-Alpine tectonic evolution of the Eastern Alps: From Prototethys to Paleotethys. *Earth-Science Reviews* 226, 103923.