Evidence from laser ablation ICPMS dating of zircons in Erzegbirge orthogneisses for early Cambrian and early Ordovician pulses of granitic plutonism in the Western Bohemian Massif

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U-Pb isotopic data obtained by laser ablation ICPMS analysis of nine zircons with centre to margin oscillatory growth zones from a K-feldspar-rich augen gneiss in the allochthonous Lower Crystalline Nappe (Konopásek et al. 2001) of the Erzgebirge domain of the western part of the Bohemian Massif are concordant, or near-concordant, and yield a concordia age of 524 ± 10 Ma (2 sigma). This Early Cambrian age represents the time of magmatic crystallization of the protolith of a representative, from near Měděnec, of the "Red gneiss" whose igneous nature is shown by the presence of (deformed) xenoliths. Data from TIMS analysis of zircons with variable proportions of unzoned xenocrystic cores surrounded by oscillatory-zoned overgrowths point to magma derivation from upper Proterozoic, or older, rocks. Data obtained for five zircon grains from another "Red gneiss" in the Lower Crystalline Nappe (in the Klínovec anticline) plot below the concordia. The age of the one point that is near concordant is 519 ± 26 Ma (2 sigma) and the upper concordia intercept age is 530 $^{+82}/_{-35}$ Ma. These data, together with internal features of the zircons, are consistent with Early Cambrian granitic plutonism also in this part of the Erzgebirge but with later Pb loss, possibly associated with considerable fluid movement during thrust nappe development. Another sample of a coarse-grained autochthonous orthogneiss from St Catherine's dome yielded a significantly younger Early Ordovician age of 480 ± 10 Ma (2 sigma) calculated from eight zircon analyses. However, three zircon grains from the same sample gave a significantly older near-concordant Late Proterozoic age of ca 620 Ma.

Provided that the age difference of ca 40 Ma between orthogneisses from Měděnec – Klínovec and St Catherine's dome holds also for other orthogneisses in the Erzgebirge, zircon U – Pb age data could be used to discriminate between allochthonous and autochthonous units in this region.

The ca 25 Ma difference between the Early Cambrian protolith age of the augen gneiss from near Měděnec determined by the laser ablation ICPMS technique and a previously reported older age of 550 ± 9 Ma for a nearby sample determined by the Pb – Pb evaporation technique (Kröner et al. 1995) is accounted for on the basis of the latter not being adequate for dating zircons with a small xenocrystic component. Almost all studied zircons from the coarse-grained orthogneisses contain inherited cores. Accordingly dating of single zircon grains by the $^{207}Pb/^{206}Pb$ evaporation technique is considered to produce mostly core – rim mixed ages. Such age data can result in inaccurate estimation of the time and duration of magmatic events. This explanation is supported by a comparison with other U – Pb and Pb – Pb zircon ages from the Lower Crystalline Nappe unit in the Erzgebirge that shows laser ablation ICPMS data to agree, within the error, with other U – Pb (ID TIMS and SHRIMP) and some of the Pb – Pb zircon evaporation ages (Tichomirowa et al. 2001; Tichomirowa 2002), but to be systematically ca 20–50 Ma younger than the Pb – Pb zircon evaporation ages reported by Kröner et al. (1995).

This study demonstrates the importance of high spatial resolution dating techniques, such as SHRIMP or laser ablation ICPMS, in dating zircons with complex growth history that are common in crustally-derived melts.

References

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