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Double dating of detrital zircon from the Dinarides by fission-track and LA–ICPMS U/Pb analysis

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In sedimentary provenance analysis, a fundamental question is the age of a crystalline source rock and the timing of subsequent thermotectonic events that affected crystalline terrains prior to exhumation and erosion. Zircon is a useful detrital mineral which carries a wealth of information about the petrogenesis, geochronology, alteration, and cooling history of its source rocks, but only few attempts were made so far to combine such data from single grains. We present an approach combining fission track (FT) and in-situ LA–ICPMS U/Pb isotopic analyses from the same grain. Detrital zircons were dated by the FT method, and grain interiors were imaged by SEM-CL to avoid ablation of inherited or other unsuitable domains. Precise and accurate U/Pb isotopic compositions were determined by a simple setup consisting of a 213 nm Nd:YAG laser source, coupled to a quadrupole ICPMS instrument. Our results are significant for at least two reasons: (1) The U/Pb analytical protocols provide an excellent trade-off between analysis quality and a high, cost-effective sample throughput (70-100 zircon grains per day). CL-control and a good spatial resolution aid in reducing age bias, as judged from the notably high proportion (>90%) of concordant (±5%) grain ages. (2) The double dating approach yields valuable insights into the thermal history of source terrains of Dinaride synorogenic sediments. Several clusters of age-pairs can be isolated that identify Alpine tectonostratigraphic units. Given that basement geochronology is known in detail, several source terranes can be pinpointed with a high level of confidence that is normally not achieved by using the two dating techniques separately. A majority of the grains indicating Late Cretaceous overprint is derived from the Austroalpine and/or Tisza Units as this thermal event is not recorded in the Central and Northern Dinarides. Our results clearly demonstrate the mixing of sediments derived from exhumed source areas that previously underwent fundamentally different thermal histories. In the light of new biostratigraphic results indicating post-Eocene depositional age for the outer Dinaride foreland basin sediments and suggesting a complex sediment reworking pattern (Mikes et al. 2008), ambiguous heavy mineral data from these sediments can be re-interpreted in terms of a large-scale dispersal history involving the Pelagonides and the Austroalpine/Tisza Units as the major sedimentary source areas.

Reference

Mikes, T., Báldi-Beke, M., Kázmér, M., Dunkl, I., and von Eynatten, H. 2008. Calcareous nannofossil age constraints on Miocene flysch sedimentation in the Outer Dinarides. In: Siegesmund, S., Fügenschuh, B. and Froitzheim, N. (Eds) Tectonic Aspects of the Alpine-Carpathian-Dinaride System. Geological Society, London, Special Publications, 298: 335-363.