Source and tectonic implication of the intermediate to acidic volcanic clasts from Jurassic Neotethyan melanges on the basis of geochemistry and radiometric age dating

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Abstract

Volcanic olistolithes were examined from the Middle to Late Jurassic low-grade metasedimentary complex of the Meliata and Mónosbél nappes (NE Hungary, SE Slovakia). These nappes consist of thin tectonic slices derived from subduction-related trenches of the Neotethys Ocean. During its closure, the Meliata nappe thrust over the northern, imbricated West Carpathian margin. In contrast, the Mónosbél nappe is situated under the obducted Dinaridic ofiolite sheet which thrust over the southern Neotethyan margin, represented by the Bükk "para-autochton".

Geochemical characteristics of cm to 100 m in size rhyolite and andesite clasts of these two melange nappes were investigated. The REE patterns of all the volcanics are very similar. They show 60-200 fold enrichment in light REE relative to CI chondrites (Anders and Grevesse 1989). However, the enrichment in heavy rare-earth elements is only 10-20 fold. Thus the light and heavy REEs are relatively well fractionated (La_N/Lu_N = 2.32-7.69). The most remarkable feature of the normalized REE pattern is the pronounced negative Eu anomaly (Eu_N/Sm_N = 0.58-0.98), indicating plagioclase crystallization prior to the genesis of the melts. Trace-element patterns of the different occurrences are also very similar. In general, CI chondrite normalized values show significant enrichment in LILE and lower enrichment in HFSE (20-50 fold). Among the LILE elements Cs, Rb, Ba along with U shows great variability due to their high mobility. U fractionation may refer to later migration of U^{6+} in well-oxygenated H_2O rich fluids. In contrast with them, the normalized Th values are almost identical, showing 470-720 fold enrichment. Y/Nb, Yb/Ta, Nb+Y/Rb and Ta+Yb/Rb discrimination diagrams indicates volcanic arc environment (Pearce et al. 1984), while Ta/Yb vs. Th/Yb diagram refers to active continental margin setting (Gorton & Schandal 2000).

U-Pb isotope analyses were performed on zircon crystals by LA-ICP-MS. The results are culminating around two ages: 220 Ma and 206 Ma. Both of them indicate volcanic activity in the Late Triassic, which can correspond to two more or less distinct episodes within a long magmatic activity.

Geochemical analysis of several potential Middle to Late Triassic rhyolites and andesites, were performed in order to find the original source of the redeposited clasts. As a result, Middle Triassic tuffs and acidic to intermediate volcanics deriving from the Bükk (Dinaridic margin) and the Transdanubian Range (Upper Austroalpine) have almost identical geochemical pattern. No significant volcanic activity has been proven on the northern margin of the Neotethys Ocean at this period.

Geodynamic implications: 1) The observed geochemical signature indicates Mid- to Late Triassic active margin setting or volcanic island arc. According to our present-day knowledge the subduction of the Neotethys Ocean had not started till that time. It raises the possibility that it is an inherited geochemical signal, indicating geochemical memories of the Paleotethyan subduction.

2) While the melange nappes thrust over the different margins (N and S), their clast composition is similar, thus the clasts at least partly have common source, from the Dinaridic and/or Austroalpine margins. While the ofiolite obduction onto the southern margin is proved to be Late Jurassic, the only Cretaceous nappe contacts have been documented on the northern (Inner Western Carpathian) margin, although subduction also started in the Middle Jurassic. It can be interpreted in two ways: either the latest Jurassic to Early Cretaceous nappe emplacement dismembered the unique (similar) Jurassic trenches into nappe sheets with different tectonic transport directions, emplaced onto different margins or alternatively the first accreted Dinaridic melange nappes were partly thrust on top of the northern margin, via back-thrusting, during the Cretaceous deformation.