Geophysical Research Abstracts, Vol. 8, 04985, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04985

^{40}Ar/^{39}Ar mica ages in flysch and foreland basins: Constraints for orogenic architecture and type of collisional orogeny

F. Neubauer, R. Handler, J. Genser, G. Friedl, D. Mader, D. Schneider

Department of Geography and Geology, University of Salzburg, Hellbrunner Str. 34, A-5020 Salzburg, Austria (franz.neubauer@sbg.ac.at; fax: ++43-662-8044-621)

Based on new ^{40}Ar/^{39}Ar single-grain ages of detrital white mica and on a literature survey, systematic differences in the record in pre-collisional flysch and syn-collisional flexural foreland and contemporaneous intramontane basins can be specified between Alpine, Himalayan and Variscan orogenic belts. The study is based on the assumption of full resetting of the Ar isotopic system in white mica between ca. 375 and 420 ˚C during post-metamorphic regional cooling at low cooling rates following peak temperature conditions during exhumation of previously buried metamorphic complexes. This allows application of the lag-time concept. The lag time is the time elapsed between regional cooling of the host metamorphic/plutonic rocks and the numerical age of deposition of a magmatic/metamorphic mineral grain. Consequently, an progressively exhuming and cooling metamorphic complex results in three distinct levels within the sedimentary column where the detritus is deposited and includes from bottom to top: (1) a layer with old ages from levels which were never affected by temperatures in excess of ca. 375 ˚C, (2) a layer from a partial resetting zone (ca. 375–420 ˚C), and (3) a layer with an increasing proportion of young ages derived from crustal levels beneath the partial resetting zone.

Flysch basins are considered to have formed during pre-collisional accretion of oceanic units. Interestingly, Lower Carboniferous flysch basins of the Variscan orogen always display a significant to relatively high proportion (10 – 50 percent) of detrital white mica, which likely formed in an accretionary wedge. Their lage time of 15 to 40 Ma constrains variable exhumation rates in the accretionary wedge. In contrast, both Jurassic resp. Cretaceous-Eocene flysch successions of Alps and Dinarides show only a very low proportion of detrital minerals from a metamorphic accretionary wedge.

Alpine and Variscan mountain belts of Central Europe and the Himalayan orogen display entirely different lag-time patterns for flexural, molasse-type foreland basins. In the Variscan orogen, the proportion of fully reset detrital white mica is between 80 and 95 percent indicating that during molasse deposition mainly metamorphic rocks were eroded from levels beneath the Ar retention temperature level. In Himalayas, this proportion reaches 10 to 40 percent, and in the Alpine orogen, the amount varies between few to maximum 20 percent. These differences suggest that the entire upper crust must have largely removed prior to molasse deposition in the Variscan orogen. In the Himalayas, exhumation of middle to lower crustal rocks is limited to the frontal part and thick, less metamorphic upper crustal successions are preserved likely because slow denudation due to inappropriate climatic conditions.

In the Alpine orogen, the age distribution of detrital white mica clearly reflects slow and limited denudation of metamorphic units, where fully reset mica arrived late in the flexural Molasse basin. A further effect is the variation of age patterns along strike of the orogen due its transpressional character in accordance with depocentre migration along strike. E.g., the Molasse basin in front of Swiss Central/Western Alps displays a relatively high proportion of young detrital white mica already early in the Molasse sediments in contrast to Eastern Alps where young detrital white mica solely occurs in youngest Molasse formation.

In conclusion, the age signal of flysch and molasses-type foreland basins can be used to constrain first order structures of orogens.