# (U-Th)/He dating of faulting in the Southern Alps

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The Dolomites of the eastern Southern Alps were formed from the Permo-Triassic sedimentary cover of the South Alpine unit that was slightly deformed in the Tertiary. The different parts of the Dolomites have suffered Alpine deformation two times, and the shortening process is actually still active along the southernmost thrusts. The direct dating of the deformation is possible only in the southern zones, where sediments are involved in the thrusts, whereas in the northern areas no or rather scarce geological evidences on the timing of structural evolution exist. The isotope geochronological dating is difficult due to lithology of the sedimentary successions, which are composed dominantly of carbonate rocks.

In order to constrain structural evolution of the area, we applied low temperature thermochronology [apatite fission track (AFT) and apatite (U-Th)/He (AHe) dating methods] on the Triassic volcanic dikes and tuff horizons. The AFT ages are ranging between 210 and 6 Ma. The oldest ages indicate the presence of slightly reset areas and date the exhumation of some structural blocks to be Late Miocene. The AHe ages are younger than the AFT ages in each sample. In the western Dolomites, where the Neogene thermal reset is not detected by the AFT thermochronometer, the AHe ages show Late Miocene reset due to the lower closure temperature of the later method. Inferring from the significant contrast between the AFT and AHe ages we conclude that the dated stratigraphic horizons were deeper than the total reset depth of AHe method but shallower than the reset depth of the AFT method between the Late Triassic and Late Miocene. We suppose that beyond the general Miocene uplift of the Dolomites mainly the displacements along the Stava line and Schio-Vicenza fault or Bassano thrust are responsible for the exhumation of Passo Feudo and Recoaro area, respectively.

# Data handling, outlier rejection and calculation of isotope concentrations from laser ICP-MS analyses by PEPITA software

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The raw output data of laser ICP-MS analyses are composed of high number of ion counts registered in time. The handling of these huge matrices and the expression of trends, isotope ratios and finally the concentrations is a rather time consuming procedure. We have created a data handling system and an evaluation software (for Windows) that stores the necessary background information, and performs several outlier tests and the computations for the concetrations.

The composition of the standards, measurments on standards and the used dwell-times are stored in different files. The blank counts can be extracted from the data files or from separate 'blank files'. The computation starts with the selection of internal standard isotope. Then PEPITA investigates the compatibility of the files and warns if one or more isotopes are not present in all kind of input files. The preferred time slices for the calculation of the isotope concentrations can be extracted graphically from a time/cps plot. The raw data or the cps values normed by the counts of the internal standard can be tested for outliers.

The time slices show always some fluctuation of the cps values, and the experiments frequently contains spikes, which appear only in single time slices. These individual data can seriously bias the average count, especially when the count rate is low. PEPITA offers three methods to visualize and/or reject the extreme values. (1) The nimimum and maximum values detected by the record of an isotope can be highlighted. (2) The Grubbs outlier test indicate the probability that the highest or lowest value belongs to the rest of the population. (3) The user can specify how many reletive standard deviation can be tolerated for the individual data points. The extreme values (e.g. having more than 4 rel. std. dev., which is rather probaly a 'technical outlier') can be rejected and this procedure can be consequently repeated for all processed files.

The software exports into files or pastes to the clipboard the results in the following order: (a) list of files, time slices used, rejection algorithm and criterion, (b) average concentrations, limit of detection and other statistical parametres, (c) concentrations and errors in time slices (d) warning in case of incompatible files.

PEPITA is freeware, downloadable from: http://www.sediment.uni-goettingen.de/staff/dunkl/software/pepita.html