3-D assessment of peak-metamorphic conditions by Raman spectroscopy of carbonaceous material at the margin of the Lepontine dome (Swiss Central Alps)

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This study monitors regional changes in the crystallinity of carbonaceous matter by applying Raman spectroscopy to samples of metasediments ("Bündnerschiefer") collected within the north-eastern rim of the Lepontine dome and the easterly adjacent areas of the Swiss Central Alps. The samples are from a large volume of former sediments deposited onto basement belonging to the European continental margin and the adjacent Valaisan oceanic domain. Based on the dataset comprising a total of 214 samples Raman spectroscopy allows for high resolution mapping of maximum metamorphic temperatures reached by these samples in three dimensions. Note that the area underwent several thermal events, ranging from subduction-related blueschist facies conditions to collision-related amphibolite facies overprint. Hence, the peak temperature distribution maps and profiles need to be discussed in terms of the P-T-paths associated with a complex polymetamorphic evolution.

3-dimensional mapping of the isotemperature contours shows, after comparison with independent petrological and structural data that the field temperature gradients inferred from Raman spectroscopy of carbonaceous material faithfully reflect the present-day distribution of peak-metamorphic temperatures. The latter results from a superposition of distinct metamorphic events in three dimensions. It was found that (1) the inferred maximum temperatures favourably compare with those inferred from other petrological data, confirming that the transformation of carbonaceous matter into graphite is a continuous and temperature dependent process (2) the derived temperatures reflect the maximum temperatures to which specimens were exposed to at various stages during a polyphase thermal evolution, (3) the 3-dimensional character of those parts of the isotemperature contours that reflect the same metamorphic event reveal geometries that are compatible with independently derived information on relationships between deformation and metamorphism.

Within the north-eastern rim of the Lepontine dome - both along and across strike - the isotemperature contours (450-570 °C) associated with the collision-related late-stage Barrow-type event clearly cut across nappe contacts and mega-folds deforming these contacts. However, further to the NE the isotemperature contours (350-425 °C) reflect temperatures reached during an earlier blueschist facies event and/or subsequent near-isothermal decompression. They are folded around large-scale post-nappe stacking mega-folds. A substantial "temperature jump" across the tectonic contact between the frontal Adula nappe complex (500-520 °C) and surrounding Valaisan-derived metasediments (410-430 °C) indicates that, in contrast to the postulates raised by earlier studies, equilibration of temperatures during the late-stage Lepontine event is incomplete in this area.