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Contrasting origin of fluids during Late Cretaceous deformation, Eastern Alps, Austria: evidence from stable isotopes, fluid inclusions and microfabrics

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The Eastern margin of the Graz Thrust Complex (Eastern Alps) represents a major late Cretaceous extensional fault zone where high-grade lower structural units (Middle Austroalpine) are juxtaposed against low-grade higher structural units (Upper Austroalpine). Approximately coeval to overall NW-SE extension the late Cretaceous Gosau molasses type basin developed (Neubauer et al., 1995; Ebner and Rantitsch, 2000). Extension tectonics and exhumation of rocks resulted in formation of an extremely disturbed and condensed metamorphic field gradient. Over a distance of 3 kilometres metamorphic conditions for the Late Cretaceous decrease from ca. 550°C and 10 kbar down to surface conditions. During exhumation of rocks close to surface levels a change from metamorphic to meteoric fluid regimes as well as a change in fluid pathways is expected. We elaborated structural and stable isotope data to put constraints on this scenario.

he general geology of the area comprises from structural footwall to hanging wall the following units: (1) The Middle Austroalpine Koralm Basement to the west and the Gleinalm Basement to the North are composed of amphibolite facies metamorphosed metapelitic rocks intercalated by marble beds, amphibolites and pegmatites. (2) Upper Austroalpine Nappes of the Graz Nappe Complex constitute carbonates of Lower Paleozoic age that are (3) transgressively overlain by terrestric to shallow marine Gosau type sediments. The contact between Graz Nappe Complex and Gosau is highly brecciated and fluid infiltrated. Several generations of reddish carbonates precipitated within veins and voids. The reddish colour is result of hematite pigmentation.

Oxygen and carbon isotope data measured systematically from Middle Austroalpine marble beds into to metapelites gave an asymmetric “bell shape” geometry indicating limited fluid exchange across lithological boundaries. Models of fluid rock interaction suggest major lateral flow of metamorphic fluid mainly parallel to lithological boundaries.

Fluid inclusion data show that an early CO_2 dominated fluid was later replaced by and aqueous fluid type with considerable amount of NaCl.

From the brecciated Upper Austroalpine carbonates we elaborated Carbon and Oxygen isotopic data form different types of newly precipitated carbonates. A trend from fresh greyish carbonates to highly infiltrated reddish ones show systematic decrease in $\delta^{18}O$ from 26 to 16 and $\delta^{13}C$ from 2 to –6.

In summary the following scenario of fluid rock interaction during late Creataceous extension and exhumation of rocks is proposes.

(1) Within deeper crustal levels predominatly CO_2 rich metamorphic fluid circulated parallel to major lithologic boundaries.
(2) At higher crustal levels the original Devonian carbonated were infiltrated by Creataceous marine and meteoric water.
(3) The isotopic signature was modified by CO_2 degassing during decompression.
(4) Highly oxidising fluids enabled precipitation of hematite

References

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