Geophysical Research Abstracts, Vol. 9, 03317, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03317

Deformation in a Subduction Channel (2): Anatomy of the deeper Portion (T 150 C̊ to 350 ˚C) of an ancient Analogue in the Swiss Alps

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Active subduction zones and the therewith associated subduction channels cannot be directly investigated due to their inaccessibility for drilling or surface examinations. Only geophysical methods, numerical modeling or sandbox simulations throw light on the shallow parts of currently active subduction zones. Hence, we additionally use direct investigations of exposed ancient subduction channels at various depths to understand their internal geometry and processes operating. Here we present the anatomy of the deeper part of a plate boundary in the temperature range between 150˚C and 350˚C represented by a mélange zone in the Swiss Alps.

A subduction channel focus deformation within subduction zones by transporting oceanic and continental material down into the mantle and by return-flow of low-viscosity material back to the surface. The subduction channel can be best defined by gradients in the flow velocity of the deforming material in respect to the upper and the lower plate. The fossil, formerly south to southeast dipping subduction channel in the Swiss Alps is sandwiched between the overlying Austroalpine nappes (African plate) and the footwall Penninic/Helvetic nappes (European plate), a setting assembled during Alpine convergent plate motion. Due to large scale tilting of the zone, a continuous outcrop today allows the identification of changes with depth along the former plate boundary. In this study we aim to quantify the evolution of different features (e.g. aspect ratio of clasts, localized deformation zones, mineralized vein systems) towards the south of the working area, where formerly deeper parts of the subduction channel are accessible. In accordance, overprint of the upper plate basement by Alpine deformation increases, and the shaly matrix of the subduction channel exhibits equally

increasing metamorphic grade. The matrix contains clasts of different size comprising upper plate basement and metasediments, as well as slivers of the oceanic lower plate and its sedimentary cover. The clast size varies from a few cm to hundreds of meters. With increasing metamorphism and deformation both upper plate basement and metasedimentary clasts are strongly mylonitized along their rims. Mylonitic shear zones cut into the clasts and enforce disintegration. Pseudotachylytes as evidence for unstable slip have been found at a limited depth range (app. 3-6 kbar, $<350^{\circ}C$) directly at the base of the upper plate. Metasedimentary clasts and metabasics reveal abundant mineralized veins with partly blocky mineralization. Additionally, a vast number of foliation-parallel mineralized veins invade the matrix of the fossil subduction channel. The relationship of these mineralized fractures to seismic faulting has yet to be evaluated. They mirror dehydration processes during prograde metamorphism within the subduction zone. Rb/Sr isotope signatures of 8 lower plate carbonatic samples provide clear indications for the presence of fluids with elevated $^{87}Sr/^{86}Sr$ ratios in the subduction channel. This suggests that dehydration of continent-derived sediments was the main fluid source in contrast to the often assumed high influence of fluids derived by the dehydration of the downgoing oceanic crust, at least for the sampled depth range.

The integration of the study's results with new insights from synthetic geophysical, numerical and analogue modelling will offer the chance for a detailed identification of processes within ancient and active subduction channels.