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Exhumation of subducted continental lithosphere in the Western Alps - From pre-orogenic transpression to lateral extension to collision

M.R. Handy (1), M. Konrad-Schmolke (1, 2), J. Babist (1) and K. Hammerschmidt (1)

(1) Dept. of Earth Sciences, Freie Universität Berlin, Germany

(2) Earth Sciences Dept., Universität Potsdam, Germany

(mhandy@zedat.fu-berlin.de)

The Sesia Zone in the Western Alps preserves crustal-scale shear zones that accommodated pre-orogenic exhumation of subducted slivers of the Apulian passive continental margin. Most of this exhumation (40 km from a maximum subduction depth of 60 km) was accommodated along a reactivated nappe contact and by a steeply dipping, retrograde, eclogite- to blueschist- to greenschist-facies shear zone with shallow to moderately plunging stretching lineations. Rb-Sr analysis of syntectonic phengite and plagioclase bearing assemblages constrain this shear zone activity at about 64 Ma. Continued exhumation of the Sesia continental slivers from 20 km to near the surface in Eocene-early Oligocene time involved SE-directed extensional shearing under retrograde greenschist facies conditions. A minimum age of 45 Ma for this extension is obtained from Rb-Sr crystallization ages on magmatic hornblende and plagioclase in undeformed, cross-cutting dykes. This extensional shearing continued downwards in the Tertiary nappe pile, effecting top-SE directed extensional exhumation of HP metamorphic rocks in the Piemont-Liguria ophiolites from 44-36 Ma (Reddy et al. 2003). After 36 Ma, the HP rocks of the Sesia Zone experienced only slow cooling and minor exhumation. They were exposed to erosion by the time of Oligocene magmatism.

Calculations of rock densities from thermodynamic modelling of element zonation patterns in HP minerals indicate that the 40 km of initial exhumation of the subducted continental margin was probably buoyancy-driven within the upper mantle (Konrad

et al., this volume). This is consistent with the occurrence of mantle imbricates in the Sesia rocks and the lack of Cretaceous clastic sediments in the westernmost part of the Southern Alps. Paleomagnetic and paleogeographical considerations indicate that this early exhumation occurred during oblique dextral convergence between Europe and Apulia, prior to and during subduction of the Piemont-Liguria ocean. The downward migration of Eo-Oligocene extensional exhumation within the Late Cretaceous-Early Tertiary nappe pile of the Western Alps may be explained by the idea that the upper plate was extended, possibly above a NW-retreating hinge in the lower, subducting European plate. We attribute the minor exhumation in Oligocene time to erosional denudation, as documented by the influx of detritus derived from the Sesia Zone in Oligo-Miocene molasse sediments of the southern Alpine Piedmont basin (Carrapa et al. 2003). Final Oligo-Miocene exhumation of the NE part of the Sesia Zone and adjacent nappe edifice involved dextral transpressional shearing, large-scale Insubric backfolding and calc-alkaline magmatism in the retro-wedge of the Alpine orogen.