Slab factory – ocean formation and subduction in the Western Alps

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The goal of the project is to reconstruct the timing and geometry of ocean formation and subduction in the Western Alps in order to better interpret the geometry of lithospheric slabs in the mantle. New results: Eclogite samples from the Internal Massives (Monte Rosa, Dora Maira), the Zermatt-Saas-type Ophiolites (ZSO), and the Sesia-type Continental Slivers (SCS) were dated using Lu-Hf geochronology (Fig. 1). ZSO eclogite from south of the Aosta Valley (Punta Nera: ~48 Ma) is younger than the overlying SCS eclogite (Emilius: ~53 Ma) and both are in the same age ranges as previously dated ZSO and SCS from north of the Aosta Valley, contradicting the interpretation of SCS as rifting-related extensional allochthons emplaced on ZSO oceanic basement. Instead, SCS come from a more internal (southeastern) palaeogeographic position than ZSO and were subducted earlier, since subduction was southeast-dipping and prograded overall northwestward. SCS represent the northwestern distal margin of the Margna-Sesia continental fragment (Cervinia).

In the Internal Massives, preliminary results show a younger age for Dora-Maira ultrahigh-pressure eclogite (~36 Ma) than for Monte Rosa eclogite (~44 Ma) although tectonic structure strongly suggests that these units are lateral equivalents of each other. This suggests that the continental crust of the Internal Massives (European distal continental margin) was first subducted to lower eclogite facies conditions during incipient collision and later parts of it were dragged still deeper, i.e. to ultrahigh-pressure conditions, when normal-thickness European crust entered the collision zone. The early start of subduction of the European margin requires a separate subduction zone in the Valais Ocean, its activity overlapping in time with the subduction zone that consumed the more internal (southeasterly located) ZSO of the Piemonte Ocean.

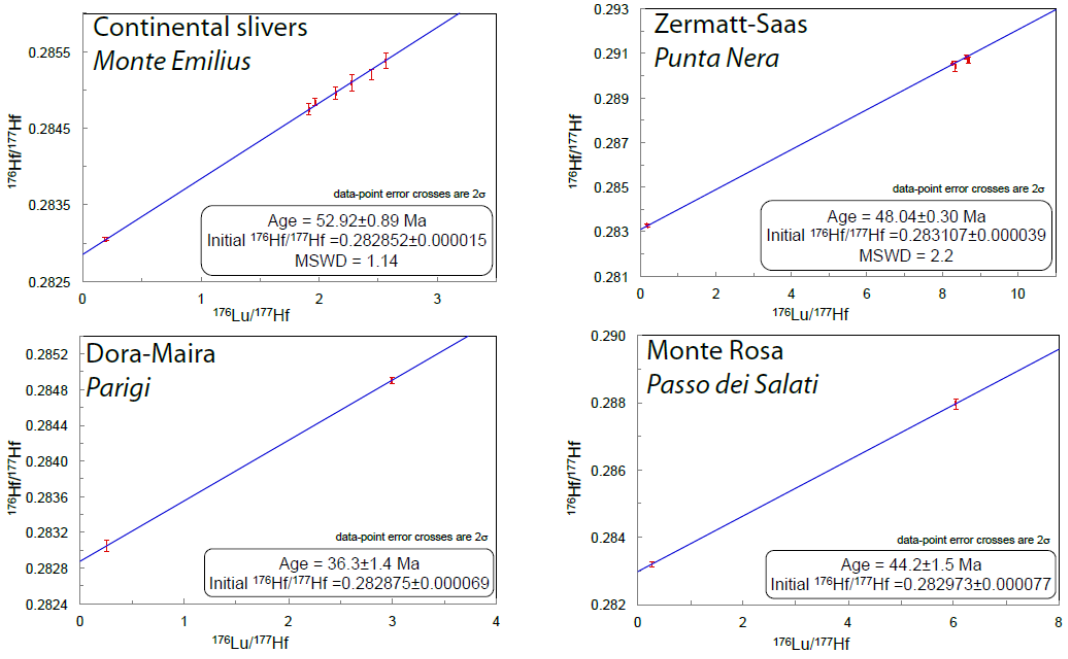

Fig. 1: Examples of new Lu-HF garnet – whole rock isochrons from the Western Alps.

The Cervinia microcontinent played a crucial role in the paleotectonic evolution. It probably represented the northern prolongation of the AlCaPeCa microcontinent of the Western Mediterranean (Fig. 2). Gabbro from ophiolite relics in the suture between Cervinia and Adria (Canavese Suture) was sampled and is currently treated for zircon separation, in order to determine the age of oceanic separation between Cervinia and Adria.

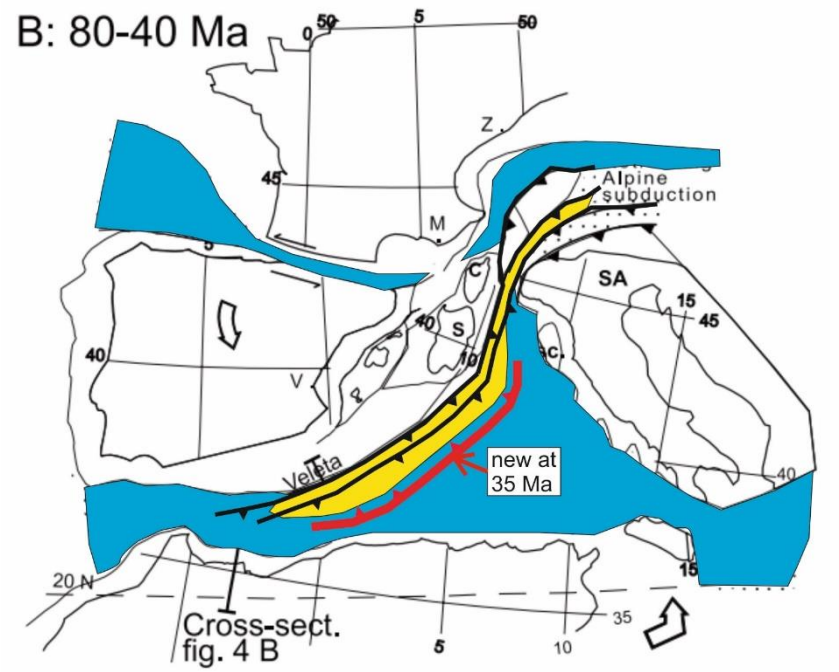

Fig. 2: Correlation between AlCaPeCa microcontinent (southern part of yellow stripe) and Cervinia (northern part). Blue: Oceanic crust. After Michard et al. (2002; Bull. Soc. géol. France, 173, 3-15), modified.

The importance of the new results for the AlpArray Experiment (Research Themes 1 - Reorganizations of the lithosphere, and 3 - Deformation of the crust and mantle) stems from the recognition of double subduction during the Eocene, one in the Piemonte Ocean (ZSO) and one in the Valais Ocean, both southeast- to east-dipping. Consequently, at least two independent slabs are expected to exist in the mantle underneath the Western Alps. Traces of subduction and collision of the AlCaPeCa/Cervinia continental ribbon are expected in the mantle under the Ligurian Sea.

Publication

Weber, S., Hauke, M., Martinez, R. E., Redler, C., Münker, C., Froitzheim, N., submitted to *Journal of Metamorphic Geology*. Fluid-driven transformation of blueschist to vein eclogite in a subducted sliver of continental crust (Monte Emilius, Italian Western Alps).