Protracted Subduction of the European Hyperextended Margin Revealed by Rutile U-Pb Geochronology Across the Dora-Maira Massif (Western Alps)

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The Dora-Maira massif is an archetypal nappe stack of subducted and exhumed upper crust. Slices of continental crust experienced metamorphism at upper blueschist to ultrahigh-pressure (UHP) eclogite- facies conditions. While the timing of peak metamorphism in the UHP unit has been extensively studied, little is known about the other units. In order to constrain the timing and conditions of high-pressure metamorphism, U-Pb-trace element analyses of rutile and titanite were carried out across the nappe stack. The data reveal Alpine peak metamorphic ages younging downwards in the stack, from ~40 to ~33 Ma. Greenschist-facies retrogression of the whole massif occurred at ~32–31 Ma, after high-pressure metamorphism of the lowermost unit (Sanfront-Pinerolo Unit). Tectonic implications include (a) continuous and fast exhumation of subducted continental crust, (b) long-lived subduction from ~60 to ~33 Ma of the distal European margin, reconstructed to be a hyperextended margin spread over ~130 km for the Dora-Maira massif alone, and (c) the initiation of continental collision synchronous with the end of high-pressure metamorphism.