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New structural field data on the timing and kinematics of deformation and exhumation of the Mont Blanc massif

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The Mont Blanc massif is one of the external crystalline massifs, which represent the basement of the former European continental margin and therefore belong to the Helvetic domain. It mainly consists of polymetamorphic Late Proterozoic to Early Paleozoic gneisses intruded by the Variscan Mont Blanc granite (Von Raumer et al. 1993). The timing and kinematics of deformation and exhumation of the Mont Blanc massif is a controversial topic and various models have been proposed. Low-temperature thermochronology studies provide an extensive data set for estimating exhumation rates in Neogene times (e.g. Seward & Mancktelow 1994; Leloup et al. 2005; Glotzbach et al. 2008), but detailed structural studies to critically asses and constrain the proposed kinematic models are largely lacking. Glotzbach et al. (2008) show that the exhumation is episodic, with rates changing from relatively fast ($\sim$2.5 km/Ma before 6 Ma) to a slow phase (<0.5 km/Ma between 6 and 3.5 Ma), in turn followed by acceleration to $\sim$1 km/Ma after 3 Ma. Our study presents new structural data from the south-eastern side of the Mont Blanc massif and the adjacent sediments and addresses the tectonic evolution and late stage exhumation history of the massif. The goal is to assess the importance of tectonics versus climate for controlling exhumation, as well as to establish the overall geometry of uplift (2D pop-up, 3D dextral transpressive model, large scale backfolding).
A major back-thrust was proposed by previous authors ("Mont Blanc back-thrust", e.g. Leloup et al. 2005, Rolland et al. 2007), characterized as a relatively steeply north-west dipping thrust bringing the Mont Blanc basement back over the tectonostratigraphically higher Helvetic and Ultrahelvetic metasediments. 40Ar¬-39Ar dating of white micas interpreted to have grown during movement on the Mont Blanc back-thrust indicates an initiation of movement around 16 Ma (Rolland et al. 2007). Leloup et al. (2005) suggest a reactivation of this thrust around 2.5 Ma, based on exhumation rates established from fission track ages. However, no sign of young movements along the boundary/back-thrust between the Mont Blanc basement and the overlying sediments has been found during our structural study. The actual contact between the basement and cover cannot be a very late stage structure because it is slightly folded with a new steep fabric developed in both the sediments and the granite. This result is in good accordance with the data of Glotzbach et al. (2008), which show no offset in FT-ages across the Mont Blanc back-thrust along their tunnel transect.
Strike-slip movements can be observed in the whole field area. The main direction is oriented SW-NE with right-lateral deformation both in the ductile and in the brittle field. This suggests a continuous dextral movement and would support the flower-structure theory. However, the most recent uplift of the Mont Blanc relative to its cover seems to be widely distributed and not restricted to discrete structures, since no major exhumation-related structures have been found. Currently, the question still remains open whether tectonics or surface processes play the dominant role in controlling this differential uplift.

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