Tectonic or climatic control on exhumation of the external crystalline massifs, Alps

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Recently several studies investigated the exhumation history of the external crystalline massifs (ECM) of the Alps using low-temperature thermochronology (e.g. Glotzbach et al. 2008; Reinecker et al. 2008). Interestingly, none found an increase in exhumation at ~5 Ma, as expected from the sediment budget, an Alpine wide compilation of thermochronological data and thermochronological data from the Molasse basin (Kuhlemann 2000; Cederboom et al. 2004; Vernon et al. 2008). Here we present new thermochronological data accompanied by numerical thermal modeling of the Mont Blanc and Gotthard massif, reporting an episodic exhumation history: Rapid exhumation (1-3 km/Ma) from ~9 Ma up to ~6 Ma is followed by slow exhumation (~0.5 km/Ma). Similar exhumation histories are recently reported for the Central Aar (Vernon et al. in press) and Pelvoux massif (van der Beek et al. 2009). We suggest that fast exhumation was caused by an increased uplift above the Alpine Sole thrust at the same time thrusting in the Jura Mountains initiated and probably sedimentation in the Molasse ended. The ECM show a drastic decrease in exhumation rates at ~6 Ma, maybe as a consequence of the overall decreasing convergence in the Alps and/or in-sequence thrust propagation of the Alpine Sole thrust. The pre-3 Ma exhumation historiy of the ECM differ; some regions show an increase in rates (e.g. SW Aar massif, Mont Blanc massif), whereas in others no increase is detectable (Central Aar and Gotthard massif). We explain this to be the consequence of regional variable climatic and tectonic forcing. Whereas the Mont Blanc massif shows a strong influence from glaciation, the increase in exhumation in the SW Aar massif was mainly triggered by tectonic denudation. In contrast the Gotthard massif shows no increase in exhumation caused by tectonic or climatic forcing.

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