Linking Oligo-Miocene drainage divide migration to orogenic wedge state in the European Alps: A multi-proxy provenance approach

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The Coulomb orogenic wedge model predicts that orogen deformation behaviour is governed by wedge state: when subcritical the orogenic wedge thickens internally, promoting hinterland exhumation, and when supercritical the wedge propagates by foreland thrusting, reducing hinterland exhumation. However, the difficulty in constraining source area palaeo-exhumation rates from the detrital record has rendered attempts to identify wedge behaviour in the European Alps challenging[1]. As internal shortening should build topography, subcritical wedge periods should promote pro-foreland migration of the orogenic drainage divide. Constraining past locations of the Alpine drainage divide therefore provides a simple way to identify wedge behaviour.

Here, we exploit the detrital record of the thermochronologically distinctive high-grade internal units in the central and western Alps (e.g., the Lepontine Dome and the Dora Maira massif), to track the orogenic drainage divide location. We apply the apatite and rutile U-Pb thermochronometers, sensitive to temperatures of ~375-550 °C and ~490-640 °C respectively[2,3], to Oligo-Miocene sediments of the Alpine foreland hosted in the Swiss Molasse, Barrême, and Valensole basins, along with the classic zircon U-Pb and apatite fission track (AFT) thermochronometers. In contrast to these conventional techniques, which are either not reset (zircon U-Pb) or widely reset (AFT) by the Alpine orogeny, the apatite and rutile U-Pb thermochronometers are ideal provenance tools for identifying debris from medium to high-grade amagmatic metamorphic source terranes.

We identify a shift from supercritical to subcritical wedge state occurring around the arc of the western and central Alps at ca. 25 Ma. We speculate on possible causal mechanisms and discuss the implications for the tectonic evolution of the Alps.

[1] Carrapa (2009), *Geology* **37,** 1127–1130. [2] Cochrane, *et al*. (2014), *Geochim. Cosmochim. Acta* **127,** 39–56. [3] Kooijman, Mezger, & Berndt (2010), *Earth Planet. Sci. Lett.* **293,** 321–330.