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Long-term exhumational history and Neogene reactivation of the Brooks Ranges, Alaska : Insights from low-T thermochronology

Maelianna Bigot-Buschendorf (1,2), Charlotte Fillon (1,2,7), Frédéric Mouthereau (1,2), Loïc Labrousse (1,2), Jean-Luc Auxiètre (3), Thomas Moore (4), Peter van der Beek (5), Daniel Stockli (6), and Todd Ehlers (7)

(1) UPMC U. Paris 6, ISTeP, 4, place Jussieu F-75005, PARIS (maelianna.bigotbuschendorf@gmail.com), (2) CNRS, UMR 7193, F-75005, PARIS, (3) Total SA, E&P Exploration New Business 2, place J.Millier 92078 Paris La Defense, (4) U.S. Geological Survey MS 901 345 Middlefield Road Menlo Park, CA 94025, (5) ISTerre, CNRS, U. Grenoble I, BP 53, 1381 rue de la Piscine, F- 38041 Grenoble, (6) University of Texas, Department of Geological Sciences, 1 University Station C1100, Austin, TX 78712, (7) Universität Tübingen, Geodynamik, Wilhelmstraße 56, 72076 Tübingen

The Brooks Ranges, northern Alaska, result from the Mesozoic collision of continental arcs with the Arctic continental margin. The foreland basin deposits indicating exhumation and creation of topography dates the formation of an orogenic wedge from 160 Ma onward. Discrete events of rapid exhumation occurred from 140 to 25 Ma, likely reflecting changes in the dynamics of the orogenic wedge, linked to rate and geometry of the subduction in the southern Alaska margin and/or climate changes.

Our study aims at quantifying rates and duration of exhumational events in the Brooks Ranges through new low-temperature thermochronology analyses, using (U-Th)/He on apatites and zircons along the Trans-Aslaskan Crustal Transect (TACT) profile from the Ruby Mountains to the North Slope, and integrating whole sediments from the basement to the Tertiary cover (Franklin Bluffs and Sagwon Bluffs).

We also combined these new thermochronological data to existing dataset in the Colville Basin and Central Brooks Ranges to unravel the thrusting sequence through a 3-D thermo-kinematic model (Pecube). The modeling of the main thrust activation sequences shows that a thick-skinned out-of-sequence thrust system must have been active from 30 to 15 Ma along the TACT, and from 40 to 15 Ma in the Shublik mountain, to reproduce the data.

Preliminary results from inverse modeling show evidences for two main exhumational events at 100-85 Ma and 35-20 Ma. The latter Neogene event appears to be related to out-of-sequence duplexing in the Doonerak mountains. Reasons for the reactivation of the Mesozoic Brooks Ranges during the Neogene must include far-field accommodation of deformation induced by subduction of the Yakutat terranes in southern Alaska coupled with transcurrent movements in the Beaufort Sea, and coeval increase in sediment yields as evidenced in the McKenzie delta.