Cooling history of the Antarctic Peninsula magmatic arc

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Here we present new zircon (U-Pb), and amphibole, biotite, and feldspar (Ar-Ar) ages collected from 15 Antarctic Peninsula plutons, which we integrate with existing fissiton-track and (U-Th-Sm)/He thermochronology data from the same rocks to understand the tectonothermal history of the peninsula and its arc. Zircon U-Pb data of these and related rocks reveal the dominance of Late Cretaceous arc plutons and the existence of Jurassic plutons on the peninsula. We achieved plausible ranges of closure temperatures for other mineral ages by applying reasonable parameter values for diffusion domain size, diffusion domain shape, and cooling rate into the Dodson equation, or through HeFTy modeling. With our closure temperature range estimates, we constrained envelopes of parsimonious cooling histories and maximum, minimum and median interval cooling rates from each sample having age dates from at least three different thermochronometers. Zircon U-Pb ages of Cretaceous arc plutons generally coincide with their high-, intermediate-, and some low-temperature cooling ages, suggesting very rapid (~40-100+°C/Myr) late Cretaceous cooling, followed by protracted slow cooling (~1-10°C/Myr). Such temperature-time histories are consistent with hypabyssal intrusion and subsequent tectonothermal quiescence. Sparse amphibole Ar-Ar results from Jurassic plutons preclude a thorough assessment of early cooling rates and emplacement depths but considerably younger intermediate-temperature cooling ages suggest a more moderate early cooling history, or a Cretaceous reheating event. Several complicated age-eU correlations in zircon (U-Th)/He data and inverted ages reveal system complexity, the causes of which may be related to variable grain diffusivities due to radiation damage, grain size, or zonation (in the case of zircon He data), and to lost or excess daughter products (in the case of U-Pb and Ar-Ar data, respectively).