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Unraveling potential biases in U-Pb detrital zircon record induced by high-temperature metamorphism (> 850 °C)

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Detrital zircon records are prone to several sources of bias that can compromise sediment provenance investigations based on U-Pb ages. High-temperature metamorphism (>850 °C) is herewith addressed as a natural cause of bias since U-Pb zircon data from rocks submitted to these extreme, often prolonged conditions, frequently display protracted apparent concordant geochronological U-Pb records. The resulting spectrum can originate from disturbance of the primary U-Pb zircon system, likewise from subsequent recrystallization and crystallization processes during multiple and/or prolonged metamorphic events. Consequently, a high-grade metamorphosed igneous rock can exhibit a zircon age spectrum similar to that produced by polymict sedimentary rocks, thereby inducing provenance misinterpretations if this rock becomes a source for a sediment. A polymict sedimentary source that undergoes such high temperatures could potentially generate an even more intricate spectrum. Archean, Neoproterozoic and Paleozoic metamorphic rocks from the literature, dated by different techniques (SIMS and LA-ICP-MS), are employed as examples to demonstrate the resulting complications. The compilation shows that (1) high-temperature metamorphism may generate age peaks of unclear or lacking geological meaning, and (2) the interpretation of detrital zircon age spectra depends on the timing of the metamorphic event (pre- or post-depositional). When high-temperature metamorphic rocks are eroded in uplifted areas, the youngest population of a detrital spectrum represents the maximum depositional age through metamorphic zircon from the source. If a sedimentary succession was subjected to high-temperature metamorphic conditions after deposition, its youngest zircon population more likely records the metamorphism, and the maximum depositional age, as well as older sources cannot be directly accessed. To evaluate the presence of high-temperature metamorphism-related bias in a given detrital zircon sample, we suggest a workflow for data acquisition and interpretation, combining a multi-proxy approach with: in situ U-Pb dating coupled with Hf analyses to retrieve the isotopic composition of the sources, and the integration of a petrochronological investigation to typify fingerprints of the (ultra)high-

temperature metamorphic event.