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Experiments on two techniques for the removal of barite from detrital zircon

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Abstract

Barite ($BaSO_4$) is a common mineral in sandstone that must be removed during separation of detrital zircon ($ZrSiO_4$). One widespread technique for the removal of barite exploits its lesser tenacity by milling the barite and zircon mixture in a ball mill. Here we test the extent to which such milling affects zircon and thus whether the milling could introduce bias into the detrital zircon sample. We then describe a new chemical technique for the removal of barite from detrital zircon. We find that milling a mixture of barite and zircon both breaks and causes loss of zircon grains, potentially introducing bias into a detrital zircon sample. Boiling barite in a 0.94 molar aqueous solution of sodium carbonate for 4 h converts most grains to barium carbonate. The barium carbonate grains are opaque white and thus visually distinguishable from zircon, allowing separation by hand under a stereoscopic microscope. Alternatively, the barium carbonate grains can be dissolved by boiling in 16 wt% nitric acid for 30 min. In our experiments, boiling zircon in sodium carbonate solution and/or concentrated (65 wt%) nitric acid cleaned the surfaces of and the cracks in the grains but did not visibly change the zircon surfaces in other ways. Boiling only in concentrated nitric acid did not measurably affect the U-Pb and Lu-Hf isotopic systems in zircon interiors, and boiling in a sodium carbonate solution followed by concentrated nitric acid did not detectably alter the Lu-Hf isotopic system. However, boiling in a concentrated sodium carbonate solution followed by concentrated nitric acid did disturb the U-Pb isotopic system in zircon interiors. We recognize this disturbance due to a ~0.5% reduction in $^{206}Pb/^{238}U$ dates of treated zircon. Our results highlight the importance of proper technique during zircon isolation to minimize the introduction of bias into the sample.

Keywords: Tenacity, sandstone, mineral separation, bias, provenance, maximum depositional age