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Compositional heterogeneity in 91500, GJ-1/89 and TEMORA-2 zircon standards

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Zircon is the most analysed mineral using laser ablation ICP-MS. However, internal chemical zoning, a common feature in zircon, can result in sampling of chemically distinct crystal domains. This affects not only unknown zircons, but also zircon secondary reference materials used to assess data accuracy and precision. To better resolve the extent of geochemical heterogeneity in zircon, we present long-term split-stream laser ablation Q-ICP-MS trace element data (n = 6342) for three widely distributed zircon reference materials: 91500, GJ-1/89 and TEMORA-2. Zircons 91500 and GJ-1/89 have volumetrically minor domains that appear anomalous in hyperspectral cathodoluminescence (CL) and represent large scale chemical features unrelated to minor banding documented in these reference materials. The extent of compositional variability is significantly greater in 91500, particularly for the REE+Y (91500 bias between zones = 51-63%; GJ-1/89 <5%, except Ce). Uranium and Th show very similar data trends with 2-3x variation. In contrast, TEMORA-2 is strongly sector-zoned, showing bimodal distributions defined by prism sectors growing perpendicular to the c-axis and pyramid sectors growing along the c-axis. Prisms are enriched in REE+Y from 330% to 85% (Pr-Lu) over pyramids. Uranium, Th and Pb show prism sector enrichments of 71%, 160% and 75%, respectively. Cerium, together with the HFSE and P appear to be sector independent. The chemical heterogeneity observed in TEMORA-2 zircon highlights the universal need to obtain texturally constrained analyses in sector-zoned zircons. Our data indicate that the GJ-1 crystals represent the best available zircon trace element reference material, and that 91500 is a good alternative provided minor anomalous domains are tracked.

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