VOLUMETRIC CHARACTERIZATION OF ZIRCON IN SUPPORT OF DETRITAL GEOCHRONOLOGY

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ABSTRACT

Zircon is one of the most studied accessory minerals due to its chemical composition and ability to record events as a geochronometer. It is highly resistant to weathering, which enables it to be transported from source to sink in a sedimentary system. The shapes of zircon grains may reflect both source rock and transport histories. An explosion in detrital geochronology studies has been driven by advances in analytical and computational techniques and a growing interest in sediment provenance, tectonics, crustal evolution, and paleogeography. This project focuses on characterizing zircon grains in 3D using X-ray Computed Tomography (CT), which nondestructively provides data on shape (including euhedrality, roundness, brokenness, etc.), composition, and structure (e.g., radiation damage). An overarching goal is to investigate whether the information gained from CT analysis of epoxy mounts used for detrital zircon geochronology justifies the effort and expense by creating new research possibilities. New functionality in the Blob3D software package provides information on crystal form by detecting faces and evaluating their arrangement and symmetry. Zircon samples are from a Neoproterozoic nepheline syenite from the Amazonian Craton, Cretaceous Great Valley Group (GVG) sandstone collected from the San Joaquin River in central California, and the Texas Colorado River sand. This project involves taking 3D measurements, comparing 2D optical to 3D CT data, evaluating consistency of human scoring between data modes, and ultimately how automated 3D analysis compared to human judgement in describing grains. Using an augmented classification scheme, grains were characterized in 3D and shape measurements taken. A novel method to quantify grain surfaces and assess the preservation of crystal structure was used by generating isosurfaces of crystal structures that were plotted on stereonets. The same classification scheme was used to characterize grains in 2D for comparison. Correlation between the 3D and 2D classification scores were evaluated and correlation between the 3D scores and the stereonet measurements were evaluated. The multi-faceted data available from CT promises to enhance our ability to interpret the complex histories recorded within zircon grains, paving the way for new insights in detrital zircon geochronology and beyond.

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