Multi-chronometer zircon dating of the Old Crow tephra

SETH D. BURGESS[1]*, MATTHEW A. COBLE,[2] AND JORGE A. VAZQUEZ[1,2]

[1]U.S. Geological Survey, 345 Middlefield Rd., Menlo Park, CA 94025 (*correspondence: sburgess@usgs.gov)
[2]Stanford-USGS Ion Microprobe Laboratory, Stanford University, Stanford, CA 94305

Tephrochronology is used to correlate and reconstruct geographically disparate sedimentary records of changing environment, climate, and landscape throughout geologic time. Single tephra layers represent isochronous markers across broad regions, thus accurate and precise radiometric constraints on the timing of eruption are critical to their utility. The Old Crow tephra is found throughout Alaska and the western Yukon, and represents the largest preserved Pleistocene tephra-fall deposit in the region, serving as the primary terrestrial marker for the end of Marine Isotope Stage (MIS) 6 in this region (Beringia). Despite its volume and significance as a stratigraphic marker for the last major interglacial, the provenance of this tephra is debated, and the accepted eruption age has varied. Old Crow eruption age was previously constrained by a glass fission track date from the late 1990's, and lacks corroboration by another geochronometer. Coupled ion microprobe (SHRIMP) zircon U/Pb and U/Th, and sector field (U-Th)/He techniques show promise in dating rocks characterized by complex zircon populations, and motivate this effort to better constrain the age of the Old Crow tephra.

Here we develop a geochemical fingerprint for the Old Crow tephra via titanomagnetite geochemistry and a revised age utilizing coupled U/Pb, U/Th, and (U-Th)/He zircon geochronology. We compare this age and compositional data to that from plausible source-proximal deposits of the Old Crow and to age-appropriate tephra from two Gulf of Alaska IODP cores. Old Crow oxides are geochemically distinct from the commonly assumed source-caldera at the Emmons Lake Volcanic Center (ELVC), and differ from all analysed IODP tephra in the MIS 5-8 age range. Zircon crystals from the Old Crow tephra range in age from Proterozoic to Pleistocene, with the youngest population of grains showing age agreement in U/Pb, U/Th, and (U-Th)/He systems, suggesting eruption at the end of MIS 8, roughly100 kyr older than the previously accepted MIS 6 age.