

VERSATILE MONAZITE: RESOLVING GEOLOGICAL RECORDS AND SOLVING CHALLENGES IN MATERIALS SCIENCE

**Monazite, zircon, and garnet growth in migmatitic pelites as a record of metamorphism and partial melting in the East Humboldt Range, Nevada†**

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**ABSTRACT**

Monazite and zircon thermometry and geochronology were applied to anatectic pelites of the northern East Humboldt Range, Nevada. The study area is an exhumed portion of the Sevier orogenic root and is characterized by two crustal blocks with different prograde metamorphic histories: the Winchell Lake nappe and the underlying Lizzies Basin block. U/Th–Pb secondary ion mass spectrometry (SHRIMP) results from zircon and monazite indicate that in the Lizzies Basin block prograde metamorphism began by  $96.5 \pm 8.0$  Ma. Cooling and melt crystallization was initiated by  $80.1 \pm 1.4$  Ma. Possible reheating and a monazite growth event occurred again at  $76.2 \pm 2.8$  to  $68.2 \pm 2.0$  Ma. In the upper limb of the overlying Winchell Lake nappe, prograde metamorphism began by  $82.8 \pm 1.3$  Ma. Cooling and melt crystallization recorded by zircon and monazite growth/recrystallization at  $77.4 \pm 12.4$  to  $58.9 \pm 3.6$  Ma. Melt may have been present in the Winchell Lake nappe upper limb for a protracted period, or may have formed during several unresolved melting events. Thin Eocene–Oligocene (~40–32 Ma) high-Y monazite rims are found in both crustal blocks. These probably represent a phase of heating during Eocene–Oligocene magmatism and extensional deformation. U/Th–Pb geochronology results are consistent with differential burial, heating, and exhumation of different crustal blocks within the East Humboldt Range. Significantly fast exhumation of upper limb rocks of the Winchell Lake nappe and somewhat slower exhumation of Lizzies Basin block rock occurred prior to the “core complex” phase of the exhumation of the Ruby Mountains–East Humboldt Range metamorphic core complex. Differences in the timing and tectonic significance of exhumation episodes within the East Humboldt Range may reflect how the localized presence of partial melt can affect the evolution of an exhumed orogenic terrane.

**Keywords:** SHRIMP, monazite, metamorphic core complex, trace elements, migmatite, exhumation