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Pressure-temperature paths from garnet-zoning: Evidence for multiple episodes of thrust burial in the hinterland of the Sevier orogenic belt

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ABSTRACT

Garnets are present in two horizons of the schist of Stevens Spring from the Basin Creek area of the Grouse Creek Mountains in northwest Utah. The two horizons possess different bulk compositions, which resulted in garnet growth by different reactions along the same pressure-temperature (*P-T*) path. Garnet in the upper horizon grew from the breakdown of chlorite at upper greenschist-facies conditions and garnet in the lower horizon grew from the breakdown of staurolite at upper amphibolite-facies conditions. From the upper horizon, five garnets from three samples were analyzed. All display growth zoning, ragged morphologies associated with secondary rim consumption, and yield garnet-biotite geothermometry temperatures of ~460–490 °C. From the lower horizon, one garnet from each of two samples was analyzed. These also display growth zoning, but differ from garnet in the upper horizon in that they are dominantly idioblastic and yield garnet-biotite geothermometry temperatures of ~635 °C. Garnet-biotite geothermometry calculated for every point along detailed compositional traverses across the garnets revealed localized reequilibration along rims, cracks and inclusions in both generations of garnet. Garnets from the upper horizon display prograde reequilibration and the garnets from the lower horizon display retrograde reequilibration. Numerical simulations of garnet growth using the Gibbs method with Duhem's theorem were carried out to determine *P-T* paths. The *P-T* path defined by the modeling of five garnets from the upper horizon is an isothermal pressure increase of ~1.7 kbar. The *P-T* path defined by the modeling of two garnets from the lower horizon has a steep *P-T* trajectory (dP/dT = 32 bars/°C) and a total pressure change of ~0.9 kbar. Both paths are indicative of thrust burial; however, the two paths cannot be reconciled as products of a single thrust episode. These data are interpreted to indicate two different episodes of thrust burial during the Sevier Orogeny, separated by ~150 °C of heating and partial exhumation.