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High-Temperature Granulite Metamorphism in the Ivanpah and Southern McCullough Mountains

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Granulite metamorphism and associated partial melting is a fundamental contributor to continental evolution. At granulite metamorphism's upper temperature limit, migmatites form due to extensive partial melting of the Earth's crust. The McCullough and Ivanpah Mountain ranges contain exposures of late Paleoproterozoic migmatites that can provide more geological insight into the Mojave Crustal Province and consequently the southern Laurentian craton. This study combines petrographic and field observations, thermobarometry, U-Pb geochronology, and quantification of total radiogenic heat production to determine the mechanisms of heating responsible for these migmatites. Understanding the heat sources responsible for these late Paleoproterozoic migmatites adds to the geological history of the Southwestern United States, evolution of North America and larger understanding of crustal evolution. Phase equilibrium modelling of garnet–sillimanite–cordierite–biotite migmatites indicates metamorphic conditions around 750-810 ^{o}C and 4.1-6.4 kbar. The total radiogenic heat production in the basement gneisses averaged 3.8 $\mu W/m^3$ with a maximum of 12.2 $\mu W/m^3$ based on U, Th, and K concentrations measured by USGS airborne radiometric surveys corrected to the time of metamorphism. These values are 2.3-7.4 time higher than the average, upper continental crust. Monazite U-Pb petrochronology will be used to determine the relative timing of peak metamorphism and mafic magmatism in the region. Petrographic relationships from observation and metamorphic conditions inferred from phase equilibrium modelling will aid in determining the P–T path of the gneisses. The P–T path will then help determine the relative roles of advective, conductive, and radiogenic heating that resulted in the crustal melting of this area.