

## **Co-existing aluminum silicates in quartz veins: A quantitative approach for determining andalusite-sillimanite equilibrium in natural samples using oxygen isotopes**

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### **ABSTRACT**

Massive quartz veins with large andalusite and sillimanite crystals in textural equilibrium were found in a Proterozoic province in the northern Colorado Front Range. The  $\delta^{18}\text{O}$  values of the andalusite and sillimanite are identical, supporting the idea that these aluminum-silicate (AS) polymorphs crystallized at the same time. These data are consistent with the findings of Sharp (1995), who reported no fractionation associated with polymorphism of the aluminum silicates. Quartz–aluminum-silicate fractionations from veins in textural equilibrium and disequilibrium are 2.63–2.93 and 2.20–2.25‰, respectively. Temperature estimates from quartz–aluminum-silicate oxygen isotope fractionations range from 603–652 °C for equilibrium veins, and geologically unreasonable temperatures of 728–788 °C from veins in textural disequilibrium. Formation temperatures determined from isotope thermometry constrain the location of the veins on the andalusite = sillimanite univariant curve, thus defining a pressure range of 1.2–2.6 kbar for vein formation. The vein *P-T* estimates from this study agree well with previous host rock *P-T* estimates from nearby localities and, in conjunction with available Ar thermochronology, indicate that the veins likely formed during a Mesoproterozoic magmatic event in the Colorado Front Range.