Mechanisms for the Formation of Spiraled Inclusion Trails in Garnet Porphyroblasts from the Precambrian Core of the Laramie Mountains, Southeastern Wyoming

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ABSTRACT

Relationships between deformation fabrics and porphyroblasts have been used to evaluate the metamorphic and deformational histories of mountain belts. However, some porphyroblast-fabric relationships, such as those of spiral inclusion trails in garnets, remain controversial.

Two end-member models for their formation include: 1) a rotational model that invokes rotation of progressively growing garnet porphyroblasts, and 2) a non-rotational model that involves multiple periods of garnet growth, resorption, and successive overprinting of near-orthogonal foliations. However, field, petrographic, and microanalytical techniques used to evaluate the origin of spiral inclusion trails from the Laramie Mountains appear consistent with overgrowth of an existing crenulation foliation and only modest rotation.

This study presents evidence to explain ~360 degrees of apparent rotation within our garnets via as little as 58 degrees of real rotation. Varying degrees of apparent rotation from our samples can be explained through the overgrowth of an asymmetric crenulation foliation during progressive shortening and continued foliation development, and foliation wrapping that occurs around the garnets during their growth. Additionally, the real garnet rotation likely results from partitioned shear strain around garnet porphyroblasts.