

Prograde, Retrograde and Structural Isograds in the Monashee Complex of the Canadian Cordillera

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Summary

A "classical" definition of isograd is: "a line joining points of similar P, T value"¹. However, this definition implies that the entire body of rocks considered was metamorphosed as a coherent block and that quenching occurred at the same point of a P-T path, presumably at the thermal peak. Carmichael (1978²) rather proposed the following definition: a "line on map across which there is a change in metamorphic mineralogy". The relevance of this descriptive definition is well illustrated in the Monashee Complex of the Canadian Cordillera where three types of isograd were identified. From upper to lower structural levels, four foliation-parallel isograds have been mapped: 1) an upward-facing Ky-out; 2) an upward-facing Ms-out; 3) a downward-facing Ms-out; and 4) a downward-facing Ky-out. The first isograd can be defined as *structural* because it is parallel to the reverse shear zone "Monashee décollement". The second isograd can be defined as *prograde* because it marks the disappearance of Ms and an increase in leucosome volume, and P-T-t paths across it are compatible with a common evolution. The third isograd can also be defined as *structural* because P-T-t paths across it imply a fault/shear zone. Finally, the fourth isograd can be defined as *retrograde* because the change in metamorphic mineralogy across it is related to the extent of retrogression. Indeed, the presence of Ky-Grt granitic leucosome in both the Ky-Kfs-Sil zone and the underlying Sil-Ms-(± Kfs) zone across the isograd implies that both zones reached similar peak metamorphic conditions. Geochronological data further suggest that the extent of retrogression was controlled by the cooling rate, which was lower in the lower zone. This study therefore demonstrates that isograds can form by different processes. The assumptions implied by the classical definition are therefore unjustified and could lead to tectonic misinterpretations. In contrast, the use of a descriptive definition combined with the construction of P-T-t paths across isograds could reveal hidden tectonic information, such as the presence of cryptic shear zones and the causes of varying cooling rates in a rock package.

References

- ¹Jackson, J.A., 1997. *Glossary of Geology, Fourth Edition*. American Geological Institute, Alexandria, VA, United States, p337.
- ²Carmichael D.M., 1978. *Metamorphic bathozones and bathograds; a measure of the depth of post-metamorphic uplift and erosion on the regional scale*. *American Journal of Science* 278, 769-797.