Tightening the Belt: Paleomagnetic Constraints on Deposition and Deformation of the Middle Proterozoic Belt-Purcell Supergroup, U.S. and Canada

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EXPANDED ABSTRACT

The Belt-Purcell Supergroup crops out in Montana, Idaho, British Columbia, and Alberta. It is the largest and most intensively studied Middle Proterozoic succession in western North America. A major paleomagnetic survey of the Belt in Montana was carried out by the U.S. Geological Survey between 1975 and 1985, but only partial results have been published. We have reanalyzed the data, have added new data from the Canadian part of the Belt-Purcell

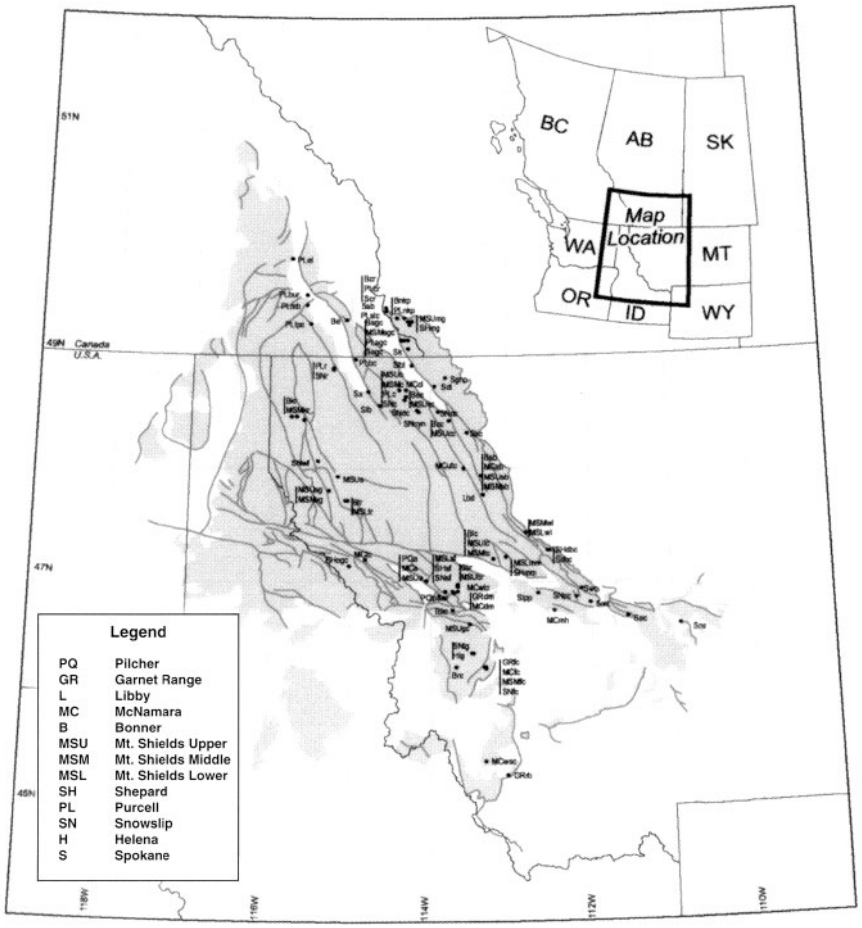


Figure 1.

Basin and report a coherent table of results. In all, results derive from more than 2700 samples from 106 localities, spanning 13 formations and members of formations.

Ancient red bed strata were sampled at the great majority of localities. They typically exhibited coherent hematite magnetizations residing in pigment and specularite. At several sites, the strata also exhibited a secondary magnetite component that carried a Cretaceous overprint direction. Oxidized basalt flows also carried stable magnetizations. Gray to brown and black carbonates and argillites were sampled widely in both intensive stratigraphic and reconnaissance sections, but none provide reliable, reproducible directions.

Reliable results obtained from the red beds clustered around middown south-westerly directions (normal polarity), and midup northeasterly directions (reverse polarity). Most mean directions were antiparallel across the Belt-Purcell section, and clearly passed fold and reversal tests within and among localities. Directions from across the Belt-Purcell section systematically steepen in ascending stratigraphic position. This systematic steepening, and a stratigraphically reproducible polarity zonation, have served to establish a coherent magnetostratigraphy throughout the basin. These observations prove that the dominant remanence is primary.

In comparison to Phanerozoic apparent polar wander rates, it is reasonable to suggest that no more than 50 million years elapsed during deposition of the Belt-Purcell Supergroup, certainly not the 400 m.y. or even 200 m.y. as suggested by some authors. Recent U/Pb dates confirm the short duration.

The Sibley Group, a large rift basin near Lake Superior, has correlatable paleomagnetic poles to the Belt-Purcell, suggesting that ancient North America was under huge extensional stresses at that time. The Electra Lake Gabbro in southwest Colorado also contains a Belt-Purcell pole. In contrast, other similarly aged poles, mostly from Elsonian intrusions in Labrador, are nearsided with respect to the Belt-Purcell poles. The discrepancy must be caused by differences in age and unrecognized tilts in the unstratified rocks.

We do not see evidence of a large clockwise rotation of the whole basin, as suggested by Sears and Price. The Belt-Purcell Basin is cut by numerous Laramide-age faults, which break it into small coherently rotated domains. Both clockwise and counter clockwise rotations are apparent, generally under 15 degrees. The Lewis and Clark line is the locus of much of this rotation.

KEY:

9. Pilcher, Garnet Range, and Libby
8. McNamara
7. Bonner
6. Mount Shields Upper
5. Mount Shields Middle
4. Mount Shields Lower
3. Shepard
2P. Purcell
2. Snowslip
1. Spokane

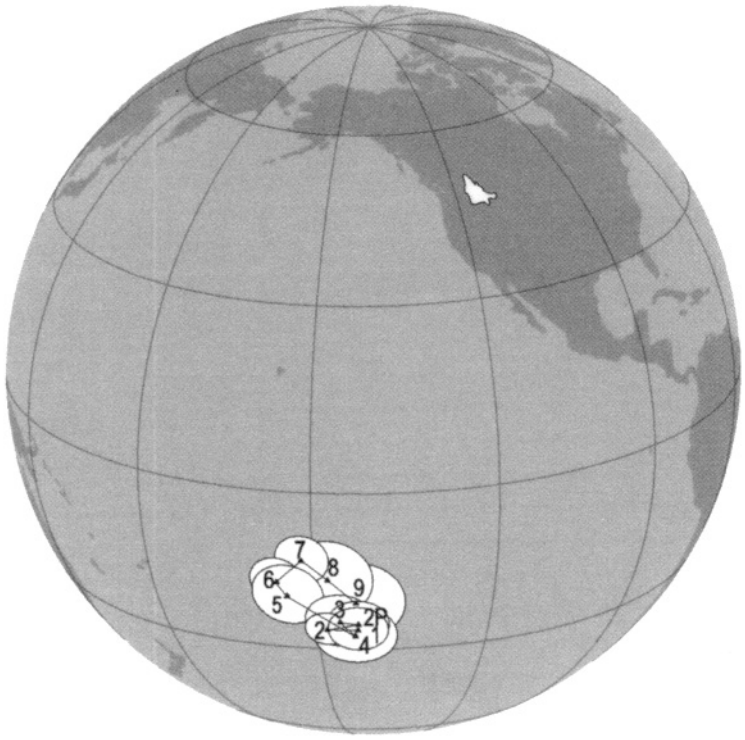
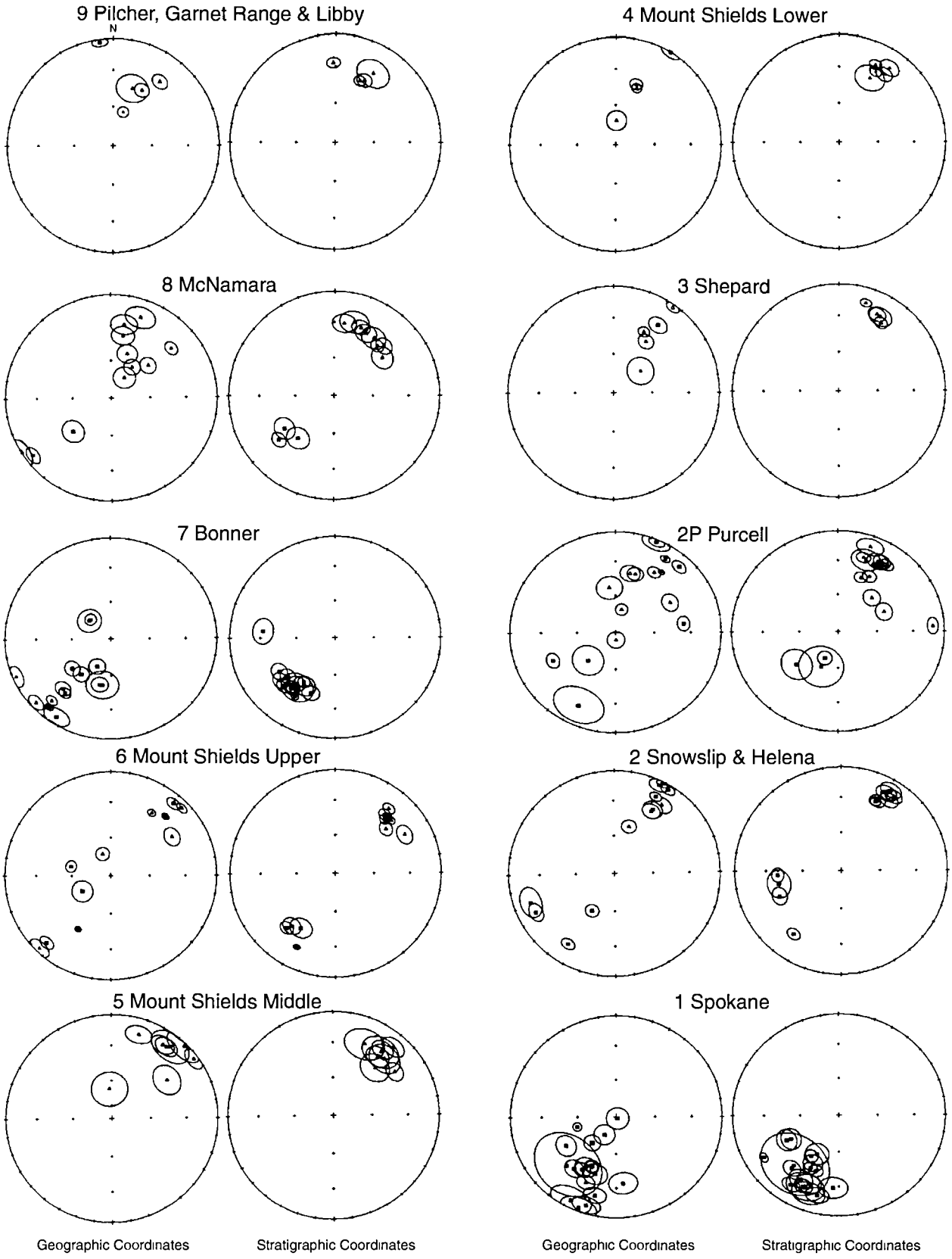


Figure 2.


9 Pilcher, Garnet Range & Libby
N
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1 Spokane
Geographic Coordinates
Stratigraphic Coordinates
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Figure 3.