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Petrology of the Libby Formation and comparison to the Garnet Range and Pilcher Formations of the Belt Supergroup: The case for stratigraphic equivalency

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Fig. 1: Geographic location of Belt Supergroup from Kidder (1992). Our samples were gathered from Libby and Fishtrap Creek localities.

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1. Introduction: Purpose and motivation

- The Belt Supergroup is a ~20km thick sequence of Middle Proterozoic rock.
- It is a unique unit: its age has been dated to ~1.5 Billion years old, and delicate sedimentary structures are preserved.
- The uppermost units of Belt, including Pilcher, Garnet Range, and the Libby Formation have not been described in petrologic detail.
- Characterizing rocks of the uppermost Belt and their lateral extent gives a glimpse into a unique time in North American geologic history that isn't readily observable elsewhere on Earth.

2. Materials and Methods

- Field sampling of exposures at Flagstaff Mountain and Fishtrap Creek, MT in October, 2015
- Cutting of coarsest siltstone samples into unstained, uncovered thin sections
- Selection of coarsest 7 samples for breaking, milling, water tabling, Frantz magnetic separation, and LST heavy liquids separation to separate heavy minerals
- Radiometric dating via Laser ablation - Inductively Coupled Plasma Mass Spectrometry of selected zircons at the Boise State Geochronology Lab
- Point count techniques to characterize framework grain composition

3. Context: Zircon Ages of the Upper Belt

Fig. 2: La-ICPMS ages and relative probabilities of detrital zircons from upper Missoula Group and above the Great Unconformity (from Hendrix, 2016).

4. Results Summary

- The upper Belt at Libby is fine-grained, and contains abundant diagenetic chert. Framework constituents are equivalent to Garnet Range and Pilcher.
- Zircon spectra from Libby show similar peak distribution as those from from Garnet Range and Pilcher.
- The upper Belt at Libby is from a quartzose-transitional orogenic provenance, as are Garnet Range and Pilcher.
- The primary difference between Libby and Garnet Range and overlying Pilcher is grain size and chert content.

4a. Results: Petrological Comparison

Fig. 3: Photomicrographs- Samples of Pilcher (right) and Libby Formation/Pilcher equivalent (left). Framework grains and major constituents include:

- Sub-rounded monocrystalline quartz
- Polycrystalline Quartz
- Fine micas (biotite)
- Diagenetic chert

4b. Results: Zircon Ages of the Upper Belt near Libby, MT

Fig. 4: La-ICPMS ages and relative probabilities of detrital zircons from the Libby Formation.

4c. Results: Framework Grains

Fig. 5: Framework Grain composition of siltstones from Libby and sandstones from Garnet Range.

5. Conclusions and Implications

- The Libby Formation is likely a distal northwestern equivalent to the Garnet Range and overlying Pilcher Formations; its nomenclature should be changed to Garnet Range and Pilcher.
- The zircon populations from Libby samples should be expanded to yield relative probabilities with lower uncertainties.
- Stratigraphic sections of Garnet Range and Pilcher should be measured and compared to identify significant surfaces and stratigraphic intervals.

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