

GEOCHRONOLOGICAL CONSTRAINTS ON THE GREYSON FORMATION

The maximum depositional age of Lower Belt Group strata within the Helena embayment (location D in Fig. DR1) comes from the youngest detrital zircon from the Neihart Quartzite measured at 1.71 Ga (Mueller et al., 2016). The Neihart is thought to be part of a broad sheet of basal quartzites that underlie Belt Supergroup strata from the Helena embayment in the east to primary axis fill sediments in the west, which are mostly composed of the Prichard Formation (locations A and E, Fig. DR1; Freeman and Winston, 1987). In the vicinity of the Priest River Complex in northern Idaho (location A, Fig. DR1) the metamorphic layering of the coarse-grained Hauser Lake Gneiss has been interpreted to derive from an originally interstratified quartz wacke and argillite, representing a metamorphosed portion of the lowermost Prichard Formation (Clark, 1973; Weissenborn and Weis, 1976; Miller, 1974; Rhodes and Hyndman, 1984; Doughty et al., 1997). The outcrop pattern of this unit tracks a distinctive white quartzite band opposite the Purcell Trench that is located about 10 km west of the easternmost exposures of the Prichard Formation known as the Gold Cup Mountain quartzite, which may be a lateral equivalent of the Neihart Formation in the Helena embayment (Freeman and Winston, 1987; Harrison, 1972). The Gold Cup Mountain quartzite separates the Hauser Lake Gneiss from the Laclede augen gneiss terrane, for which Evans and Fischer (1986) established an age of 1576 ± 13 Ma (based on upper-intercept concordia for moderately discordant cogenetic zircons from the gneiss terrane).

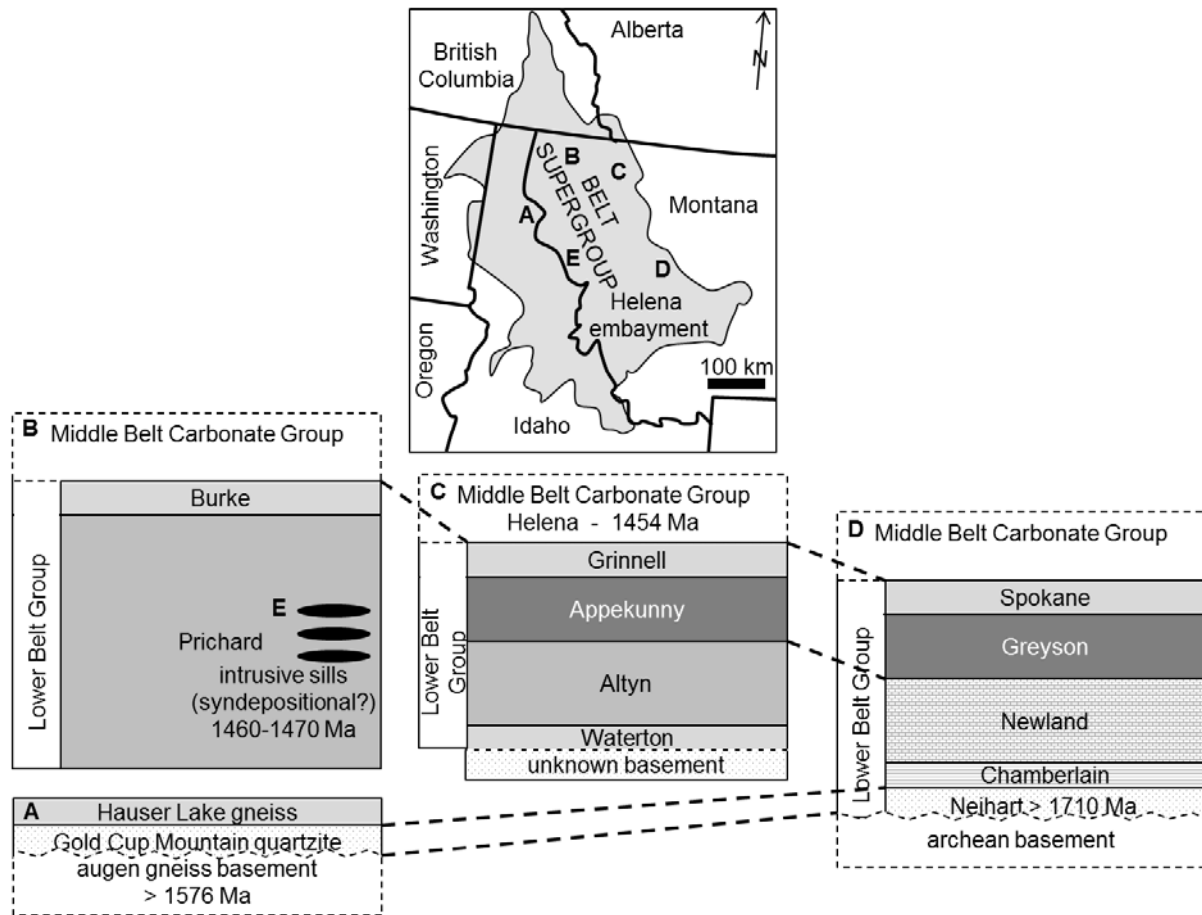


Figure DR1. Regional stratigraphy and geochronological constraints on the age of the Greyson Formation. Figure details based on Evans and Fischer, 1986; Anderson and Davis, 1995; Doughty et al., 1997; Davis and Schandl, 2000; Evans et al., 2000; Mueller et al., 2016.

The minimum depositional age of Lower Belt Group strata is a 1454 ± 13 Ma U-Pb zircon date from a tuff within the Helena Formation of the Middle Belt Carbonate Group (location C, Fig. DR1; Evans et al., 2000). The Middle Belt Carbonate Group overlies the Lower Belt Group and can be tracked across the entire surface exposure of the Belt Supergroup. Similar continuity of the underlying redbed argillites of the Spokane (location D), Grinnell (Location C)

and Burke (Location B) formations provides clear stratigraphic control (Lydon, 2007). The Appekunny Formation in Glacier National Park is most likely correlative with the Greyson Formation (Horodyski, 1993; Slotznick et al., 2016). The Helena Formation age is consistent with two other dates obtained from units overlying the Middle Belt Carbonate in the northern Belt Supergroup (location B, Fig. DR1): 1443 Ma from a latite flow of the Purcell Lava within the Snowslip Formation, and 1401 Ma from an airfall tuff between Bonner and Libby Formations near Libby, Montana (Evans et al., 2000).

Multiple sills in the Prichard Formation of western Montana (Location E, Fig. DR1) have yielded U-Pb dates in the range of 1455-1470 Ma (Sears et al., 1998). The Moyie Sills in the correlative middle Aldridge Formation of southeastern British Columbia also have U-Pb dates of 1468 ± 2 Ma (Anderson and Davis, 1995). Significantly, one of the sills of the Prichard Formation – the Plains Sill – is associated with a chaotic mixture of partially fused granosediments indicating that it intruded into unconsolidated, water-saturated sediments. With an age of 1468 ± 3 Ma, the effectively syndepositional Plains Sill puts at least this part of Prichard deposition well within the (early) Mesoproterozoic.

Synopsis

There are no direct age constraints for the Greyson Formation or the units immediately surrounding it within the Helena embayment. However, all available stratigraphic correlations point to the Helena Formation date at 1454 Ma providing an effective youngest age, and the ~1470 Ma age of the intrusive sills within the Prichard Formation serving as an approximate correlative age for an unknown part of a rock package that includes the Newland, Greyson and Chamberlain Formations. An extrapolation of ages from upper and middle Belt Supergroup

strata through those ages that are available for the Lower Belt Group (Lydon, 2007) suggest that Greyson deposition falls closer to the 1454 Ma age of the Helena Formation than to the maximum 1710 Ma age from the Neihart Quartzite zircons. This interpretation is consistent with the use of the 1576 Ma age of the augen gneiss terrane from northern Idaho to constrain the age of the contact between the basal quartzite of the Neihart Formation with its underlying basement rocks. It remains possible, but unlikely, that the Greyson Formation fossils are older than 1576 Ma; more precise resolution will require direct ages from the Helena embayment.

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