Giant iron-ore deposits of the Hamersley province related to the breakup of Paleoproterozoic Australia: New insights from in situ SHRIMP dating of baddeleyite from mafic intrusions: Comment and reply

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Müller et al. (2005) have presented important new age data for mafic intrusions in the Hamersley province of Western Australia, which they use to constrain the ages of the Ophthalmlian orogeny and giant iron-ore deposits. Their 2208 ± 10 Ma age for dolerite sills intruded into the Turee Creek Group is within analytical error of the 2209 ± 15 Ma maximum age determined by Martin et al. (1998) for the Cheela Springs Basalt near the base of the unconformably overlying Wyloo Group. Interpretation of these statistically indistinguishable and apparently contradictory ages is dependent on critical field relationships that the authors have not presented or do not appear to have considered.

The assumption that ca. 2208 Ma dolerite sills were intruded at approximately the same stratigraphic level throughout the region would imply a facies change from glacialic diamictites in the Hamersley province (Martin, 1999) to deltaic and marine quartzites in the Turee Creek syncline (Thorne and Seymour, 1991; Martin et al., 2000). This implied facies change, and resultant differences in lithology, grain size, and paleocurrent directions, is not accounted for. Such a correlation also does not consider that dolerite-hosting quartzites in the Turee Creek syncline are conformably overlain by vesicular basalts of the Cheela Springs Basalt (Thorne et al., 1991), a stratigraphic relationship consistent with their correlation with the Beasley River Quartzite as exposed throughout the Hamersley province. Undated dolerite sills intrude the Beasley River Quartzite at the eastern end of the Hardye syncline and along the northern flank of the Wyloo Dome (Seymour et al., 1988; Thorne and Tyler, 2006), as well as in the Duck Creek syncline. Undated dolerite sills also intrude the overlying Cheela Springs Basalt (Trendall, 1979; Thorne and Seymour, 1991; Martin et al., 2000).

An important field relationship for the interpretation of dolerite sills that have intruded into the Turee Creek Group is the presence of a highly discordant sill at the eastern end of the Wyloo Dome. This sill cuts across stratigraphy from within the Turee Creek Group up to the unconformity at the base of the Beasley River Quartzite (Seymour et al., 1988; Trendall, 1979). My own unpublished mapping shows that the sill locally intrudes ~50 m above the unconformity, separating the basal Three Corner Conglomerate Member from the remainder of the formation. Interestingly, the youngest detrital zircon in the Beasley River Quartzite is 2420 ± 18 Ma (Geological Survey of Western Australia, 2005; sample number 169084), the youngest detrital zircon in the Beasley River Quartzite is 2420 ± 18 Ma (Geological Survey of Western Australia, 2005; sample number 169084), and was deformed during the Ophthalmlian orogeny (Cawood and Tyler, 2004). Clearly further dating, particularly of mafic intrusions and detrital zircons, is required in order to resolve the timing and significance of the Ophthalmlian orogeny.

The ca. 2008 Ma age proposed for the giant iron-ore deposits of the Hamersley province is a reliable maximum age for mineralization at the Paraburdoo mine, but may not necessarily apply to all deposits. Small ore clasts are present in the basal Cheela Springs Basalt and Beasley River Quartzite, suggesting that some iron enrichment occurred prior to ca. 2209 Ma (Martin et al., 1998). This observation is supported by recent studies of the timing of regional-scale metamorphic fluid flow (Rasmussen et al., 2005) and the formation of hematite veins associated with the Mount Whaleback deposit (Brown et al., 2004).

REFERENCES CITED


Geological Survey of Western Australia, 2005, Compilation of geochronology data, June 2005 update: Geological Society of Western Australia, CD-ROM.


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We do not use dolerite sills for stratigraphic correlation. We obtained identical ages for sills that intruded the Turee Creek Group prior to the Ophthalmian orogeny, and so determined the maximum age of orogeny from them. The age is considerably older than the depositional age of the Wooly Dolomite and, by inference, the age of the Cheela Springs Basalt. The assertion that ca. 2208 Ma dolerite sills are sub-volcanic to the Cheela Springs Basalt is not consistent with the field relationships. Krapež (1999) did not consider that the sills were subvolcanic to the Cheela Springs Basalt. He stated that the dolerite sills are the only rock record of an extensional event that occurred prior to the Ophthalmian orogeny and long before the Beasley River Quartzite was deposited.

The premise that the Beasley River Quartzite and Cheela Springs Basalt are deformed by the same folds as the Turee Creek Group is a persisting myth. Orthoquartzites in the Turee Creek syncline are folded concordantly with strata that are Turee Creek Group, but we contend that those orthoquartzites are part of the Turee Creek Group and not the Beasley River Quartzite. Poor documentation of the Turee Creek Group is responsible for the belief that the same cleavage is present in the Beasley River Quartzite and Turee Creek Group. Krapež (1996), following fieldwork with A.B. Goddard in 1992, documented the sequence stratigraphy of the Turee Creek Group in the Hardey syncline. Martin et al. (2000) admitted that the unconformity-bound unit they initially believed was basal Beasley River Quartzite was actually part of the Turee Creek Group, but they did not correct their earlier structural interpretation, continuing the belief that the cleavage they identified in the unit that they incorrectly assigned to the Beasley River Quartzite records common folding between the Beasley River Quartzite and the Turee Creek Group. Although critical field relationships were eventually accepted, there is reluctance to give up the structural misinterpretation.

We did not assign the Panhandle event to the 1780 Ma Capricorn orogeny. Krapež (1999) recognized it as a ca. 2000 Ma syn-rift deformation, and Taylor et al. (2001) reached a similar conclusion.

Fieldwork during 2006 will include a search for iron-ore clasts in the Beasley River Quartzite and Cheela Springs Basalt, and if found, we will publish field coordinates of localities. It is unlikely all iron-ore deposits are the same age, but no structural, ore-deposit, or geochronologic studies have reasonably established that iron ores are linked to compressional tectonics. Rather, iron ores formed during extension or transtension, most likely subsequent to the Ophthalmian orogeny, the age of which is <2208 Ma (the age of pre-folding dolerites) and >2030 Ma (the age of the Wooly Dolomite). The significance of the ca. 2030 Ma Wooly Dolomite to the age of the Beasley River Quartzite and Cheela Springs Basalt appears to have been ignored by Martin. This is surprising, because it is difficult, if not impossible, to believe that the syn-rift Beasley River Quartzite and Cheela Springs Basalt spanned the period 2208 Ma to 2030 Ma.

REFERENCES CITED


