COMMENT

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Simondon (1992), Simonson and Hassler (1997), and Simonson et al. (2000) discovered extraterrestrial impact ejecta in the Hamersley and Fortescue Groups, Pilbara Craton, Western Australia, and noted the absence of shocked quartz grains (Simonson et al., 1998). Rasmussen and Koeberl (2004) identify a quartz grain with planar deformation features (PDFs) in the ~2.63 Ga Jeerinah Impact Layer—the oldest shocked quartz grain recorded to date. These authors extend the known distribution of the Jeerinah Impact Layer to two new drill holes (WRL-1, DNH-186) and refer to the possible correlation between the Jeerinah Impact Layer (central Hamersley Basin) and impact spherules in the Carawine Dolomite (east Hamersley Basin)—~200 km east-northeast from the easternmost known occurrence of the Jeerinah Impact Layer. I question (1) the stratigraphic correlations between the Jeerinah Impact Layer and Carawine Dolomite, and (2) the authors’ suggestion that the Jeerinah Impact Layer impact occurred on continental crust.

Rasmussen and Koeberl (2004, p. 1031) state: “Based on petrographic similarities and stratigraphic position, the Jeerinah spherule layer was recently correlated with the Carawine horizon in the Oakover River area of the Pilbara Craton (Fig. 1) (Simonson et al., 2000):” However, whereas the Jeerinah Impact Layer occurs at the top of the Jeerinah Formation (shale, mafic volcanics, 2.68–2.63 Ga), the Carawine Dolomite is located within carbonate-dominated basin facies of this formation. Due to the absence in the east Hamersley Basin of the marker Marra Mamba Iron Formation (2597 ± 5 Ma; Trendall et al., 1998), a Jeerinah Impact Layer–Carawine Dolomite correlation is far from certain. I list here several factors which support a correlation between the Carawine Dolomite and the 2560 ± 7 Ma spherule marker bed of the Wittenoom Formation (Glikson, 2004):

1. Microkrystite spherules of the Carawine Dolomite are located stratigraphically above, as well as injected as microbreccia veins into, a 10–30 m-thick stratigraphically consistent chert fragment–bearing carbonate megabreccia (Simulation, 1992; Simulation and Hassler, 1997). This Carawine Dolomite unit straddles a ~100-km-long strike between Ripon Hills and the Woodie-Woodie area, east Hamersley Basin, and is interpreted in terms of sea floor excavation by a mega-tsunami immediately preceding the fallout of microkrystite spherules (Glikson, 2004).

2. The above relations contrast with the Jeerinah Impact Layer–type section at Hesta (see Figure 1 in Rasmussen and Koeberl, 2004) where the Jeerinah Impact Layer is located above interlayered felsicogenic shale and chert above the Jeerinah Formation. The spherules underlie a debris flow breccia, suggesting arrival of the tsunami postdated fallout of spherules. These differences, which reflect differential timing of ejecta fallout and tsunami arrival, complicate stratigraphic correlations.

3. Pb-Pb isotopic studies (Woodhead et al., 1998) suggest a broad age overlap between the Carawine Dolomite (2548 +26/-29 Ma) and the Wittenoom Formation (2541 +18/-15 Ma), consistent with the U-Pb age of felsic tuff within the latter (2561 ± 6; Trendall et al., 1998). Both of these units contain microtektites as well as microkrystites. Despite the large errors of the Pb-Pb ages, the Jeerinah Impact Layer may thus be older than the Carawine Dolomite by at least 55 m.y.

Rasmussen and Koeberl (2004, p. 1031) state: “The presence of shocked quartz in the Jeerinah spherule bed indicates that the impact site contained quartz, favoring a continental target rather than an oceanic site.” This interpretation appears to assume that early Precambrian oceanic regimes were lacking in quartz-bearing felsic volcanics and derived sediments, as contrasted with the common occurrence of dacite and rhyolite and felsic tuff intercalations in mafic-ultramafic sequences of Archaean greenstone belts—variedly interpreted in terms of sismic crustal relics or island arc assemblages. Thus, the presence of a minor shocked quartz component is not evidence for continental impact, nor does it preclude impact in simatic or mixed sial-sima crustal environments.

Clues to the composition of the impacted crust may be furnished from the overall chemistry of least-altered portions of the ejecta. The extensive replacement of spherules by en echond spars, possibly representing absorption of K from seawater during settling of the spherules due to high felsic component. Partition coefficients (Glikson and Allen, 2004), and subsequent burial metamorphism, complicate identification of primary geochemical features. On the other hand, the preservation of platinum-group-element anomalies (McDonald and Simonson, 2002; Rasmussen and Koeberl, 2004) in the Jeerinah Impact Layer and of nickel nanonuggets in the 2.47–2.50 Ga DGS4 impact unit (Glikson and Allen, 2004) suggest local retention of primary chemical and mineralogical features. The common presence of chlorite in the Jeerinah Impact Layer microkrystite spherules and locally elevated ferromagnesian element abundances hint at mafic components in the source. Further geochemical studies of the Jeerinah Impact Layer are required to elucidate its origin. A study of orientation of the PDFs in the shocked quartz fragment (Rasmussen and Koeberl, 2004) may yield further clues to the shock pressures involved in the ~2.63 Ga impact.

REFERENCES CITED


We welcome a discussion of the Jeerinah Impact Layer and its likely stratigraphic correlation. Glikson accepts the interpretation of the Jeerinah Impact Layer as a distal ejecta layer as first proposed by Simonson et al. (2000), but questions our correlation of the Jeerinah Impact Layer with the Carawine layer, as well as our suggestion that the layer contains debris from a continental impact.

Glikson argues for a correlation between the Wittenoom (rather than Jeerinah) and Carawine spherule beds based on two lines of evidence, the first of which is the different location of spherules relative to interpreted Jeerinah) and Carawine spherule beds based on two lines of evidence, the first of which is the different location of spherules relative to interpreted stratigraphic correlation. Glikson accepts the interpretation of the Jeerinah Impact Layer as a distal ejecta layer as first proposed by Simonson et al. (2000), but questions our correlation of the Jeerinah Impact Layer with the Carawine layer, as well as our suggestion that the layer contains debris from a continental impact.

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