**A NEWLY RECOGNIZED LATE ARCHEAN IMPACT SPHERULE LAYER IN THE REIVILO FORMATION, GRIQUALAND WEST BASIN, SOUTH AFRICA.** B. M. Simonson[1] and D. Y. Sumner[2], [1]Geology Dept., Oberlin College, Oberlin, OH 44074 (bruce.simonson@oberlin.edu), [2]Geology, University of California, Davis, Davis, CA 95616 (sumner@geology.ucdavis.edu).

**Introduction:** Spherule layers, particularly those hosted by deeper-water Precambrian successions, are emerging as important sources of information on large terrestrial impacts [1-3]. Searches in the late Archean to early Paleoproterozoic Hamersley basin of Western Australia have been especially fruitful as spherule layers from a minimum of 3 large impacts have already been found [4]. Strata of comparable age and deposited in similar environments are preserved over large areas in the Transvaal Supergroup of South Africa. An initial search resulted in the discovery of a late Archean layer in the Griqualand West basin hosted by the Monteville Formation of the Campbellrand Subgroup [5]. Here we report the discovery of a second late Archean spherule layer 250 to 300 m above the Monteville layer stratigraphically. Preliminary data will be presented with an eye to comparing the new layer to known spherule layers of roughly comparable age.

**Stratigraphic and Geographic Setting**: The new spherule layer was first recognized by one of us (DYS) in cores GH6-3 drilled by Doe Run Exploration and GKP01 sponsored by the Agouron Institute from 10 and 40 km south of Griquatown respectively. The layer is in the Reivilo Formation [6] and is 83 and 54 meters below the base of the Kamden Member in GH6-3 and GKP01, respectively. However, it is closer to the Kamden than that stratigraphically because layers in the cores are inclined 10-60˚ from horizontal. The strata surrounding the spherule layer consist of carbonaceous shale and carbonate with abundant microbial structures indicative of deposition below wave base (like those described by [6,7]). In GH6-3, the spherule layer is 2 cm thick and consists mainly of well-sorted spherules. It is abruptly overlain by a millimeter-scale lamina of silty detritus consisting of angular crystals with other clast types admixed (Fig. 1), including small pieces of broken spherules. In GKP01, spherules are mixed with 20 cm-thick carbonate breccia, which is the only indication of high energy deposition in this stratigraphic interval. Age constraints are sparse [8], but we estimate the Reivilo layer formed at approximately 2.56 Ga.

**Description of Spherules in GH6-3**: Originally the spherules appear to have been well-sorted spherical grains in the coarse sand size range. The original sizes and shapes have been obscured by compaction, especially pressure solution along grain-to-grain contacts (Fig. 2). The spherules consist almost exclusively of K-feldspar with the low sodium content typical of authigenic phases plus minor amounts of finely crystalline mica. Late Archean to Paleoproterozoic impact spherules have very distinctive textures [3]. The Reivilo spherules display some of these textures, most notably an abundance of confocal sprays of highly elongated feldspar crystals, many radiating inwards from spherule margins (Fig. 2). Another similarity is that the feldspars in the Reivilo spherules are shaped like skeletal plagioclase crystals grown rapidly from a melt under conditions of strong supercooling [9-11]. On the other hand, the feldspar crystals in the Reivilo spherules are thicker and coarser and make up a higher percentage of the spherules than those in other Late Archean to Paleoproterozoic layers. In addition, infilled vesicles, relict glass cores replaced by clear phases, and botryoidal fans of acicular feldspar crystals are a common feature of spherules from other layers [3], but quite rare in the Reivilo spherules.

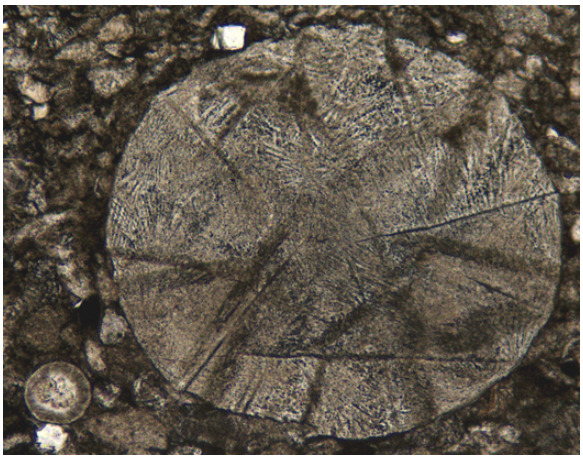

Fig. 1. Photomicrograph of spherule in basal part of silty lamina on top of Reivilo layer in core GH6-3. Long axis of spherule is 0.85 mm.

**Interpretation of Reivilo Spherule Layer**: All of the known Archean to Paleoproterozoic spherule layers occur as discrete layers rich in coarse sand-size grains with predominantly spherical shapes and a heterogeneous suite of internal textures indicating they were formerly molten; geochemical evidence of extraterrestrial material has been detected in most of

them [1-5]. We interpret the Reivilo spherule layer as impact ejecta because it fits the pattern texturally, even though we have no geochemical data as yet. If the Reivilo spherules are like those in the other layers, they were probably generated by an object very roughly the size of the K/T impactor and represent silicate melt droplets with a low silica composition along the lines of basalt [12]. The well-sorted nature of the layer and the abrupt transition to silt at the top further suggest that the layer was deposited under the influence of high-energy waves and/or currents, perhaps generated by the impact itself, as shown by many of the other layers [2,4]. After the Reivilo spherules came to rest on the seafloor, they were compacted as overburden slowly increased and original crystals were replaced with authigenic K-feldspar. However, shapes and internal textures were sufficiently well preserved for them to be recognized as impact spherules.

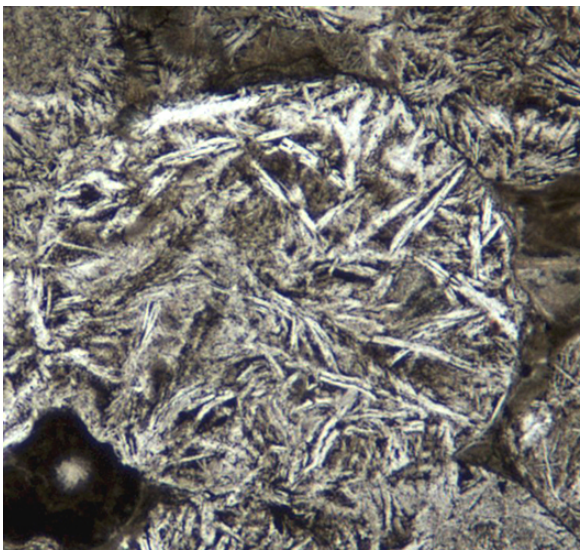

Fig. 1. Photomicrograph of more typical spherule from main body of Reivilo layer in core GH6-3. Note its pressured-solved contacts with adjacent spherules. Long axis of spherule is 0.9 mm.

**Broader Implications**: The discovery of the Reivilo spherule layer has interesting ramifications both for correlations between the Hamersley and Transvaal successions and for the genesis of impact spherules. A persuasive case has been made that 3.47 Ga spherule layers in South Africa and Western Australia are products of a single impact [13]. The Jeerinah and Monteveille spherule layers are both close to 2.63 Ga in age and could likewise be ejecta from a single large impact [14]. The next layer above the Jeerinah in the Hamersley succession is in the Wittenoom Formation, which appears to be around 2.54 Ga in age [8,15]. Given the significant uncertainties in their ages, the Wittenoom and Reivilo layers could be contemporaneous. However, the spherules in the Wittenoom and Reivilo layers differ texturally as. vesicles and botryoidal to acicular crystal formations are much more abundant in the former than in the latter (provided our sample is representative). This leaves only two alternatives. The first logical alternative is that the Wittenoom and Reivilo layers represent ejecta from a single large impact within which there were downrange changes in the textures of spherules. Major textural changes occur downrange in the K/T boundary spherules, but this does not offer a good analog for the Wittenoom-Reivilo correlation. In the K/T boundary layer, the more distal spherules (known as microkrystites) are much more highly crystallized [16], whereas the more crystalline Reivilo spherules appear to be larger than the Wittenoom spherules, suggesting they are the more proximal. Perhaps the Reivilo spherules spent a longer time in a higher-temperature part of the ejecta cloud, allowing them to crystallize more rapidly and thoroughly. Prolific early crystal growth could also preempt the appearance of vesicles and decrease the abundance of glassy cores. The second logical alternative is that the Wittenoom and Reivilo are not correlative, in which case the Reivilo layer represents a major impact not recognized before. Either result is interesting, and whatever their mode of origin, the recognition of the Reivilo layer reaffirms the fact that impact spherule layers, though thin, are highly distinctive and can be recognized by very “low-tech” methods.

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