GEOCHEMICAL CHANGE ASSOCIATED WITH PRECAMBRIAN IMPACT EVENTS. A. K. Davatzes\textsuperscript{1} and K. S. Korman\textsuperscript{2}, \textsuperscript{1}Department of Earth and Environmental Science, Temple University, alix@temple.edu, \textsuperscript{2}Department of Earth and Environmental Science, Temple University, katrina.korman@temple.edu.

Introduction: Globally, large impacts to the Earth’s surface would release substantial amounts of gases, including CO\textsubscript{2}, NO\textsubscript{x}, SO\textsubscript{2}, and water vapor \cite{1}, with the relative abundances of these dependent on the target rock composition. In addition, they create mechanical and thermal effects, such as earthquakes, fires and hydrothermal activity \cite{1}. Evidence of global environmental change associated with large impacts are well documented in the sedimentary record associated with Phanerozoic events, but the lack of fossils, lack of abundant rock record, and differences in atmospheric chemistry compared to the modern Earth have made it more difficult to observe these effects in the Precambrian record. Meteor impact-induced changes to the biosphere, atmosphere, hydrosphere, and lithosphere in the Precambrian should be discernible as consistent shifts in geochemical patterns within the stratigraphy. Through detailed petrographic and geochemical analysis, we present evidence of micro-scale changes in the geochemistry of the sedimentary layers associated with two impact events.

Samples and Methods: Spherule beds from both the Barberton greenstone belt of South Africa and the Hamersley Basin of Western Australia, ranging in age from 3.3 Ga to 2.4 Ga, were sampled along with associated sedimentary layers. Here we focus on five sections: the Loop Road and Barite Valley Sections of the S3 spherule bed (\~{}3.24 Ga), and the Paraburdoo, Weeli Wolli, and Governor sections of the Paraburdoo Spherule Layer (PSL; \~{}2.57 Ga). These sections are selected because the spherule bed is deposited in a section with quiescent water, with little or no evidence of wave or tsunami reworking that would disrupt a stratigraphic depositional sequence. Both the PSL and S3 layer are well-preserved at these locations with fully concentrated spherule beds lacking admixed material, and both spherule layers contain primary Ni-chromites and relict textures, as well as Ir anomalies.

The PSL layer is contained within the Paraburdoo Member of the Wittenoom Formation, with associated stratigraphy composed primarily of thin beds of ankerite and argillite (Fig 1A). The S3 spherule bed is preserved at the base of the Fig Tree Group in finely laminated grey chert (Fig 1B,C). Despite these differences in sediment lithologies, we note some consistent patterns associated with both impact events.

Major and trace element geochemistry was analyzed in the sedimentary layers below, within, and above the impact deposit by bulk XRF, handheld XRF, and bulk ICP-MS analysis for both the S3 and PSL layer. In addition, bulk total organic carbon (TOC) was measured for S3 and the adjacent sedimentary layers.

Results: In handheld XRF analyses, arsenic and iron concentrations increase above the PSL and S3 impact layer at all sites, and Ba increases at the Paraburdoo section of the PSL and in both S3 sections (Fig 2). Maximum values of As are 60 ppm, compared to pre-impact levels below 20 ppm in the PSL, and 100 ppm compared to pre-impact levels of \~{}35 ppm in S3 (error is \~{}5 ppm). Ba increases by a couple hundred ppm in the PSL, and increases from about 1500 ppm to 6000 ppm in S3 (error is \~{}50 ppm). Iron increases by about a weight percent in the PSL and 2 weight percent in S3 (error is \~{}100 ppm).

Total organic carbon (TOC) is also higher within and above the spherule bed in both the Loop Road and Barite Valley sections, compared to below, and this correlates strongly with the Ba concentrations (Figure 3).

Figure 1: (A) Field photo from the Governor section of the PSL. White arrow points to the impact layer, stratigraphy above and below is fine-grained ankerite and argillite. (B) Top of the spherule bed and overlying fine-grained laminated grey chert at Loop Road section of S3. (C) Underlying laminated grey chert. Top of this sample is just below the base of S3 at Loop Road.
**Discussion:** Given the relative mobility of Ba, As, and Fe in sedimentary systems, we are cautious, but find it notable that the same trend is observed in multiple sections, hosted in very different sediments, with different diagenetic histories, and several hundred million years apart in age. We investigate 3 possible explanations for the geochemical change noted above the impact layer: 1) Increased terrigenous input and/or increased aeolian dust due to an increase in weathering, 2) Die off of organisms leading to increase C deposition and barite production, 3) Hydrothermal activity associated with fallout of hot particles. We can largely eliminate the third, as these are both distal deposits in relatively deep water, and are therefore likely to be relatively cool at the time of deposition. In addition, similar effects are not observed below the bed, as would be expected in this scenario. Further TOC analyses and ongoing isotopic analyses will help to further explore the second possibility. We find the first explanation particularly compelling for many reasons. Dust from the impact may have persisted in the atmosphere long after the impact spherules had deposited, and increased dust from climatic change associated with a period of high temperatures after the impact could have resulted in increased terrigenous dust production. Dust particles are believed to be the primary source of iron to the open oceans [2], though alteration of basalt or hydrothermal activity may also have been important sources, particularly in the low-oxygen Archean oceans [3]. Regardless, it remains striking that more pronounced evidence of climatic change is not observed in these very large impacts.