Early Life on Earth and the Search for Extraterrestrial Biosignatures

Dorothy Z. Oehler, Christopher House (Penn State University)

In the last 2 years, scientists within the ARES Directorate at JSC have applied the technology of Secondary Ion Mass Spectrometry (SIMS) to individual organic structures preserved in Archean (~3 billion years old) sediments on Earth. These organic structures are among the oldest on Earth that may be microfossils – structurally preserved remnants of ancient microbes. The SIMS work was done to determine the microfossils' stable carbon isotopic composition ($\delta^{13}C$ values). This is the first time that such ancient, potential microfossils have been successfully analyzed for their individual $\delta^{13}C$ values. The results support the interpretation that these structures are remnants of early life on Earth and that they may represent planktonic organisms that were widely distributed in the Earth's earliest oceans. This study has been accepted for publication in the journal *Geology*.

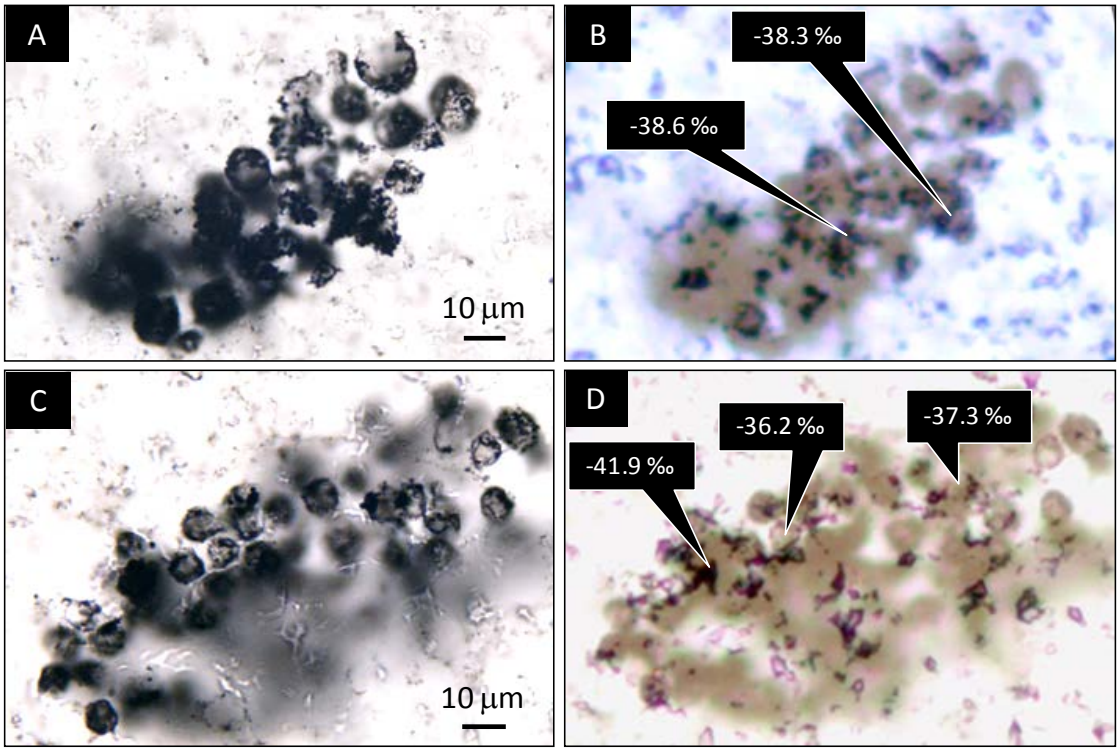

Figure. 1.– Optical photomicrographs of clusters of approximately 3-billion-year-old, spheroidal structures from the Farrel Quartzite of Australia, as seen in petrographic thin section. (A) and (C) are in transmitted light. (B) and (D) show the same structures in a combination of transmitted and reflected light with the locations of SIMS analyses and the SIMS-measured $\delta^{13}C$ values superimposed.

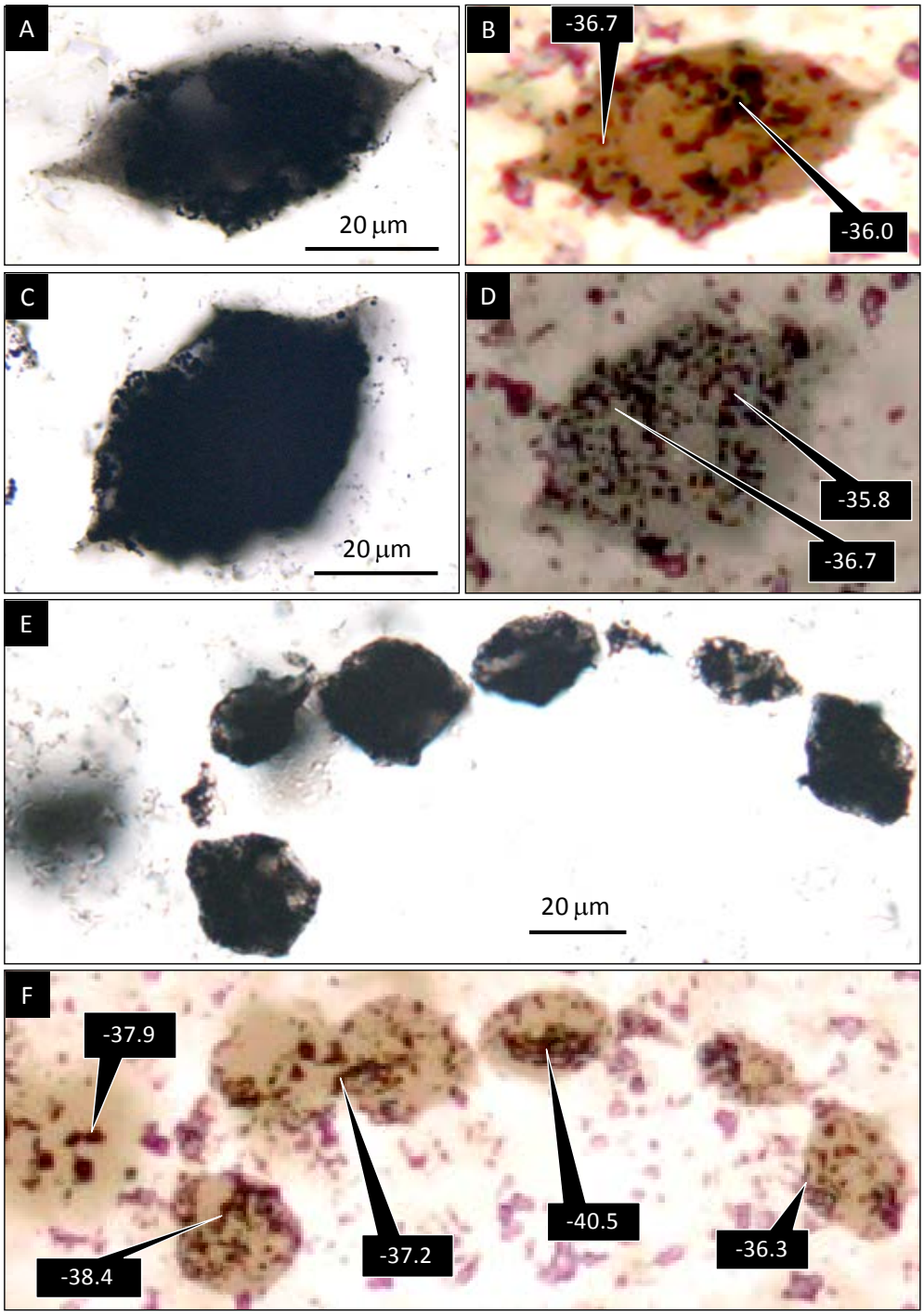

Figure 2.– Optical photomicrographs of approximately 3-billion-year-old, spindle-like microstructures from the Farrel Quartzite of Australia, as seen in petrographic thin section. (A, C, and E) are in transmitted light.
(B, D, and F) show the same structures in a combination of transmitted and reflected light, with the locations of SIMS analyses and the SIMS-measured $\delta^{13}C$ values superimposed.