GSA DATA REPOSITORY 2012025 **Butterfield and Harvey**

Methods

Our protocol for recovering SCFs combines low manipulation processing of fossiliferous host rocks with a search image aimed at structures other than conventional palynomorphs. Depending on availability, 10–50 grams of unoxidized shale/mudstone chips are washed, placed in acid-resistant beakers, and immersed in concentrated (typically 40%) hydrofluoric acid. After 1–2 days, the reacted mixture is diluted with excess water, passed through a 30 μm or 60 μm sieve, and the filtered residue recovered in aqueous suspension. Subsamples of this material are then transferred to disposable Petri dishes and scanned for fossils under a binocular stereoscope using transmitted and/or reflected light. Fossils are collected individually by pipette (200 μl disposable plastic tips fitted with an eyedropper bulb), and passed by pipette through two baths of distilled water before being transferred to microscope-slide cover-slips. Once the fossils have settled out, the water droplet is removed by pipette, leaving the SCFs adhering to the glass. For optical microscopy, the cover-slips are fixed to microscope slides using heat-sensitive epoxy (Petropoxy 154); for SEM, they are mounted on stubs and trimmed to size using a tungsten carbide scribe.

There are clearly significant collection biases associated with this procedure. Anything smaller than ca. 25 μm, for example, is unlikely to be detected with a stereoscope, and the recovery of specimens smaller than ca. 50 μm requires trained expertise in both detection and micro-manipulation. Conventional palynological procedures are unquestionably superior when it comes to dealing with small, mechanically robust microfossils; unfortunately, they also tend to destroy the larger, more delicate, and potentially more informative constituents of the SCF record.

Low manipulation procedures aimed at recovering larger SCFs are not new. Shear et al. (1984) and Braun (1997), for example, have taken a similar approach to recovering the remains of early terrestrial arthropods, Steiner and Fatka (1996) for a study of the Cambrian "mega-alga" *Marpolia*, and Burzin (1989) for Ediacaran work. Even so, most of these protocols entail direct physical contact of the fossils with an extraction tool such as tweezers, limiting recovery to larger and particularly flexible specimens. Most of the informative arthropod fragments from Gilboa, for example, exceed 500 μm in maximum dimension (see Shear et al. 1987), whereas corresponding SCFs in the Cambrian are significantly smaller, typically 50–500 μm. The dearth of larger Cambrian material likely relates to the cumulative loss of fossil quality/extractability over time, though taphonomic differences between marine and non-marine systems are possible contributing factors.

References

Braun, A., 1997, Vokommen, untersuchungsmethoden und bedeutung tierischer cuticulae in kohligen sedimentgesteinen des Devon un Karbons: Palaeontographica Abt. A, v. 245, P. 83–156.

Burzin, M.B., 1989, A modification of the method of extracting organic-walled microfossils from rocks as applied to the solution of paleobiological problems: Paleontological Journal, v. 1989 (4), p. 104–107.

Shear, W.A., Bonamo, P.M., Grierson, J.D., Rolfe, W.D.I., Smith, E.L., Norton, R.A., 1984, Early land animals in North America: evidence from Devonian age arthropods from Gilboa, New York: Science, v. 224, p. 492–494.

Shear, W.A., Selden, P. A., Rolfe, W.D.I., Bonamo, P.M., Grierson, J.D., 1987, New terrestrial arachnids from the Devonian of Gilboa, New York (Arachnida, Trigonotarbida): American Museum Novitates, v. 290, pp. 1–74.

Steiner, M., Fatka, O., 1996, Lower Cambrian tubular micro- to macrofossils from the Paseky Shale of the Barrandian area (Czech Republic): Paläontologische Zeitschrift, v, 70, p. 275–299.