

Liberating microfossils from indurated carbonates: comparison of three disaggregation methods

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Study objectives

Indurated carbonate-rich sedimentary rocks can be extremely **difficult to disaggregate** in order to conduct either geochemical or taxonomic analyses. As such, a **new, minimally destructive method** for disaggregating heavily cemented carbonates was sought; known as **Electric Pulse Fragmentation (EPF)** this method is more commonly used for liberation of coarse zircon grains for geochronological studies. This new technique was compared to two more traditional disaggregation methods of **Calgon** (buffered sodium hexametaphosphate) and **acetic acid**.

Materials

- Field samples from United Arab Emirates, Malta and Tanzania (Figure 1)
- Heavily **lithified carbonate-rich** sediments
- Deposited in dominantly shallow (<250 m) water environment
- Range of **diagenetic cements and secondary infilling**: calcite, quartz, clays
- Samples dominated by **larger benthic foraminifera (LBF), but smaller foraminifera, ostracods, bryozoans, and red and green algae** were also observed

Methods for comparison

- Calgon:** Immersion of samples into buffered sodium hexametaphosphate ($[\text{NaPO}_3]_6$ with Na_2CO_3) for at least 4 days, interspersed with 2 hour intervals on a shaker table. Samples then washed over 63 μm sieve and dried overnight at 50°C.
- Acetic acid:** Samples immersed in 80% acetic acid, 20% de-ionised water mixture for 24 hours, then washed thoroughly with de-ionised water over a 63 μm sieve and dried overnight at 50°C.
- EPF:** Pulsed electrical discharges break apart composite materials, submerged in a process medium (water), along internal compositional or mechanical boundaries (Figure 2). Samples were subjected to 10 pulses in the first instance; any disaggregated material then falls through a sieve (4–10 mm aperture for this study) in the processing vessel in order to be protected from further treatment.

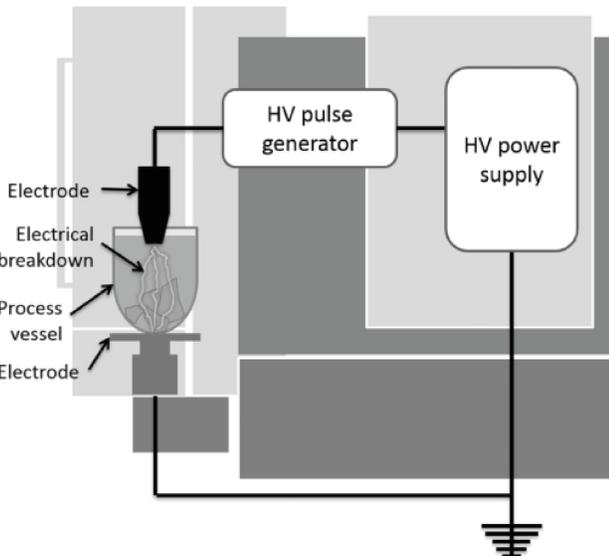


Figure 2: SELFRAG EPF system set-up

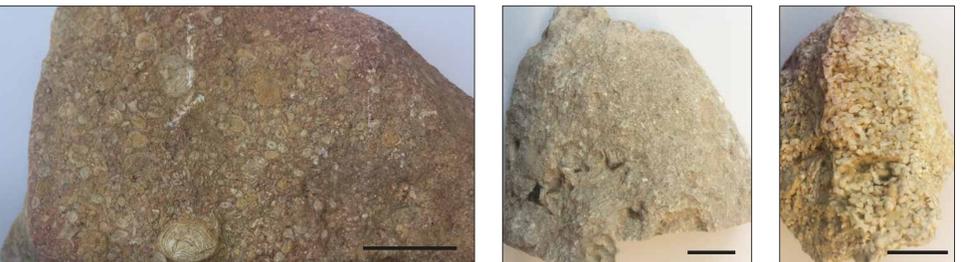


Figure 1: Example hand specimens (scale bar 2 cm)

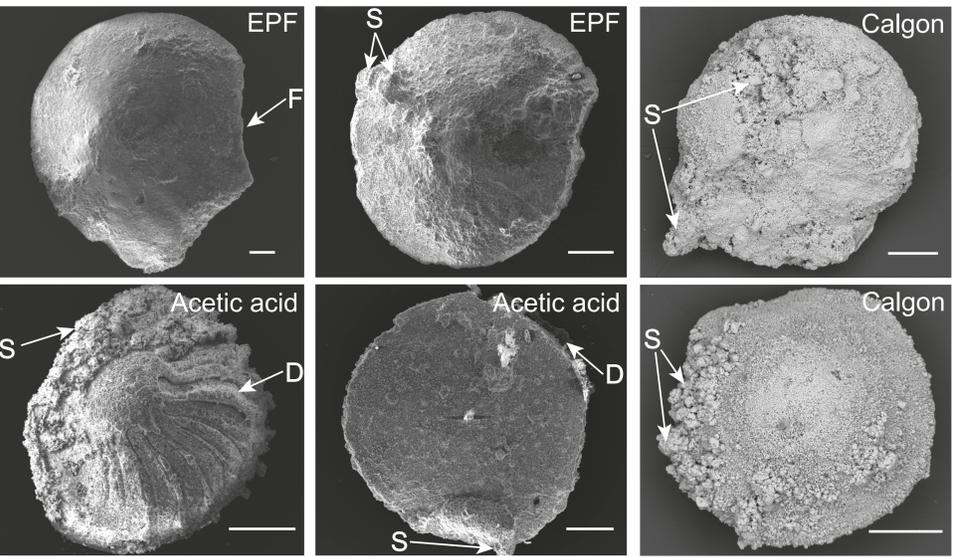
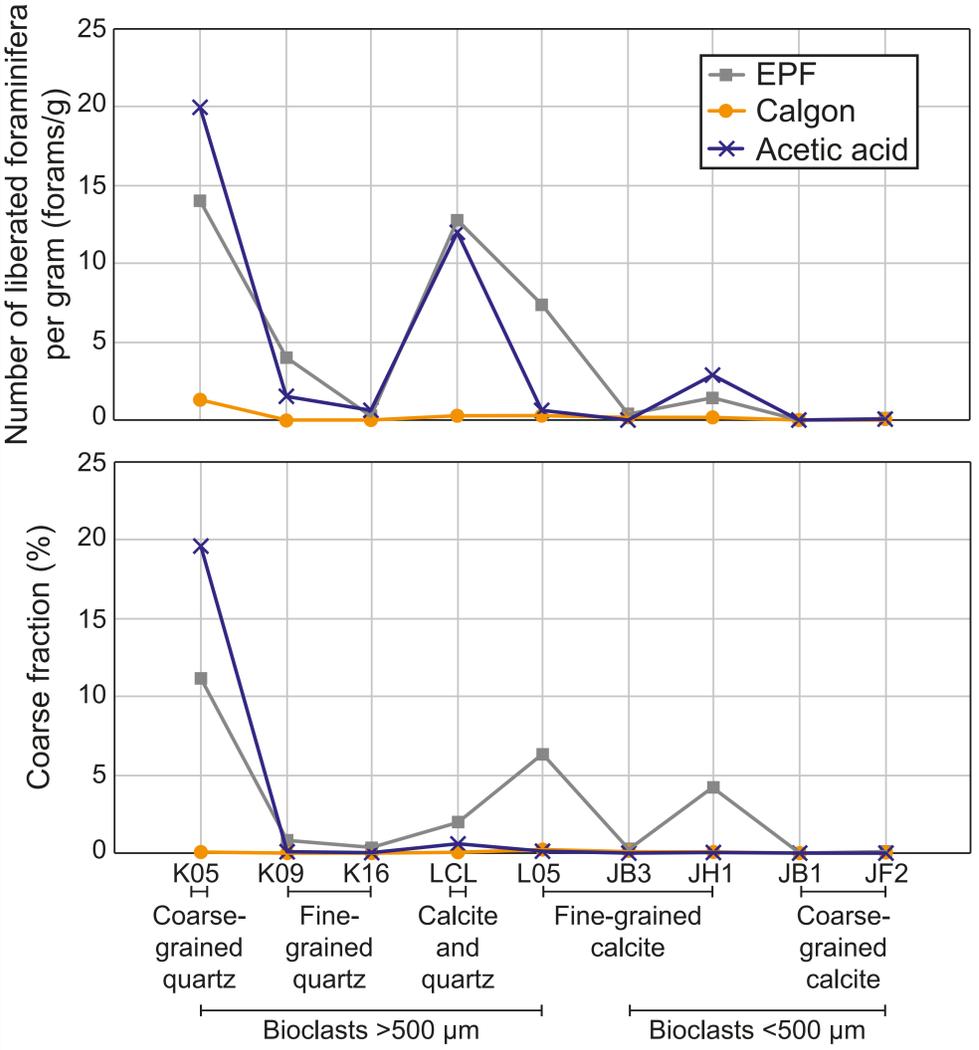


Figure 3: SEM images of select larger foraminifera from samples show differential preservation from each of the applied disaggregation techniques. S = sediment remaining attached to foraminiferal test; F = fragmentation of specimen; D = dissolution of test surface. Scale bars are 200 μm .

Results



- **Acetic acid** proved effective in some highly lithified samples, however, the time taken to process the samples is significantly longer and larger foraminifera **preservation was compromised**.
- **Calgon** was unable to disaggregate any of the carbonate samples successfully (i.e., **few or no LF were liberated**) and so is unsuitable for processing these highly lithified sedimentary rocks.
- The **EPF** method is highly efficient and effective as a disaggregation technique for liberating **larger microfossils (>500 μm)**.
- EPF indiscriminately disaggregated indurated **carbonates** with a mixture of **calcitic, silicic, and clay matrices/cements**; it has also previously been shown to liberate microfossils from **sandstones and shales** (Saini-Eidukat and Weiblen, 1996), showing it to be a broadly applicable method to micropalaeontology.
- We suggest that the EPF method could be tailored to effectively liberate smaller (<500 μm) microfossils by using repeated rounds of processing and progressively smaller sieve aperture sizes, although further investigation is required.
- **Compared to the traditional methods of disaggregation, soaking in Calgon and acetic acid, the time required is significantly reduced and the preservation of liberated material is excellent (Figure 3).**

For any queries regarding specifics of the EPF method, please contact Dan Parvaz (d.parvaz@lightningmachines.com) Saini-Eidukat and Weiblen, *Curator: The Museum Journal* 39, p. 139–144 (1996)