Ophiuroid fragments in insoluble residues of limestones from the upper Lower Triassic Virgin Limestone Member, southern Nevada

Vivienne Maxwell and Sara B. Pruss
Department of Geosciences, Smith College, Northampton, MA 01063

Introduction

The recovery period from the end-Permian mass extinction was protracted, perhaps a reflection of the devastation of this event (Payne et al., 2004). This recovery has been studied intensively, particularly from the upper lower Triassic (Spathian) Virgin Limestone Member of the western United States (Pruss et al., 2004; Pruss et al., 2018). In residues of limestones from these units, a new assemblage of minute fossils replaced by glauconite and apatite was recently described. In our work here, we describe newly-discovered fossils in these residues collected from the Virgin Limestone Member at Lost Cabin Springs in southern Nevada (Figures 1—3).

Fig. 1: Lost Cabin Springs Locality in Southern Nevada, ~30 miles west of Las Vegas

Fig. 2: View of outcrop where samples were collected

Methods

A set of samples from 9 different localities from Lost Cabin Springs were dissolved in dilute acetic acid. The samples were sieved and insoluble residues >0.420 mm, >0.250 mm and >0.177 mm were collected. These residues were then picked for microfossils under the Nikon SMZ645 stereoscopic microscope. The microfossils were imaged using the Olympus BHS BH-2 Light Microscope. After light images were captured, the microfossils were coated gold and palladium and imaged using the FEI Quanta 450 Scanning Electron Microscope (SEM). EDS (Energy Dispersive Spectroscopy) Team software was also used to analyze the elements present in the microfossils.

Stratigraphic Column and Diversity of Ophiuroid Fragments

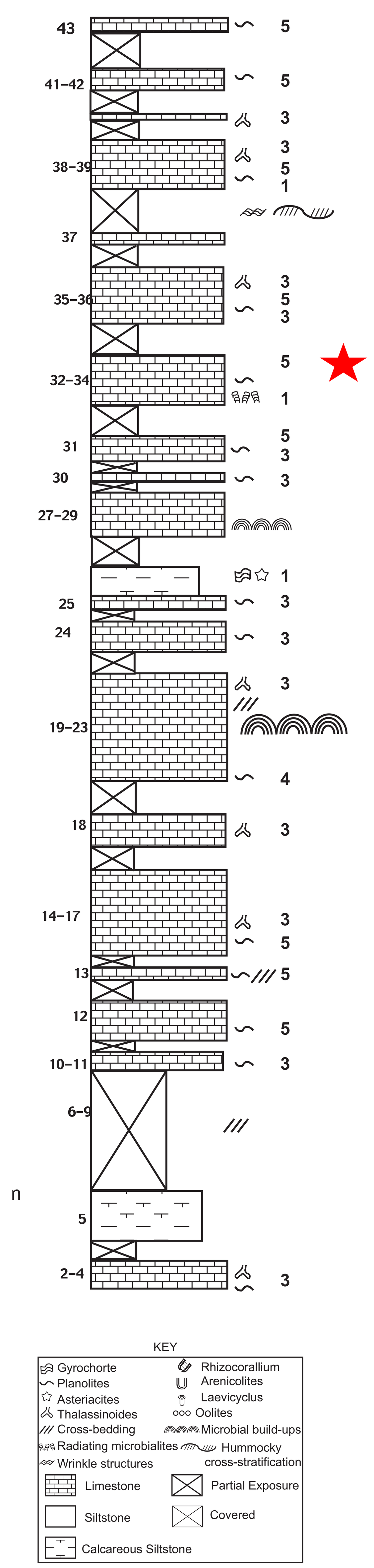

Fig. 3: Stratigraphic column of Virgin Limestone Member where samples were collected; red star indicates fossiliferous bed that produced fossils shown in Figure 4.

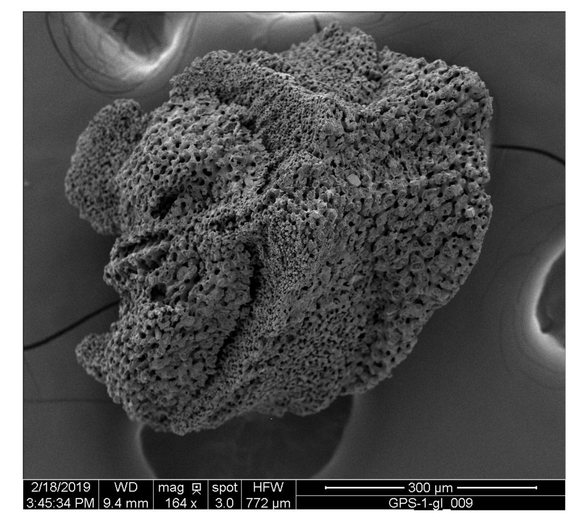

Fig. 4a: Dorso Distal

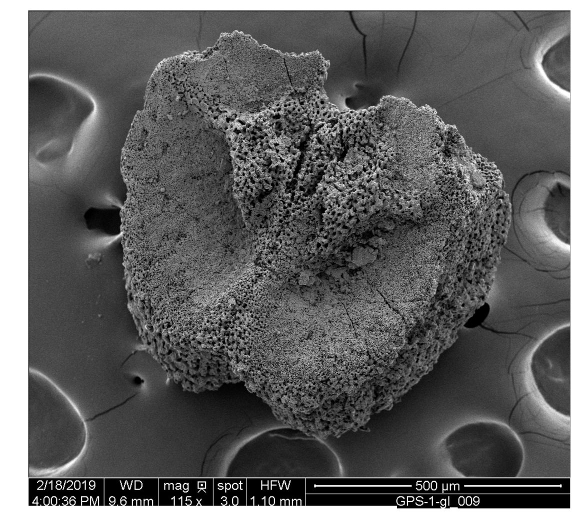

Fig. 4b: Dorso Distal

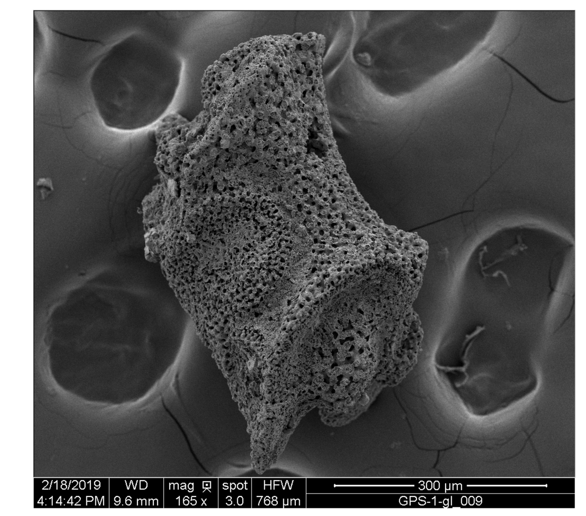

Fig. 4e: Lateral

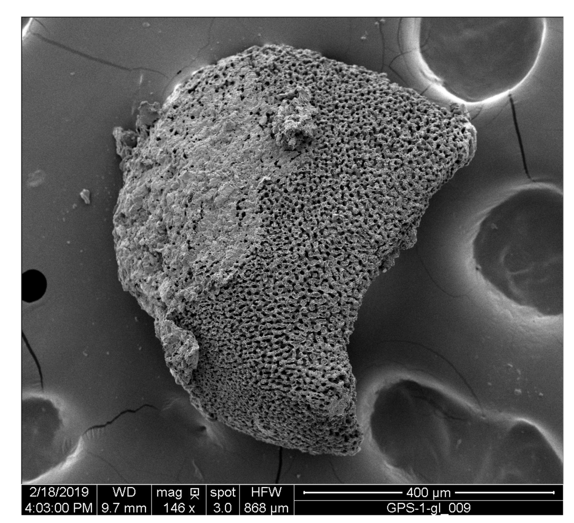

Fig. 4c: Lateral External

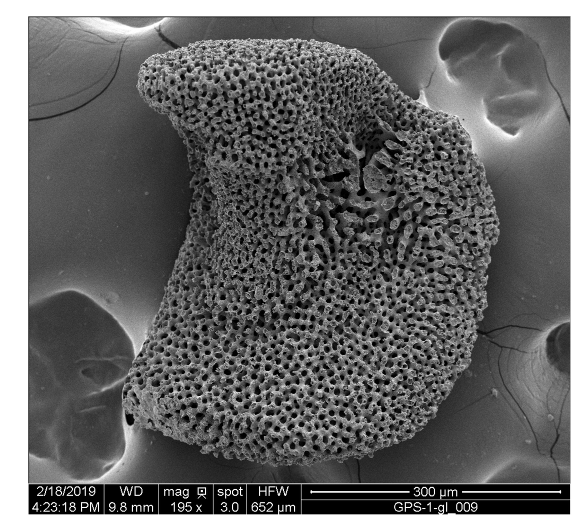

Fig. 4d: Lateral Internal

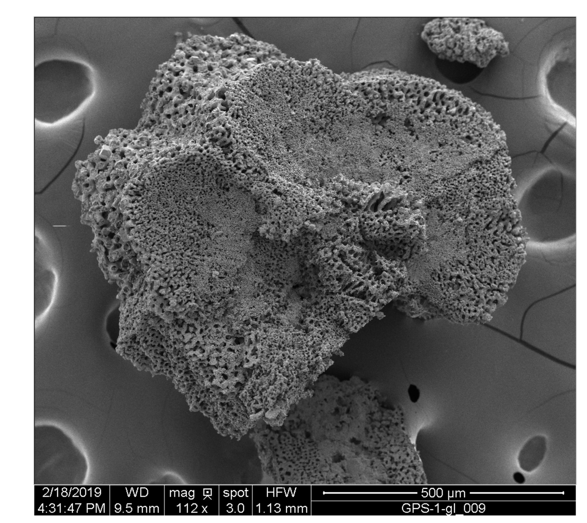

Fig. 4f: Proximal

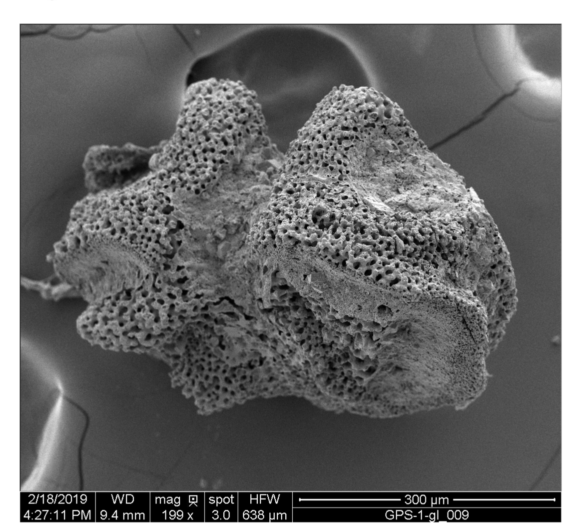

Fig. 4g: Ventral

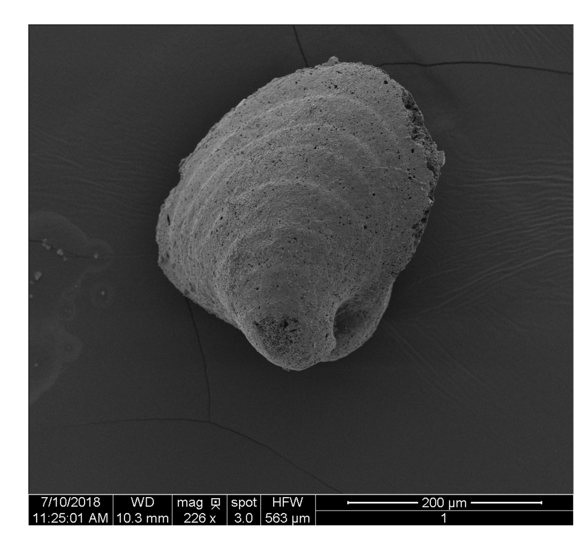

Fig. 4h : LC-18-22A Brachiopod

Fig. 4i: LC-18-34 Coil

Fig. 4: Phosphatized fossils from sample LC-18-34 showing ophiuroid fragments (a—g), an internal mold of a brachiopod (h); and an internal mold of a snail (i).

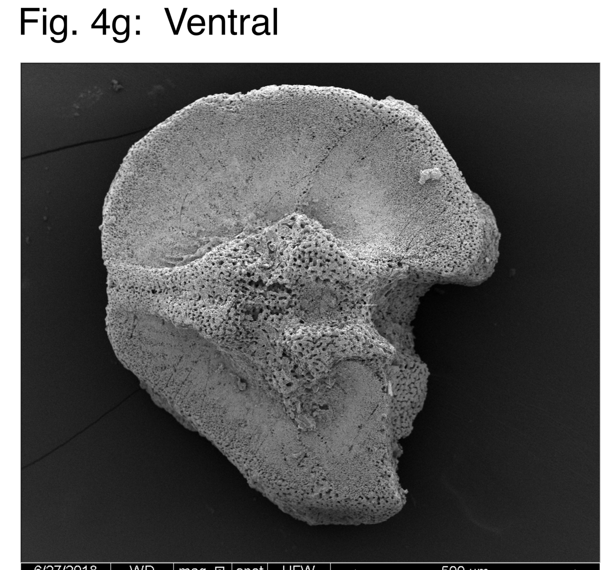

Fig. 5a: LC-18-34 sample

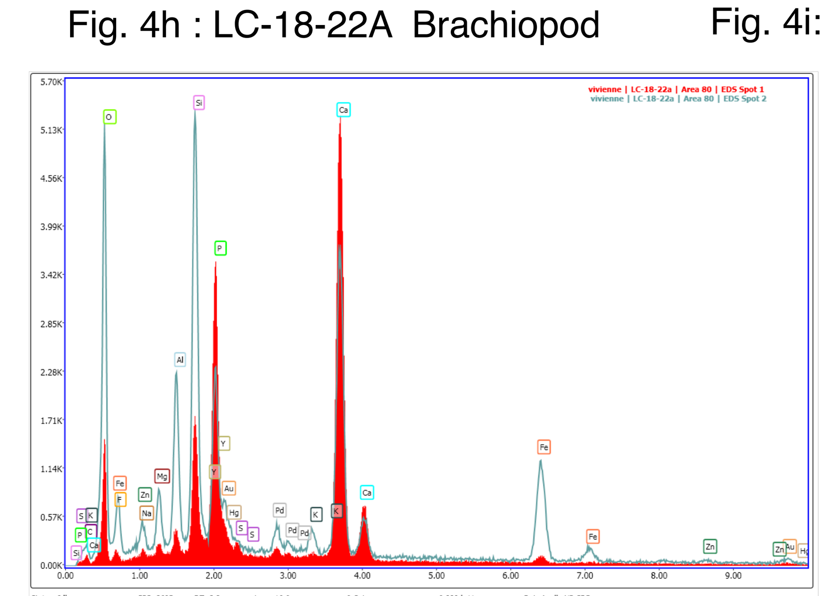

Fig. 5b: LC-18-34 Element Analysis

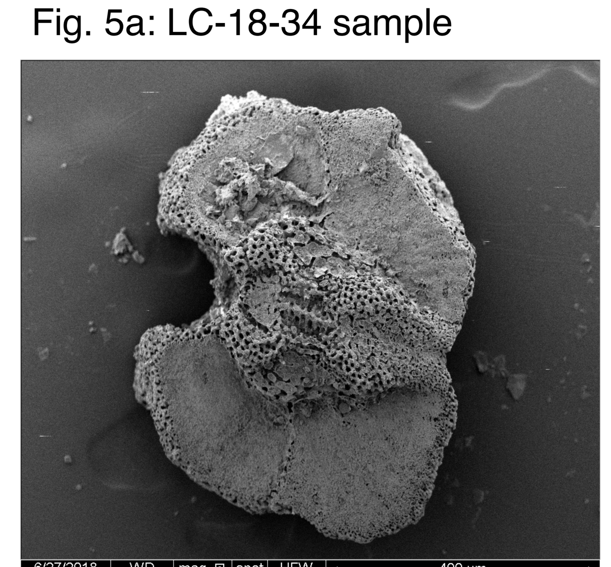

Fig. 5c: LC-18-34 sample

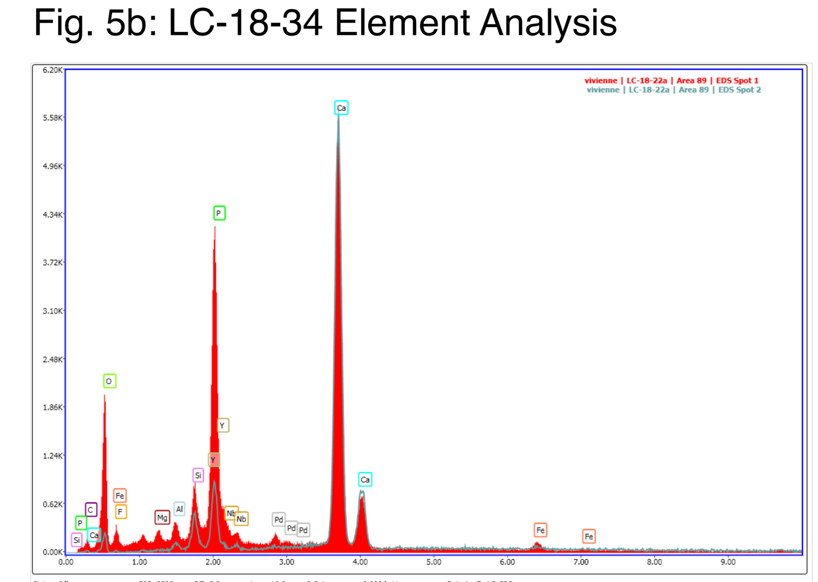

Fig. 5d: LC-18-34 Element Analysis

Fig. 5: Ophiuroid fragments and complementary elemental analysis.
a) shows peaks consistent with apatite and glauconite;
b) shows apatite and minor iron minerals.

Results and Discussion

The assemblages in the limestones from Lost Cabin Springs were different than those previously examined from the Muddy Mountains locality. Ophiuroid fragments later identified as lateral external and internal arm plates as well as proximal and ventral arm plates were common in our assemblage (Figure 4) (Thuy et al., 2012). EDS analysis revealed peaks in phosphorus, calcium, iron, silica and oxygen (Figure 5). This suggests that the ophiuroids, like fossils from the other assemblages, are replaced by apatite, which likely created stereomic molds during early diagenesis (Dattilo et al. 2016, Pruss et al., 2018). Some glauconite may also be present.

These ophiuroids are some of the first well-preserved ophiuroid fragments from the Lower Triassic, and although we have not yet identified these to the species level, these may represent a previously undescribed species (Thuy et al., pers. Comm, 2018). Future work will involve imaging more ophiuroid fragments, identifying these fossils to the species level, and better characterizing their taphomonic environment.

Citations

Payne, J. L., Lehrmann, D., Wei, J., Orchard, M., Schrag, D., & Knoll, A. (2004). Large perturbations of the carbon cycle during recovery from the end-Permian extinction. *Science, 305*, 506-509. doi:10.1126/science.1097023

Pruss, S., Fraiser, M., & Bottjer, D. J. (2004). Proliferation of Early Triassic wrinkle structures: Implications for environmental stress following the end-Permian mass extinction. *Geology, 32*(5), 461. doi:10.1130/g20354.1

Stark, C., Tosca, N., & Pruss, S. B. (2017). Small Shelly-Style Preservation Of Fossils In Lower Triassic Carbonates Of The Western Us. *PALAIOS, 33*, 441-450. doi:10.1130/abs/2017am-302459

Stöhr, S., Ohara, T. D., & Thuy, B. (2012). Global Diversity of Brittle Stars (Echinodermata: Ophiuroidea). *PLoS ONE, 7*(3). doi:10.1371/journal.pone.0031940

Acknowledgements

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