

## **Supplementary Data to “A new Early Jurassic fossil Lagerstätte from Ya Ha Tinda, Canada (~183 Ma)”- GSA Data Repository 2017066**

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### **YA HA TINDA LITHOLOGY**

At Ya Ha Tinda Ranch, exceptionally preserved fossils can be found in the Red Deer and Poker Chip Shale members of the Fernie Formation. The Pliensbachian to early Toarcian Red Deer Member consists of grey to black platy calcareous shales interbedded with fine siltstones and fetid black limestones (Fig. 2). In contrast, the overlying Toarcian Poker Chip Shale (above 11.3 m) is finer grained, poorly cemented, and fissile (Fig. 2). The Poker Chip comprises predominately black, calcareous shales and mudstones interbedded occasionally with bituminous limestones. Ages are constrained by ammonite and coccolith biostratigraphy (Hall and Howarth, 1983; Hall, 1984, 1987, 2006; Hall et al., 1998; 2000; 2004; Asgar-Deen, 2003; Them et al., In Press) and U-Pb dating of zircon from ash beds at Ya Ha Tinda (Hall et al., 2004; Them et al., In Press).

### **METHODS**

The Ya Ha Tinda fossil localities described in this study are protected under the Canadian National Parks Act and thus the locations cannot be disclosed here. Inquires about the location of the fossil sites can be directed to Parks Canada or the Royal Tyrrell Museum of Palaeontology in Drumheller, Canada. All fossils and geological samples were collected under a Parks Canada collection and research permit (#YHTR-2014-16156) and fossil excavation permits from the Alberta Government (RTMP Permit #13-058, #14-009, #15-019, and #16-063). All specimens are curated at the Royal Tyrrell Museum of Palaeontology in Drumheller, Alberta, Canada in accordance with provincial laws. Studied sites are Royal Tyrrell Museum of Palaeontology Localities #L2428, #L2429, #L2430.

Stratigraphic sections (e.g., Fig. 2) were created for all Lagerstätte-bearing intervals. Areas with exceptional preservation were quarried (using hand tools such as rock hammers, sledges, picks, chisels and brushes) and power tools (Hilti TE 500-AVR Demolition Hammer and Hilti DEG 600 6" Angle grinder with a diamond blade). Some delicate specimens were encased in Gypsona S (Plaster of Paris) bandages or jacketed (encased in paper towel, burlap, and Plaster of Paris) and cut out of the rock.

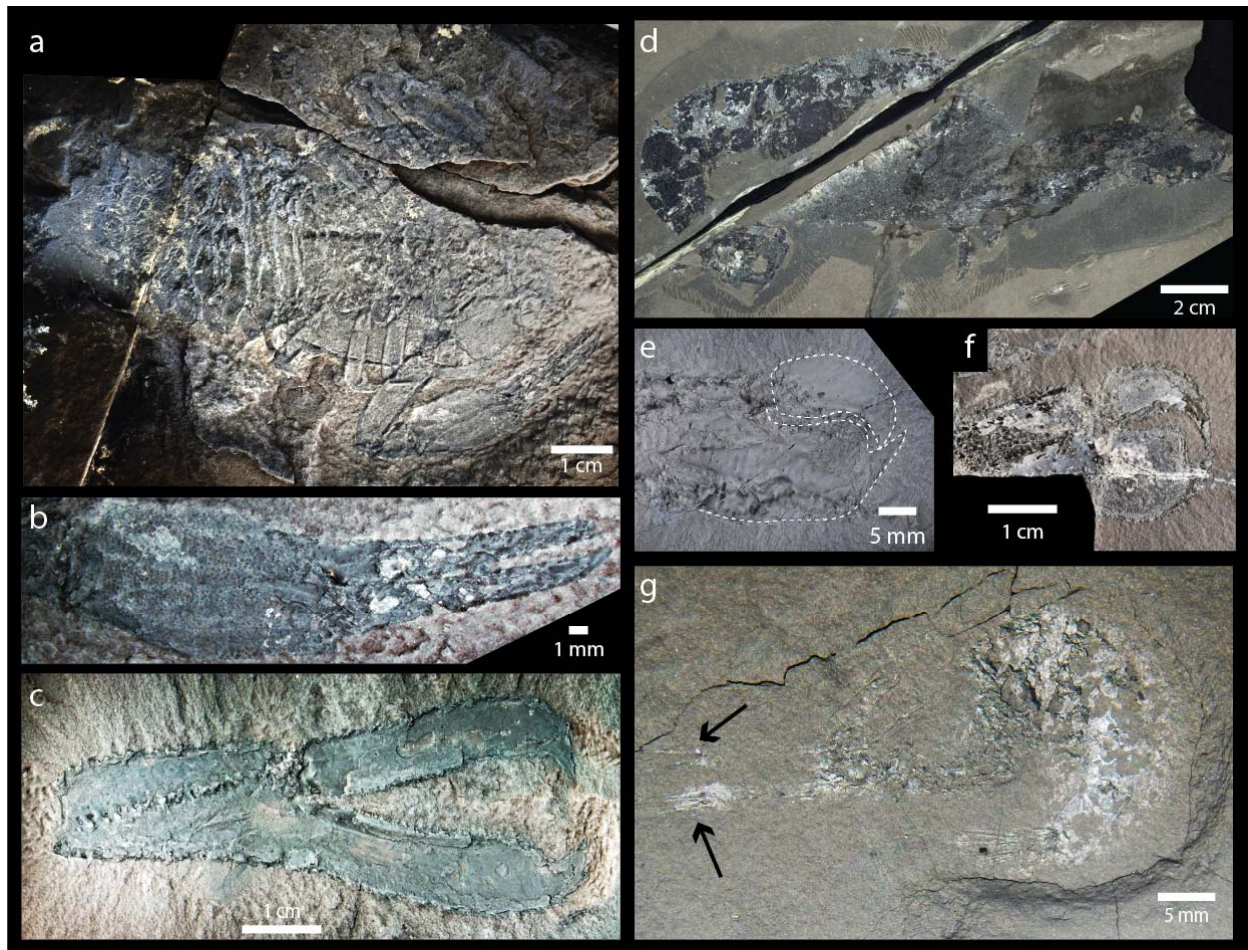
Most fossils needed minimal preparation, but some, such as the coleoids and the crustaceans were partially covered with a thin layer of overburden. In these cases, the overlying matrix was removed using a Micro-Jack tool (or comparable compressed air-driven stylus). Fossils that broke during excavation or transportation were glued together with Paraloid B-72 consolidate (diluted with acetone); where fossil material was flaking (drying of the shales), a thin coat of Primal WS-24 (a water soluble acrylic polymer) was used to veneer the top surface of the specimen to keep it intact. Full details of fossil preparation or consolidation for each specimen are recorded in the Royal Tyrrell Museum of Palaeontology specimen database. See Them et al. (In Press) for details of geochemical analyses on the Ya Ha Tinda sections.

Several of the best-preserved specimens were imaged in UV light. Specimens were examined under UV-A, B, C, and a combination of all three; no samples exhibited fluorescence of fossil material, though calcite veins fluoresced strongly. When small specimens or fragments of soft tissue were available (i.e. lobster claws, matrix, coleoid mantle and ink sac) preliminary

elemental analyses were conducted. Samples were placed into a Philips/FEI XL30 environmental scanning electron microscope (ESEM) and analyzed with Energy Dispersive X-ray Spectroscopy (EDS).

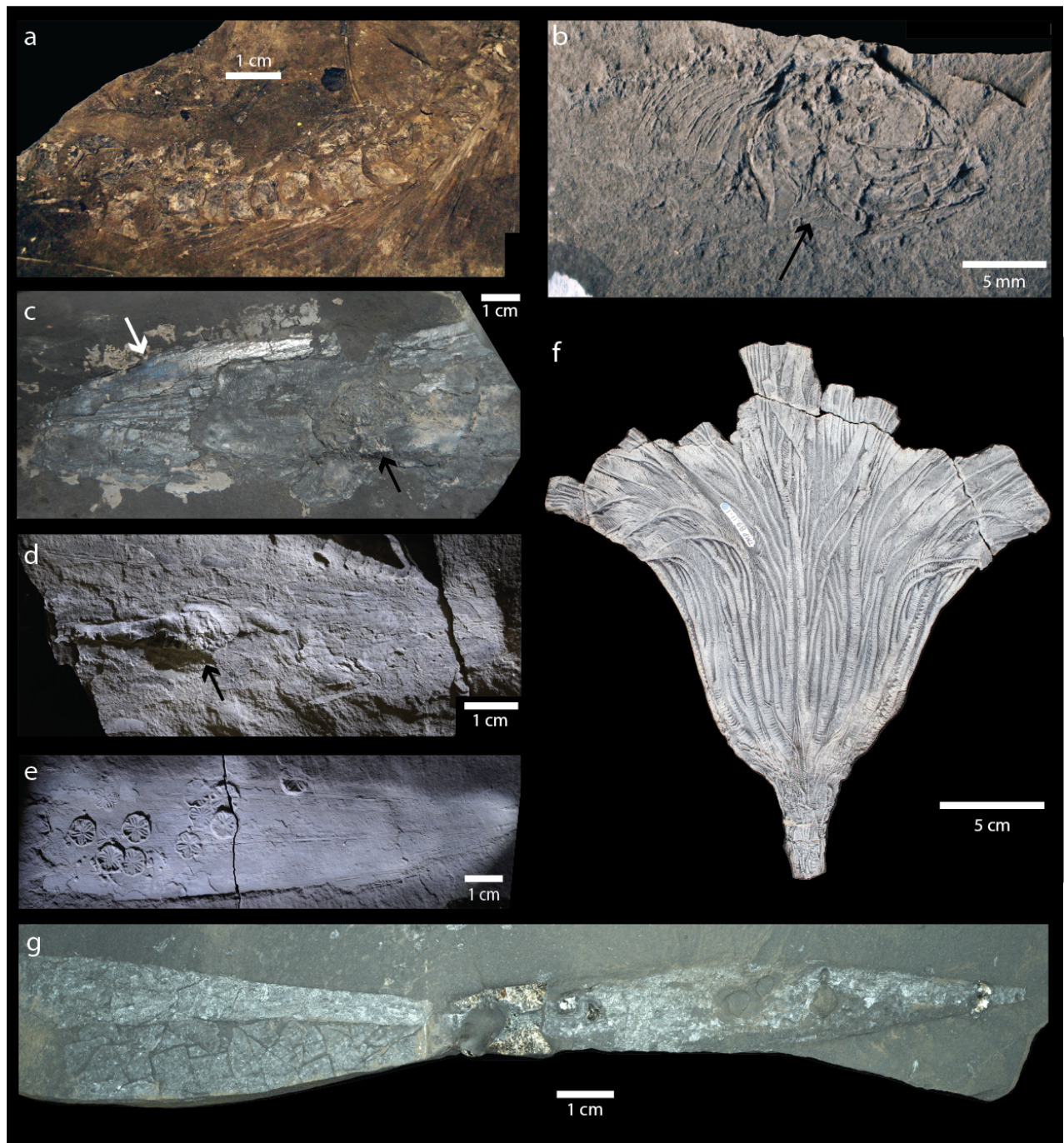
## ADDITIONAL FIGURES OF BIOTA

See supplemental figures 1 and 2 for additional fossil specimen images and fossil identification numbers.



Supplemental Figure 1. Exceptionally preserved crustacean fossils of the Ya Ha Tinda Lagerstätte. a) Complete body fossil of eryonid lobster from East Tributary (Red Deer Member, late Pliensbachian), dorsoventrally flattened, ventral view; specimen TMP 2013.036.0003. b) Close up of eryonid lobster claw from Fig. 4a. c) Claw of new *Uncina* species, *Uncina* sp.1 (Red Deer Member, late Pliensbachian); specimen TMP 2013.036.0002. d) Complete body fossil of *Uncina pacifica* lobster from East Tributary (Red Deer Member, late Pliensbachian), proximo-distal flattened; specimen TMP 2013.036.0004. e) Close up of eryonid lobster claw from Fig. 4d. f) Holotype of *Uncina pacifica* (claw); specimen TMP 2002.043.0005. g) Shrimp body fossil (Poker Chip Shale, early Toarcian, within the T-OAE CIE), black arrows indicate the claws on the chelipeds; specimen TMP 2013.036.0007.

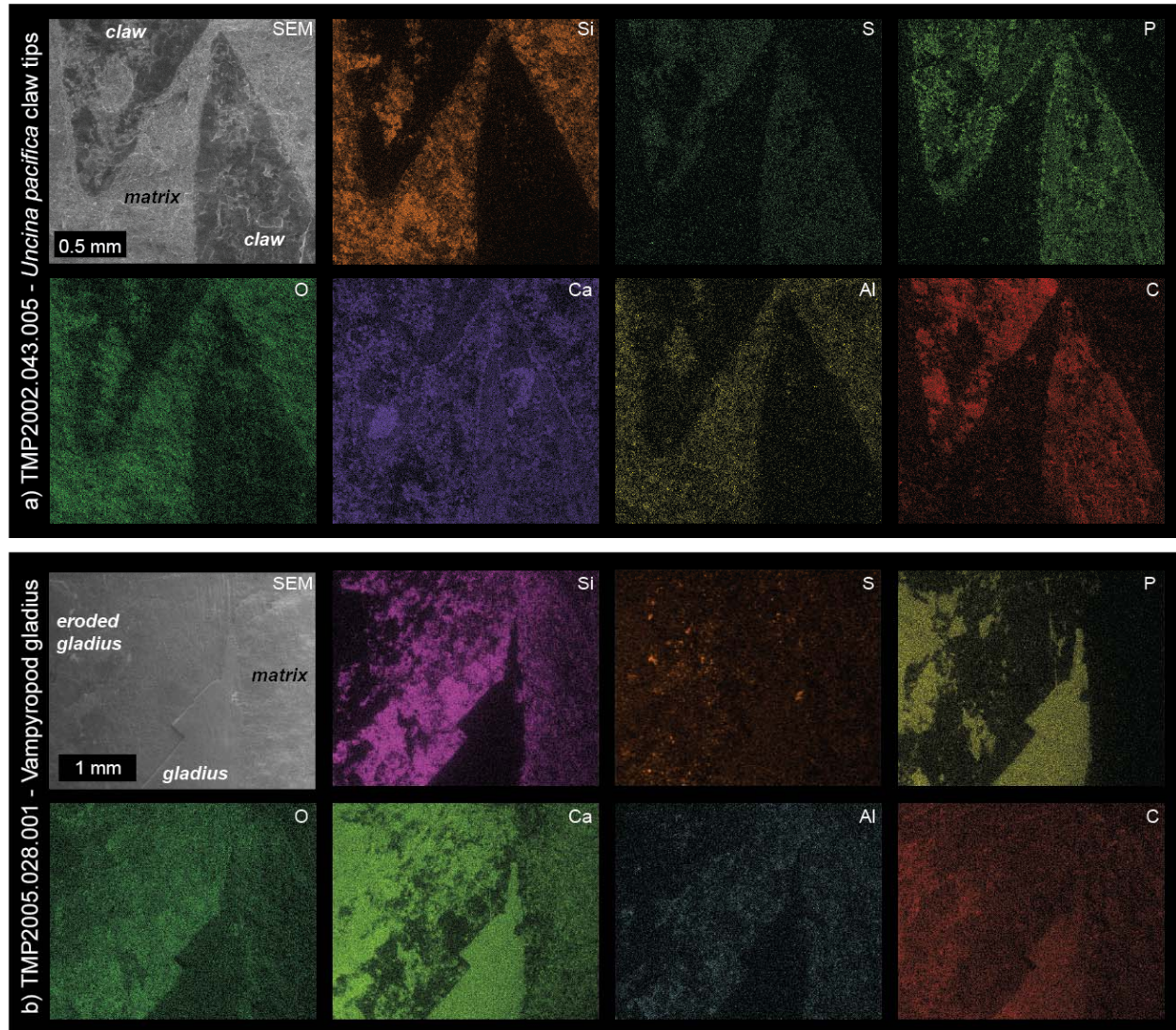




Supplemental Figure 2. Exceptionally preserved fossils of the Ya Ha Tinda Lagerstätte. a) Articulated ichthyosaur vertebrae and ribs from Scalp Creek, RTMP locality #L2430 (Red Deer Member, late Pliensbachian); specimen TMP 1994.108.0001. b) Skull of a small fish from East Tributary site (Poker Chip Shale, early Toarcian, within the T-OAE CIE), note the preservation of gills (arrow); specimen TMP 2014.021.0043. c-e) Gladius-bearing coleoids (Vampyropoda) c) Vampyropod gladius with mantle muscle (white arrow) and ink sac (black arrow) preserved (Red Deer Member, early Toarcian); specimen TMP 2013.036.0005. d) Loligosepiid vampyropod gladius with ink sac (black arrow) preserved (Red Deer Member, early Toarcian); specimen TMP 2014.021.0058. e) Ossicles of *Seirocrinus* sp. crinoid stem preserved with Prototeuthid vampyropod gladius (no ink sack) (Red Deer Member, late Pliensbachian); specimen TMP 2005.028.0001. f) *Seirocrinus subangularis* crinoid calyx collected by Russell Hall from Scalp Creek (Red Deer Member, late Pliensbachian); specimen TMP 1989.011.0001. g) *Atractites* sp. (a belemnoid) with calcified proostracum and carbonaceous compression of soft tissue from East Tributary (Red Deer Member, late Pliensbachian); specimen TMP 2014.021.0037.

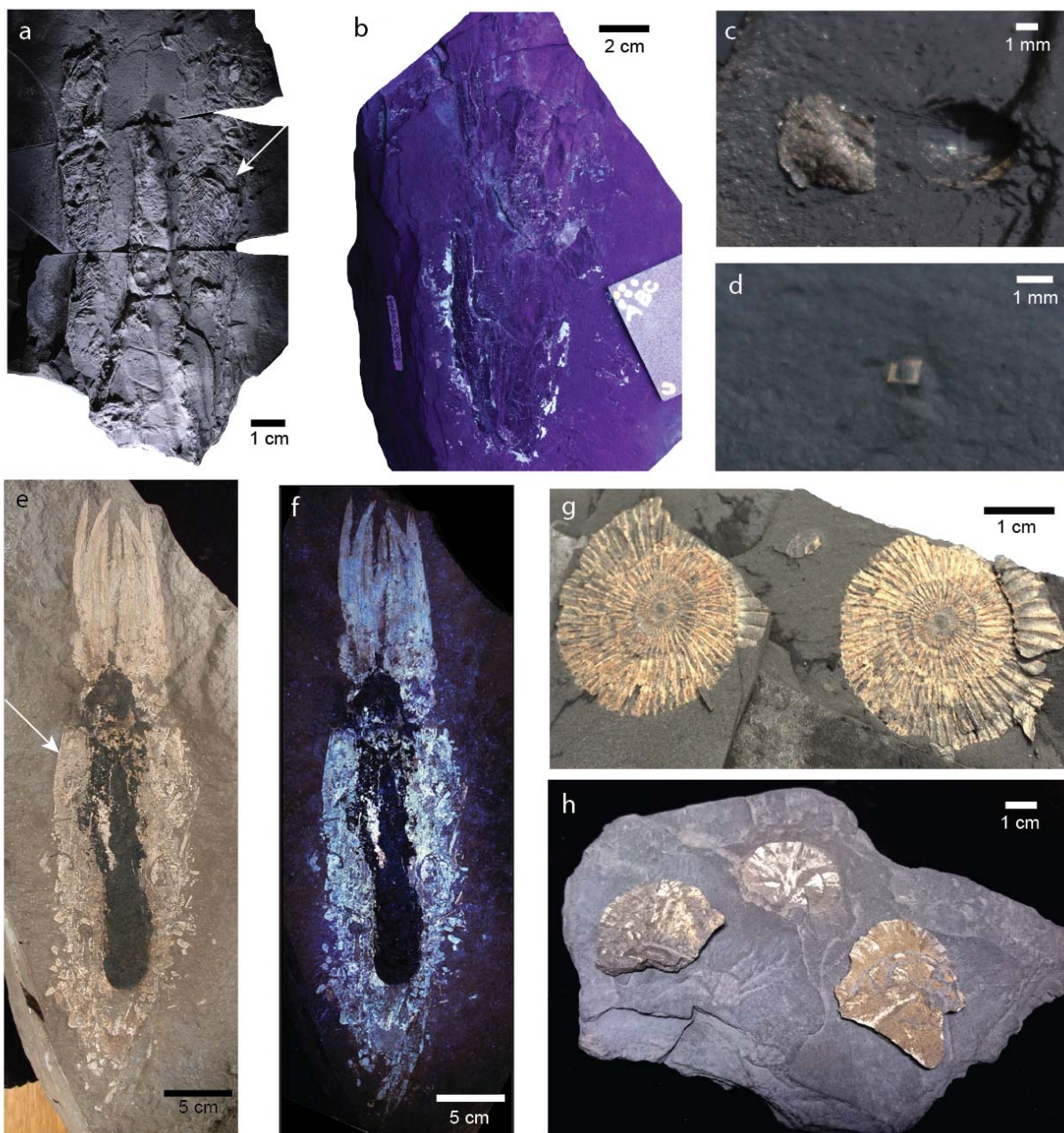


Supplemental figures 3 and 4 highlight the preservation (taphonomy) of Ya Ha Tinda specimens. Detailed taphonomic study of the Ya Ha Tinda biota is not yet complete, but the nature of the fossils suggests that carbonization and mineral replacement (apatite) are the primary taphonomic pathways.



Supplemental Figure 3. Elemental analysis of Ya Ha Tinda fossils; note the different color scheme in a and b. a) *Uncina pacifica* claw tips (specimen TMP2002.043.005); note the abundance of carbon, phosphorous, and sulfur in the claws. b) *Vampyropod gladius*, some of which has flaked off during erosion (specimen TMP2005.028.001); note the abundance of carbon, phosphorous, and calcium in the gladius.





Supplemental Figure 4. Comparison of preservation between Ya Ha Tinda and Posidonia Shale Lagerstätten. a) Vampyropod from East Tributary site, (Poker Chip Shale, early Toarcian), note the impressions striated mantle tissue (arrow); specimen TMP 2013.036.0008. b) Vampyropod from East Tributary site (same specimen as in Fig. 3d in main text) under UV-A, B, and C light, note the lack of fluorescence of mantle tissue (Red Deer Member, early Toarcian); specimen TMP 2013.036.0005. c) Diminutive, pyritized *Meleagrinella* bivalve from East Tributary (Poker Chip Shale, above the T-OAE CIE interval). d) Small pyrite cube from from East Tributary (Poker Chip Shale, above the T-OAE CIE interval). e) Vampyropod from German Posidonia Shale material (Toarcian), note white striated mantle tissue (arrow); specimen P60140a (part; see description in Fuchs et al. 2013). f) Phosphatic preservation of vampyropod specimen (e) fluorescing under UV light (photos in this and previous image courtesy of D. Fuchs). g) Pyritized ammonites from Posidonia Shale strata, Dotternhausen quarry. h) Pyrite suns collected from the Posidonia Shale Ohmden quarry. Note difference in scale between supplemental figures 4d and 4h.

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