

Deposit-feeding strategy as an adaptation to substrate: comparison of Phymatoderma from shallow- and deep-sea deposits

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Phymatoderma is a branching burrow system consisting of tunnels filled with fecal pellets, and has been interpreted as a product of a surface deposit-feeding animal. Elemental analyses of Phymatoderma were conducted to reveal the feeding mode of its producer, using samples from the Lower Jurassic epicontinental shelf deposits in the Dotternhausen section, southern Germany and from the Upper Pliocene continental slope deposits in the Shioura section, central Japan. Elemental compositions of the pelletal infill of Phymatoderma and its overlying mudstone from the Dotternhausen section show no significant difference, suggesting that the tracemaker was a non-selective deposit feeder. In contrast, elemental compositions of the tuffaceous pellets of Phymatoderma from the Shioura section and its overlying volcanic ash show a difference: Ca is significantly concentrated in the pellets. Because microfossils such as foraminifera and coccoliths are occasionally found in the tuffaceous pellets, Ca accumulation in the pelletal infill indicates that the Phymatoderma-producer that lived in the Pliocene slope setting selectively ingested particles with higher biomass of such microorganisms (or ingested microorganisms themselves) when feeding the surface sediments. These two feeding modes of the producer were recognized in Phymatoderma of different bathymetrical settings, and each feeding mode seems to be an effective strategy to intake nutrients from the surface sediments, reflecting an adaptation of the tracemaker to the food-contents in the surrounding substrate. This study demonstrated for the first time that geochemical composition of fecal pellets of trace fossils can be a useful indicator of grain-selective/non-selective deposit-feeding strategies of ancient animals.