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EXQUISITE PRESERVATION OF SCORPION FOSSILS FROM THE CRATO FORMATION, EARLY CRETACEOUS OF THE ARARIPE BASIN, BRAZIL

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The Crato Formation is an Early Cretaceous Lagerstätte in the Araripe Basin, Brazil, globally recognized for the high-quality preservation of its fossils, including invertebrates, vertebrates, plants, and fungi. Among the invertebrates, arachnids are represented by fossils of spiders, scorpions, whip scorpions, whip spiders, solifuges, and mites, comprising the most diverse Mesozoic arachnid fauna on a global scale. Given this high representativeness, two scorpion fossils from the Crato Formation were analyzed under a stereomicroscope and SEM/EDX, aiming to understand the mechanisms responsible for their exceptional preservation. The specimens UFRJ-DG 31-Ac and UFRJ-DG 78-Ac (Macrofossil Collection, Rio de Janeiro Federal University) were collected in the Pedra Branca Mine, Nova Olinda City, State of Ceará. Both fossils exhibit a high degree of preservation, with articulated and poorly fragmented carcasses, but differentiate in the preservation mode and the rock type. Specimen UFRJ-DG 31-Ac shows a massive film of dark gray color, preserved in a grayish laminated limestone. EDX analysis exhibits major peaks of iron and sulfur associated with the scorpion cuticle. On the other hand, fossil UFRJ-DG 78-Ac is found in yellowish laminated limestone, preserved in three dimensions with three different textures. One texture is massive, with a brownish color composed of iron and oxygen, and associated with replacing external cuticular features. The other two textures are granular, and associated with replacing

internal portions. One is orange-brown, also composed of iron and oxide, and particularly visible in a segment of the preserved muscular tissue in the pedipalp, while the other is light gray, composed of phosphorous and calcium, and observed in the dorsal carapace of the prosoma. The granular microfabric of the fossil UFRJ-DG 78-Ac consists of microspheres, with sizes smaller than 5 µm, along with subordinate microfilaments with a longitudinal axis smaller than 5 µm. Associated with these elements is a network-like texture that penetrates the internal portions of the fossil. The taphonomic and geochemical analysis of the scorpion fossils indicates that their preservation mode follows the same model previously interpreted for the insect and fish fossils from the Crato Formation. The fossils composed of iron and oxygen represent a secondary phase of specimens originally pyritized, with a punctual phosphatization process mainly associated with the replication of soft tissues. In the UFRJ-DG 31-Ac specimen, the sulfur and iron peaks may indicate this primary pyritization process. The morphotypes (microspheres and microfilaments) identified in the arachnid microfabric can be associated with organomineralized features resulting from microbial mat activity during the fossilization process. This activity is also supported by the widespread identification of a network-like texture, representing the extracellular polymeric substances (EPS) secreted by the mats, culminating in the creation of a microbial sarcophagus when they cover the carcass in the lacustrine substrate. Within this sarcophagus, there is a high mineralization of organic remains through pyritization and phosphatization, allowing the exquisite preservation of the scorpions [CAPES 88887.481076/2020-00, FAPERJ E-26/200.828/2021 and CNPq 303596/2016-3]