

Ediacaran to Cambrian enigmatic structures in iron ore from Santa Cruz Formation (Jacadigo Group, Urucum, MS, Brazil): Did complex organisms exist at the end of the Neoproterozoic?

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The enigmatic structures from the Santa Cruz Formation (Jacadigo Group, Corumbá, MS, Brazil) occur exclusively in COR-14, an Ediacaran hematite ore layer hosted by jaspilites, limited, on top, by a thin yellow bed composed of silica and goethite. This ore is a diagenetic product of chemical silica and iron rich sediments that filled an ancient marginal basin with seawater contaminated by fluids that exhaled through faults that cross the granite basement. Enigmatic structures occur mixed with jasper nodules and micro-lenses, have dimensions from 5 to 30 mm, varied shapes, and an iron-silicon composition with high free carbon and anomalous phosphorous contents. Ten distinct structures were identified and generically called morphotypes. Morphotypes on general have a coating, an infill and solid and sharp peripheral structures around a main central part, and present punch structures, formed when a peripheral structure of a morphotype press against another, deforming, piercing or crossing the other exemplar. The diagenesis and weathering of jasper nodules resulted in complex water exuding structures, distinct from morphotypes. If abiotic, the morphotypes, the punch structures and jasper nodules with micro-channels are new diagenetic “exuding structures”, never observed in iron ores. If they were residues of dead organisms, they would be organic structures with distinct and bizarre original forms that occur mixed with jasper nodules and only a few nodules would undergo the exudation process. This would also explain the variety and peculiarity of morphotypes and the high contents of bioelements such as carbon and phosphorus. The punch structures would be formed by lateral appendages that pierce the tegument or shell of other organisms when pressed during the burial/diagenesis. The peripheral structures would be locomotor organs and sensory appendages of these organisms. The interpretation of morphotypes as dubiofossils is suggested, considering mainly the general biotic morphology, the punch structures, the presence of peripheral structures looking like appendages, their bilateral symmetry in some cases, as well as their chemical compositions. Based on the interpretation of the morphotype parts, dubiofossils were tentatively reconstructed. If dubiofossils were organisms, the microsphere morphotype could be their coprolites; others, which are organized into colonies and microfilms, could be microbes. If some of the enigmatic structures were organisms, they would be extremophiles that adapted to an environment saturated in iron and silica and became extinct when the hydrothermal exhalation of these substances ceased, a moment marked by the sedimentation of the yellow bed. The small size of these extremophiles would be an adaptation to the chemically aggressive environment, which would have prevented them from growing. It is unlikely that diagenesis generated structures with the forms and organizations of the dubiofossils from jasper nodules or micro-lens.

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