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Ejemplo de cita:

A new pane for the Cambrian taphonomic window: Preservation of fossils in the Mesones Group, Cadenas Ibéricas, Spain

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The Cambrian taphonomic window is a lithological–palaeontological phenomenon resulting in exceptional mass preservation of fully articulated intact skeletons, fossils with weakly skeletonized integuments, and even some soft tissues within a restricted interval. This window was opened by the end of the Lower Cambrian Ovetian Stage and closed within the Middle Cambrian Drumian Stage. The Lower–Middle Cambrian Mesones Group of the Cadenas Ibéricas (NE Spain) yields diverse fossils of exceptional preservation (Murero biota) and abuts a significant part of the entire taphonomic window of about 15 m.y. (Liñán, 2003).

The preservation of the Murero biota is indebted to replication of integuments, skeletons, and soft tissues in chlorite, illite, and some other minerals. The chlorite that replicated the skeletons and cuticles, invariably of their pristine composition (carbon, calcite, apatite), contains high Mg and Fe and low Al, Si, and K relative to the detrital chlorite and illite in the surrounding rock matrix; if Ca is present it confines to euhedral chlorite and fibrous illite replicating fossils only. This difference as well as the replication of minute details allows us to suggest that these chlorite and illite, probably, are incipient anchizonal minerals having been formed after an iron- and magnesium-rich verdine-type clays. The same conclusion follows from the preservation of tangentially oriented euhedral chlorite blades, subhedral flakes, chlorite replacement of carbonate fabrics, and high Fe/(Fe + Mg) and Al/Fe ratios (Grigsby, 2001; Ryan & Hillier, 2002).

Verdine clays grew by incorporating terrestrially derived Fe and Al, seawater Mg, and pore water Si. Here, silica was easily accessible from dissolution of opal provided by abundant demosponge spicules. Sufficient reactive Fe(III) readily available from the detrital minerals was the principal electron acceptor involved in organic matter oxidation pathway in suboxic environment. This pathway resulted in authigenic clay mineral adsorption by decaying organic compounds. The mineral precursor, probably, was precipitated under a catalytic promotion of bacteria, which sequestered Fe(III) cations from solution and, after reduction inducing the surface oxygen enrichment, provided nucleation sites for the precipitation of a ferric hydroxide phase on the negatively charged bacterial cell surface; followed by reaction with dissolved Si and Al and the growth of an amorphous clay-like phase (Konhauser & Urrutia, 1999). Actually, Fe(III) reduction as well as extracelluar polysaccharides expelling by bacteria are the major factors that control clay particle flocculation; face-to-face (blades) and edge-to-edge (fibers) clay aggregates are common end-products of this process (Jaisi et al., 2007). The process was accompanied by step by step dissolution of primary minerals (carbonates and apatite), which was facilitated by decreased pH due to hydrogen ions released during clay mineral formation and by high H2S supplied during soft tissue decay.

Over time, after total mineralization of organic matter and stoppage of bacterial activity, the redox conditions changed at the scale of the microsystem, and amorphous clay-like phase converted to more stable crystalline phase replicating the structural and sculptural peculiarities of dead organisms. Within the formation-water hydopressure zone (within a temperature range of c. 20°C–40°C), the authigenic verdine-type clay mineral was eventually...
transformed into either euhedral chlorite or fibrous illite crystals (Grigsby, 2001). Although, this neomorphism could start as early as under normal marine conditions enhanced by bacterial activity (Kim et al., 2004). The selective formation of either chlorite or illite was related to primary structural features of replicable substrate (Wilkinson & Haszeldine, 2002). This difference is especially well expressed in two-layered trilobite carapace. However, a difference of pristine organic compounds of these layers cannot be excluded as a factor responsible for final mineralogical unevenness.

It is very probable that principal Burgess Shale-type Lagerstätten are formed by a similar pathway although in general Cambrian taphonomic window was open for a large variety of mineralogies preserving exceptional fossils. Thus the uniqueness of fossilization in the Murero Lagerstätte was relied upon almost unlimited iron supply.

The opening of the taphonomic window is definitely related to the mass appearance of fossil record of diverse arthropods, lobopodians, and cephalorhynchs which compose the bulk of any Cambrian Lagerstätte in sense of biovolume, number of individuals, species and generic diversity. These are the fossils that are commonly coined ‘soft bodied’ fossils although this is not quite the case. The closure of the window occurred during the late Middle Cambrian. This interval is signified by several important events pointing to the end of the coldhouse epoch and the beginning of relatively more humid greenhouse epoch. Such a switch inescapably would influence the clay mineral composition of sediments. Thus, transition from more arid and cool to more humid and warm climate favored kaolin supply over illite/chlorite-group clays (Parrish, 1998). Besides, a following mineralogical shift from mica-illite and chlorite toward smectite and kaolin assemblages, which was linked with changes in terrestrial weathering regimes (Kennedy et al., 2006), undoubtedly framed the taphonomic window (kaolin is a non-expandable clay with low cation exchange capacity and hardly may play a role in fossil replication). Another consequence of the greenhouse epoch commence, that was improved aeration of bottom waters after increased hurricane intensity and duration, had to facilitate the bioturbation shift into deeper environments.

If in Cambrian preservation of fossils replicated in clay minerals was rather a common place due to a unique combinations of sedimentological and ecological conditions, later a similar replication required a really unique combination of events.

References