Palaeoecology of the Upper Tournaisian "Petit Granit": much more than crinoids!

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The Tournaisian stage (Lower Carboniferous) is considered as the golden age of crinoids. In S Belgium, upper Tournaisian crinoidal limestones – "Petit Granit" - are known in the Condroz area (Ourthe Formation) and in the Soignies area (Soignies Member) where tens of quarries expose the crinoidal facies. Despite its apparent monotony, five crinoidal and peloidal microfacies are identified throughout the formation, and the size and preservation of the crinoid columnals vary vertically and laterally. The encrinite deposited as amalgamated tempestites that accumulated under the fair-weather wave base. An estimation of the carbonate production rate in both sedimentation areas was calculated based on geological and biological hypothesis. A value of c. 1200 $cm^3/m^2.y$ is proposed for the Ourthe Fm. The crinoid density was lower in the HSA (Hainaut Sedimentation Area) possibly due to its deeper situation, as also suggested by the dominance of packstone microfacies. An isopachs map shows that the Ourthe Formation thins westwards and northwards, with a maximal thickness in the Ourthe valley area. The local variation of thickness is tentatively interpreted by variations in subsidence due to synsedimentary block faulting.

The modern taxonomy of crinoids is based on the morphological characters of the crown (calyx, arms) but complete calyxes are extremely rare in the "Petit Granit" due to hydrodynamic disarticulation. Hence, the parataxonomy based on the morphology of columnals, developed by Moore & Jeffords (1968), was used on disarticulated crinoid columnals in thin sections. Though not perfect, this analysis provides a good rough approach of the diversity. It reveals an unexpectedly diverse crinoidal meadows where several genera and species co-existed. The identified crinoid taxa are of several size class and were seemingly distributed following a vertical tiering model to maximise the capture of food particles from the water column.

Beside the crinoids, the fauna was dominated by suspension feeders (brachiopods, bryozoan, sponges, tabulate and rugose corals) adapted to a weakly-agitated environment and a relatively soft ground. The trilobites and palaechinids were the dominant benthic macrophages, the latter being known as a predator of crinoids. Rare nektonic predators were occasional dwellers of the crinoidal meadows (holocephalan chondrychthian, actinoceratoids, palaechinids and trilobites) shows that the ecosystem was relatively complex despite a simple appearance. Moreover, it witnesses the recovery of the marine environment after the collapse of the reefal ecosystem at the end of the Devonian, when the echinoderms became the dominant carbonate producer in neritic environments.

References

Moore, R.C. & Jeffords, R.M., 1968. Classification and nomenclature of fossil crinoids based on studies of dissociated parts of their columns. University of Kansas, Paleontological Contributions, Echinodermata, 9, 1-86.