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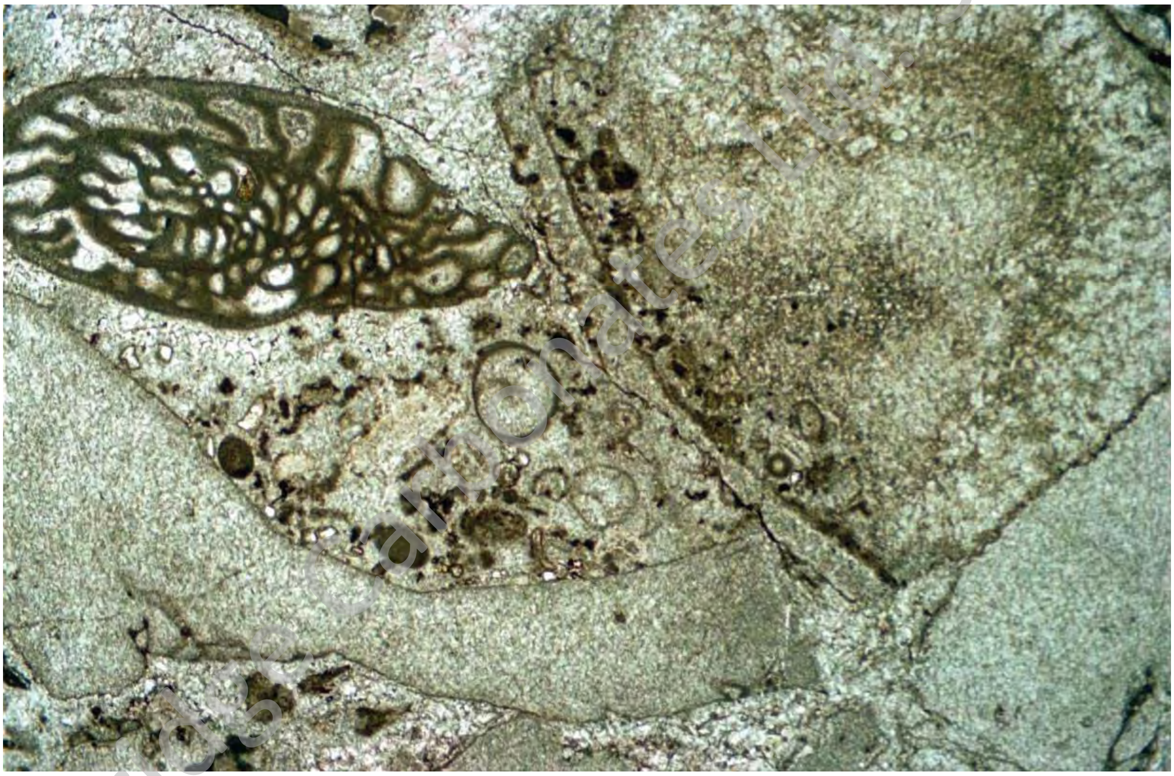

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Late Palaeozoic Sedimentology of 7229/11-1

Volume 1

Contents

4. BRYOZOAN BIOHERMS

4.1. Introduction

4.1.1. Recognition of bioherms in core

The bryozoan bioherms have a carbonate mud-dominated fabric and are examples of carbonate mud mounds. They are recognized by the association of whole fenestrate bryozoan sheets and irregular spar-filled cavities lined by fibrous cement within a bioclast wackestone or carbonate mudstone. The cavities typically have flat bases, complex digitate tops and are partly infilled by internal sediment. All gradations from bioclast wackestone with occasional isolated cavities to cementstone supported by a framework of fenestrate bryozoan sheets are present.

4.1.2. Terminology

The terms used to describe these bioherms are based on studies on Lower Carboniferous carbonate mud mounds (including Waulsortian carbonate mud mounds) in Ireland and northern England by (Lees 1964, Miller 1986 and Lees & Miller 1995) all of which show close sedimentological similarities to the bryozoan bioherms described here. The definitions are summarized by Figure 10 and this facies model is used to interpret the internal facies architecture and large scale geometry of the bioherms.

A **bioherm** is a non-genetic term which refers to the whole sedimentary package. The "fundamental units" of bioherms are **bank beds** which are laterally-extensive beds up to 1m thick and form stacked off- and onlapping packages. Outcrop studies show that individual bank beds often show an upward gradation from wackestone with isolated cavities to more complex interconnected cavities, often culminating in the development of the bryozoan bafflestone / cementstone. There is also often a lateral gradation within bank beds from wackestone-dominated at the margin to more spar-dominated towards the centre of a carbonate mud mound.

4.5.2. *Evidence from the bioherms*

The presence of reworked bioclast grainstone/packstone with disarticulated, fragmented and abraded bioclasts and reworked early marine cement indicate periods of reworking. The abundant marine cement and evidence for internal erosion requires a system of pore water circulation within the bioherm. This suggests that the bioherms grew upwards into shallower, higher energy conditions.

4.5.3. *Microfacies assemblage*

Microfacies analysis shows that the cored part of the bryozoan bioherms can be divided into two intervals on the basis of bioclast diversity (Figure 26):

1. A lower interval with moderate to high diversity.

2. An upper interval with lower diversity.

The distribution of individual bioclasts shows that this upward decrease in diversity is caused by the progressive upward decrease in abundance of various bioclasts. A series of depth-related microfacies assemblages have been identified in similar Lower Carboniferous carbonate mud mounds by Lees and Miller (1985) and Lees *et al*. (1985). They also showed that carbonate mud mounds which grew in shallow water had higher bioclast diversity than those grown in deeper water. The microfacies variations in these bryozoan bioherms may also be depth-related. The more diverse bioclast assemblage in the lower part of the bryozoan bioherm suggests relatively shallow water setting while the less diverse upper part of the bioherm may have been deposited in deeper water. The change in microfacies types and sedimentological textures is interpreted as a rise in sea level. The progressive decrease in abundance of different bioclast types may be a reflection of the differing depth ranges and tolerance of the different bioclasts.

6. DIAGENESIS AND CONTROLS ON RESERVOIR PROPERTIES (NON-BIOHERM FACIES)

No special core analysis was carried out on the sidewall cores; quantitative porosity data from these was gained by point counting (Figures 35 & 36).

Porosity of up to 15% is found in dolomitised intervals within the mixed carbonate - siliciclastic unit where biomoulds and intercrystal porosity has escaped cementation by poikilotopic calcite and anhydrite (Figure 35). Sandstones at the base of the cyclic carbonate - evaporite unit also contain relict intergranular, fracture and feldspar mouldic porosity of up to 5% (Figure 35).

Elsewhere, there is minimal porosity within the stratigraphic units defined in Section 5. Primary porosity within sandstones and siltstones has been reduced by compaction and cementation by carbonate and quartz. Limestones generally have poor depositional porosity which has been further reduced by compaction and cementation. Mouldic porosity produced by dissolution of aragonitic bioclasts has generally been infilled by non-ferroan calcite spar. Secondary porosity is generally only present in tectonic fractures which have been partly infilled by non-ferroan calcite.

Occasional hydrocarbon inclusions within fracture and mouldic porosity are present throughout the succession. This implies that hydrocarbon migration has taken place at this locality but post dates the porosity occluding processes.

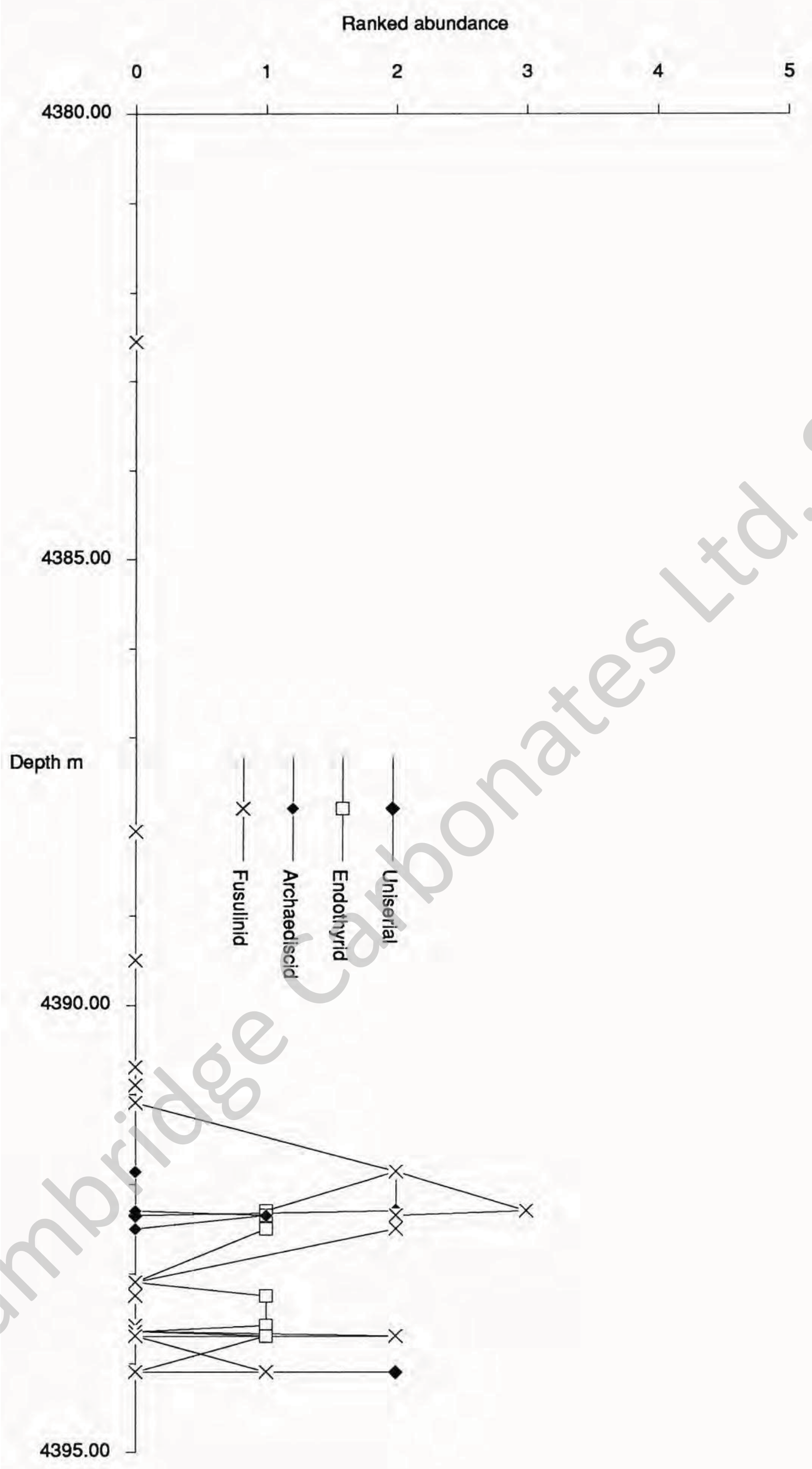

Figure 5 Distribution of benthic foraminifera through core 9.

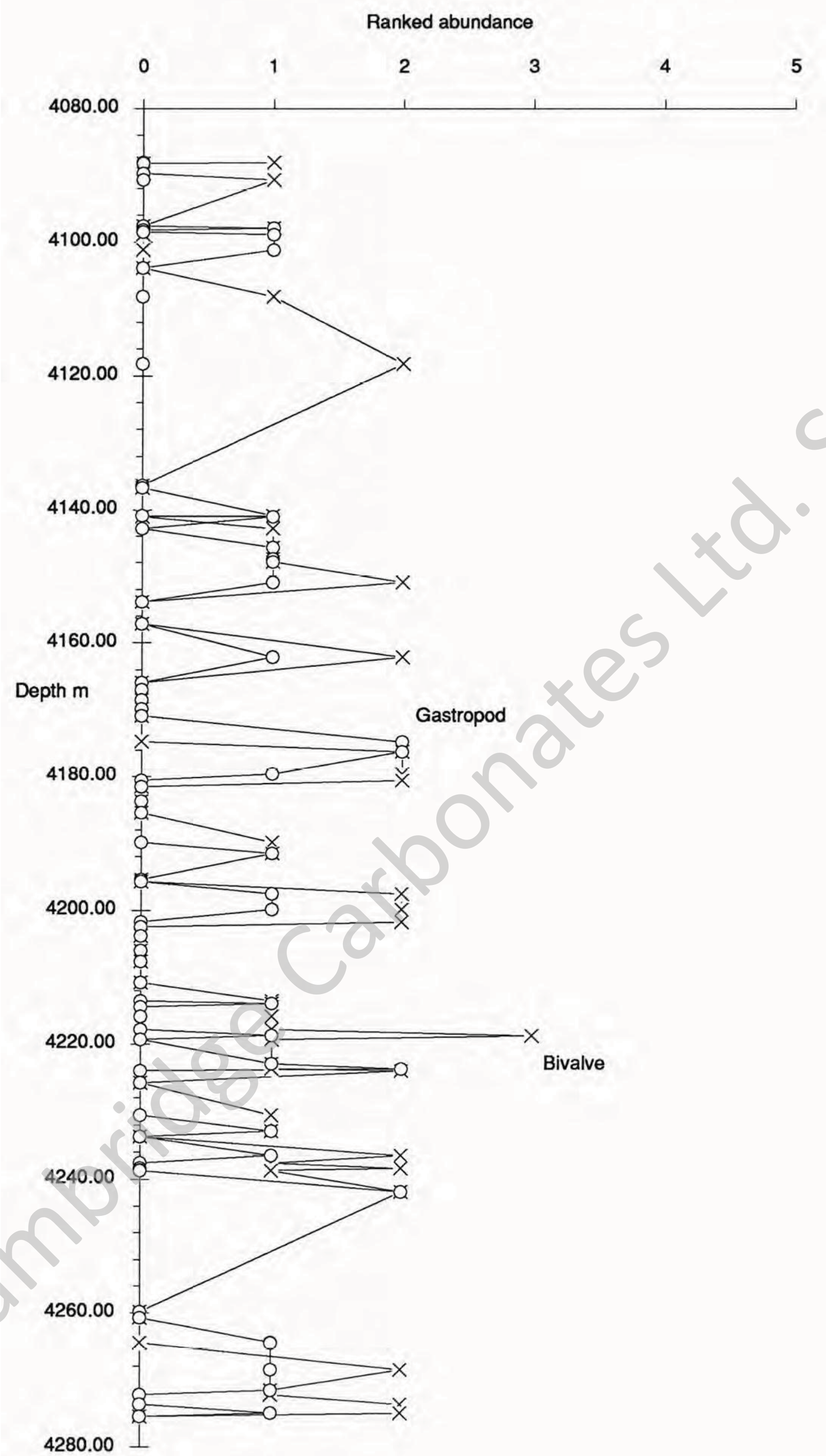

Figure 15 Distribution of molluscs through bioherms.

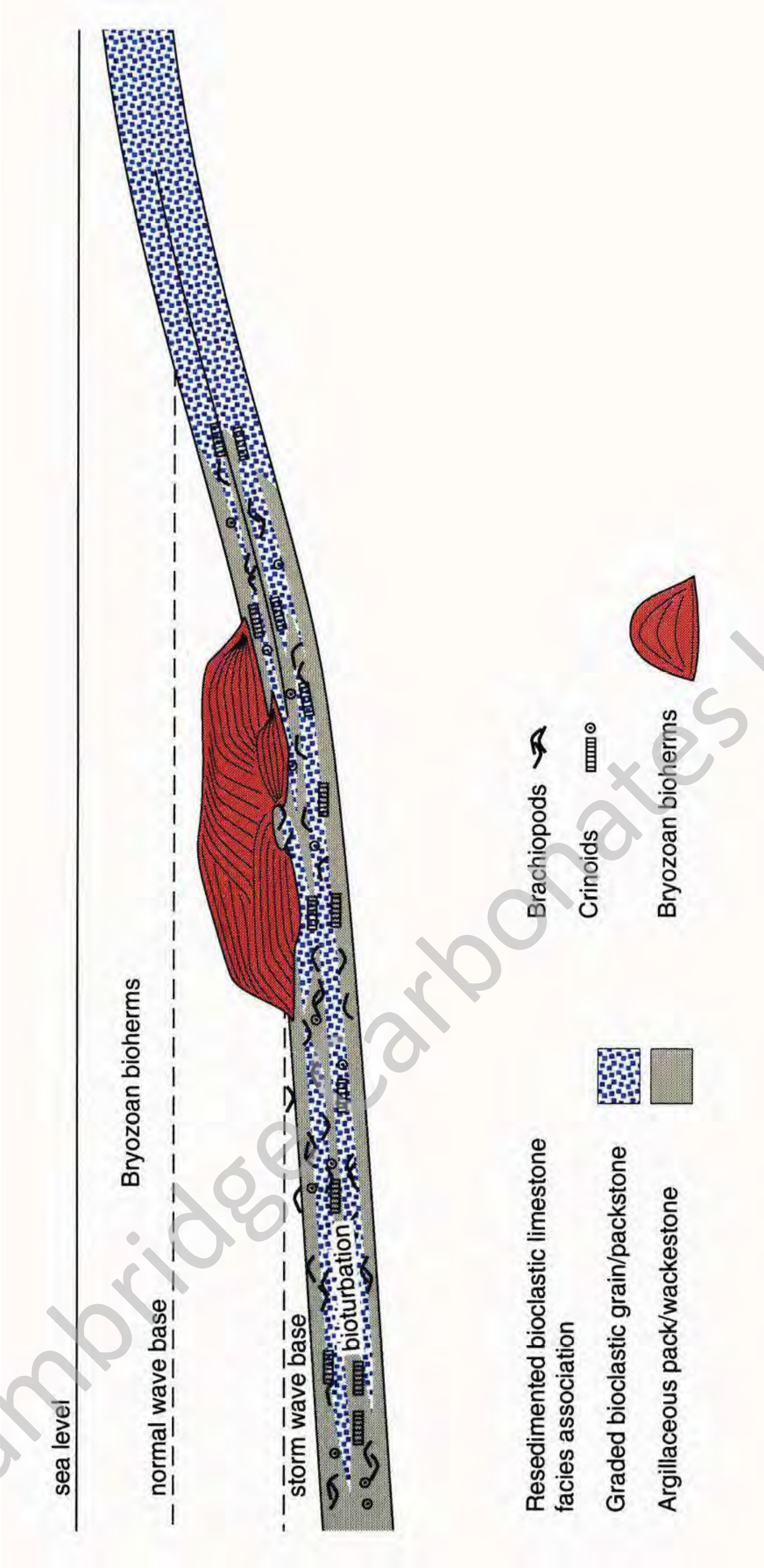

Figure 25 Depositional setting of bryozoan bioherms and the resedimented bioclastic limestone facies association.

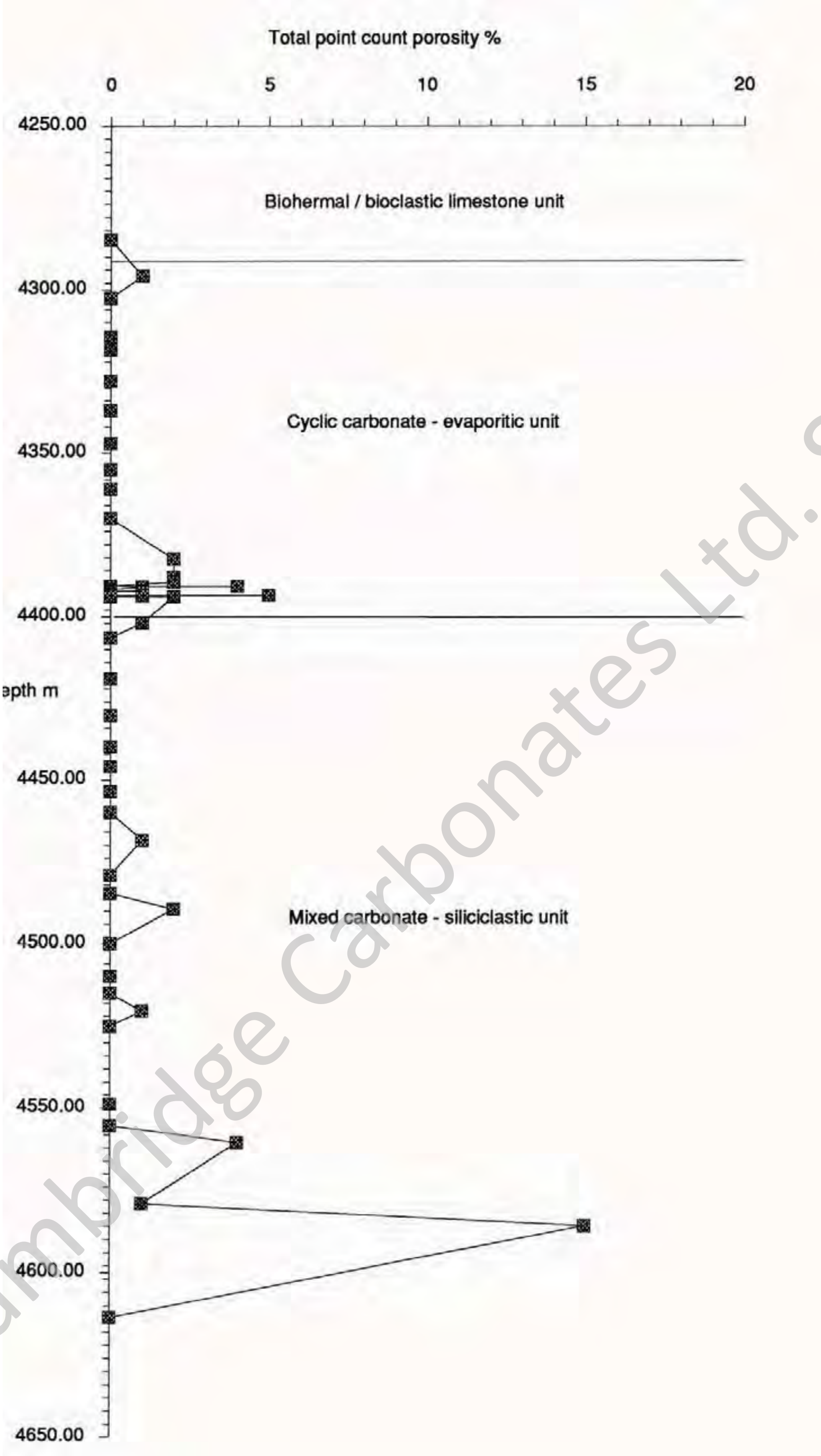

Figure 35 Point count porosity sidewall cores.