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Rugose coral biostromes in the late Viséan (Mississippian) of NW Ireland: Bioevents on an extensive carbonate platform

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ABSTRACT

The extensive upper Viséan (Asbian) platform carbonates in NW Ireland (Bricklieve Limestone Fm, Glencar Limestone Fm and Dartry Limestone Fm) contain distinctive rugose coral biostromes, which are dominated by different species of the genus *Siphonodendron*. These are in stratigraphic sequence: *pauciradiale* biostrome (oldest), *martini* biostrome and several *junceum* biostromes (youngest). They represent bioevents caused by special short-lasting ecological conditions and can be used as approximately synchronous horizons to correlate within the region.

The *pauciradiale* biostrome is the thickest, laterally most persistent and most variable in facies and biotic composition of all biostromes. It formed on a tectonically influenced platform with a landward–seaward zonation from northwest to southeast, mainly above storm wave-base and below fair-weather wave-base. The northwestern Streedagh facies is characterized by the presence of clusters of large sheet-like colonies of *S. pauciradiale*. The intermediate O'Donnell's Rock facies is unique for the predominance of the fasciculate genus *Solenodendron*. The southeastern Bricklieve facies represents the amalgamation of autochthonous and allochthonous coral debris and bioclastic debris with localized small patches of coral boundstone. Mass occurrences of fasciculate rugose corals re-appear in the *martini* biostrome. This biostrome developed in a shallower water setting, just above fair-weather wave-base on a levelled carbonate platform. The *junceum* biostromes are thinner, decimetre to some metres thick, and less persistent. They formed in deeper water mostly below storm wave-base, except for the composite 2nd *junceum* biostrome of the Bricklieve Mountains, which records a period of shallowing.

According to facies and coral morphologies, which were compared with modern scleractinian growth forms, sea-level variation exerted one of the strong controls on the rise and decline of the biostromes. The *pauciradiale* biostrome formed during an extended shallowing-upward cycle in a depth interval leading to the climax of *Siphonodendron pauciradiale*. The cycle ended with the development of the *martini* biostrome in shallow water. Its demise is probably caused by drowning during the late Asbian sea-level rise. During that time slice the *junceum* biostromes flourished in deeper water on the platform. Coral growth ceased almost completely after formation of the *junceum* biostromes during the falling sea level of the latest Asbian. Siliciclastic input and resulting turbidity, as well as turbulence formed a complex cascade of ecological constraints. In addition to the local tectonic influences, they combined to result in the "depth" factor which controlled the distribution of predominating coral populations and the succession of the different biostromes in the Asbian of NW Ireland.

1. Introduction

Beginning with the pioneer work of Vaughan (1905), corals within shallow-water carbonates have long been recognized as important for the stratigraphic division of the European Mississippian (e.g. Mitchell, 1989; Poty et al., 2006; Somerville, 2008). Coral accumulations, thickets and biostromes are common features in Mississippian shallow-water carbonate facies. Although in Britain and southern Belgium the usefulness of some of these beds as stratigraphic marker horizons has been demonstrated (e.g. George et al., 1976; Somerville, 1979; Aretz, 2002; Aretz and Nudds, 2005, 2007), only limited data are available on their faunal composition and variation, and depositional environments.

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Northwestern Ireland contains an embayment of the vast Northwest-European late Tournaisian–Viséan carbonate platform. The proximity to the coastal zones of the Laurussian Continent to the north is one distinctive characteristic for this internal platform (George, 1958; Graham, 1996; Mitchell, 2004; Sevastopulo and Wyse Jackson, 2009). The deposition of fluvial and deltaic siliciclastic rocks is more common in this area than in most other parts of Western and Central Europe at that time. Upper Viséan rocks in northwestern Ireland are mainly limited to three NE–SW-trending structures; from north to the south these are, the Sligo, Ballymote, and Carrick synclines (George, 1958). The synclines are separated by the Ox Mountains Inlier and the Curlew Mountains Inlier, respectively (Fig. 1).

Upper Viséan carbonates from northwestern Ireland have been described in the important regional studies of Oswald (1955), George and Oswald (1957), Caldwell (1959) and Dixon (1972). Hubbard (1966, 1970) and Dixon (1970) have dealt with the splendid Viséan coral occurrences around the Donegal Bay area and Caldwell and Charlesworth (1962) described several horizons rich in *Siphonodendron*, which they termed 'coral-reefs', in the Asbian successions of the Bricklieve Mountains (southern Ballymote Syncline) (Figs. 1, 2). Dixon (1972) and Somerville et al. (2009) showed that at least some of these horizons could be traced throughout the Ballymote Syncline. Aretz (2002) addressed carbonate microfacies and distribution of corals in the *pauciradiale* biostrome of the Bricklieve Mountains and from Streedagh Point (Sligo Syncline) including some taxonomical descriptions. Aretz and Herbig (2003a) first commented on the palaeoecology and depositional setting of the *Siphonodendron* biostromes. The results of their short contribution and the succeeding studies of Cózar et al. (2005) and Somerville et al. (2009) formed the basis for this present paper. It attempts (i) to describe the different types of rugose coral biostromes and their lateral variations in northwestern Ireland within a stratigraphic framework; (ii) to interpret the environmental setting and factors controlling their rise and decline; and (iii) to use comparisons in morphology with analogous modern scleractinian corals to understand ecological constraints on growth style and water depth.

2. Depositional setting and stratigraphy

The spatial and temporal distribution of carbonate-dominated facies in the Mississippian succession of northwestern Ireland is mainly controlled by the advance and retreat of siliciclastic-dominated facies from the NNW (George, 1958; Graham, 1996). Particular advances took place during the Tournaisian, mid-Viséan, and latest Viséan–Namurian times and can be related to (1) the regional tectonic regime with a number of important displacement pulses during Mississippian time (see Mitchell, 2004), and (2) sea-level oscillations, especially during the late Viséan, triggered by the glaciation and deglaciation cycles in the southern hemisphere (e.g. Hance et al., 2001; Wright and Vanstone, 2001).

In a first generalized step, during the Viséan the Northwest Irish shelf is dominated by fluvial and deltaic depositions in the north and deposition of fully-marine mud-dominated and/or carbonate facies in southern areas. This pattern advocates for a generalized image of a southward-dipping shelf. However, this simple shelf geometry is much complicated by SW–NE or W–E-trending active fault systems (see Mitchell, 1992; Philcox et al., 1992; Somerville et al., 2009), which may have partly controlled the distribution of mudbanks and which acted during different times. During Arundian–Holkerian times, the Ox Mountains Inlier (OMI) was a major barrier for siliciclastic input from the NNW towards the SSE (Dixon, 1972; Graham, 1996). Therefore, the succession of the Sligo Syncline is much richer in siliciclastic rocks than the succession of the Ballymote Syncline.

The Asbian carbonates studied herein are sandwiched in all synclines between siliciclastic-dominated deposits of Arundian to Asbian age (the traditional 'Calp') and Brigantian–Namurian deposits of the Leitrim Group ('Yoredale Series'). The existence of separate lithostratigraphic nomenclatures for each syncline reflects the lateral

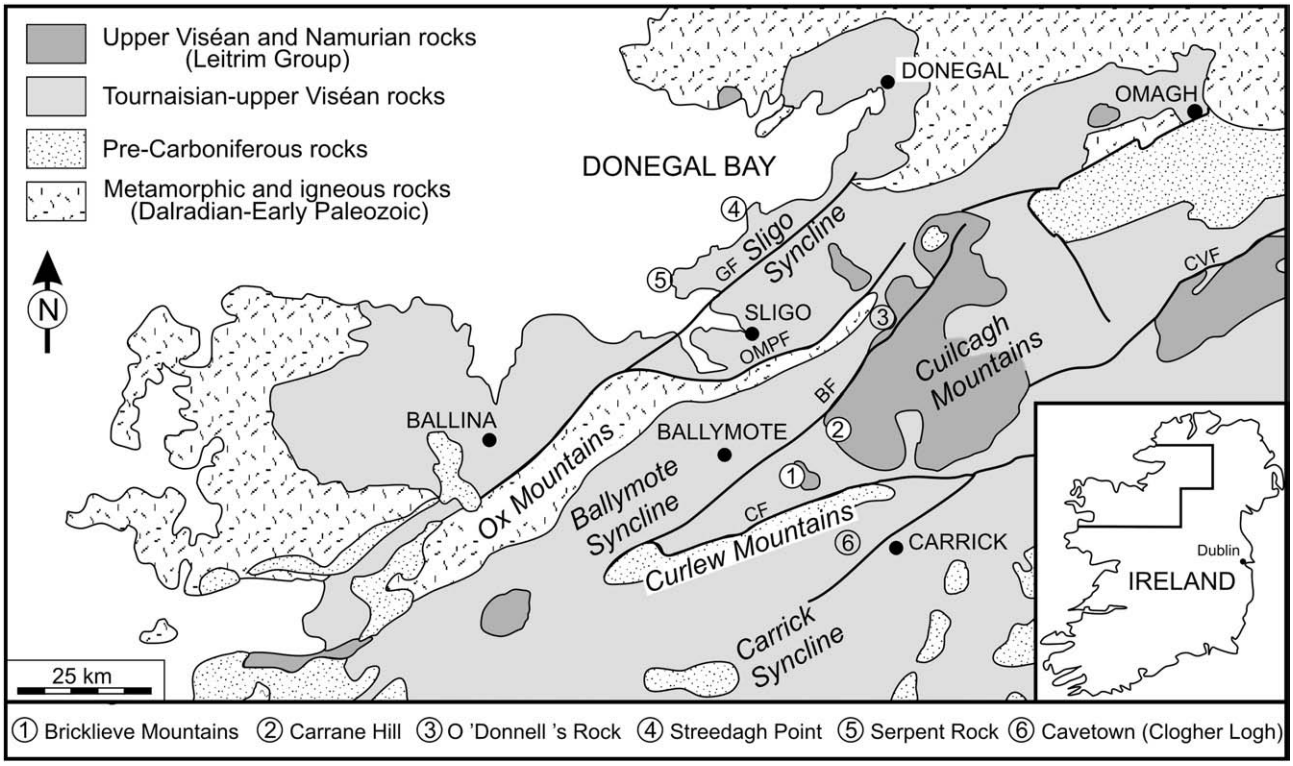

Fig. 1. Geology of northwest Ireland showing the main synclinal structures (modified from Dixon, 1972, fig. 1). BF = Belhavel Fault; CF = Curlew Fault; CVF = Clogher Valley Fault; GF = Grange Fault; OMPF = Ox Mountains - Pettigoe Fault. Localities: 1) Bricklieve Mountains, 2) Carrane Hill, 3) O'Donnell's Rock, 4) Streedagh Point, 5) Serpent Rock, 6) Cavetown.