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Early–Middle Ordovician conodont biofacies on the Yangtze Platform margin, South China: Applications to palaeoenvironment and sea-level changes

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ABSTRACT

9172 Conodonts have been recovered from the uppermost Hunghuayuan Formation and the Zitai Formation at two sections in Shitai County, southern Anhui Province, South China, which was situated close to the margin of the Lower Yangtze Platform during the Early to Middle Ordovician. Systematic and multivariate statistical studies on these conodonts permit recognition of seven conodont biofacies: *Tropodus* biofacies, *Diaphorodus* biofacies, *Oepikodus* biofacies, *Baltoniodus* biofacies, *Paroistodus* biofacies, *Periodon* biofacies and *Protopanderodus* biofacies. Each biofacies is restricted to a particular lithofacies and stratal position and shows a consistent order and/or position within the succession. Turnover of these conodont biofacies is related to sea-level changes. The transgressive–regressive patterns demonstrated by the conodont biofacies compare closely to published sea level curves for South China, and highlight the utility of conodont biofacies as a means of confirming sedimentological evidence of relative sea-level change.

1. Introduction

Ordovician conodont palaeoecology has received much attention from many researchers during the past decades (e.g. Seddon and Sweet, 1971; Barnes and Fåhræus, 1975; Bergström and Carnes, 1976; Fortey and Barnes, 1977; Ethington and Repetski, 1984; Stouge, 1984; Sweet, 1988; Pohler and Barnes, 1990). Seddon and Sweet (1971) proposed a palaeoecological model for the conodontophorid animal, characterized by depth stratification. In contrast, Barnes et al. (1973), Barnes and Fåhræus (1975) and Fåhræus and Barnes (1975) regarded conodontophorids as predominantly benthic or nektobenthic with communities showing a lateral segregation, but including also some pelagic conodonts (Stouge, 1984). Rasmussen (1998) distinguished endemic and pandemic groups of conodonts and argued that pandemic, oceanic conodonts should be excluded from analysis of conodont palaeobiogeography. Zhen and Percival (2003) discussed an ecological model for conodont distribution combining attributes of the previous classical models of Seddon and Sweet (1971) and Barnes and Fåhræus (1975).

Many factors controlled the distribution of nektobenthic and pelagic conodonts. Barnes and Fåhræus (1975), and Lindström (1984) proposed temperature and salinity as significant parameters, but also substrate, seawater chemistry and oxygen levels may play a role in the distribution of the conodontophorid animal. With ongoing study, more and more researchers use multivariate statistical methods in order to distinguish conodont biofacies (corresponding to the term 'community' as used for benthic shelly faunas, e.g. Boucot, 1975, 1999) and many have related changes of biofacies to sea-level fluctuations (Sweet and Bergström, 1984; Ji and Barnes, 1994; Rasmussen and Stouge, 1995; Bagnoli and Stouge, 1996; Zhang and Barnes, 2002, 2004).

The Hunghuayuan and Zitai Formations crop out in the shelf to shelf margin of the Yangtze Platform in southern China (Zhan and Jin, 2007). The succession provides an excellent setting for detailed description of the conodont palaeocology of the Early to early Middle Ordovician in South China. Although biofacies have been identified from the Middle Ordovician (Darriwilian) shelf to shelf margin sediments (Zhang, 1998), the late Early Ordovician (Floian)

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and early Middle Ordovician (Dapingian to early Darriwilian) biofacies have not been described from South China and accordingly relatively little is understood about conodont community composition during this time.

Wu et al. (2010) analyzed the distribution of conodonts from the Early to Middle Ordovician Zitai Formation in Anhui Province of eastern China, relating the biodiversification of these faunas to regional sea-level fluctuations. Here we expand that study to include the conodonts of the uppermost Hunghuayuan Formation and the Zitai Formation at Dingxiang and Liushuting sections, near Shitai county town (Fig. 1). The present research differentiates conodont biofacies from the outer shelf margin of the Yangtze Platform by use of multivariate analysis and examines their relationship to sea-level changes during Floian–early Darriwilian time.

2. Geological setting

Three depositional regions are distinguished across the South China palaeoplate during the Early–Middle Ordovician, i.e. the Yangtze Platform, the Jiangnan Slope, and the Zhujiang Basin (Chen et al., 1995). During this interval, several older orogens (called as 'oldlands' in Chinese literature) were distributed along the western margin of the Upper Yangtze Platform (Zhang et al., 2002). The Dingxiang and Liushuting sections, selected for this study, are located in Shitai county, southern Anhui province, where the Hunghuayuan and Zitai Formations are well-exposed (Fig. 1). During the Ordovician, the study area was located on the margin of the Lower Yangtze Platform.

The Hunghuayuan Formation, established by Chang and Sheng (1958), consists of a sequence of thick, grey to white grainstones, and is widely distributed on the vast area of the Upper and Lower Yangtze platform (Chen et al., 1995). In the Lower Yangtze Platform, the formation has a thickness of 60–130 m. At Dingxiang section, the Hunghuayuan Formation is characterized by thick-bedded grainstone with a thickness of more than 60 m that accumulated under energetic water conditions on the shallow water shelf. In this study, we collected five samples from the uppermost part of the formation at Dingxiang.

The Zitai Formation is characterized by reddish argillaceous limestone intercalated with a few yellowish-green shale beds, being conformably underlain by the Hunghuayuan Formation and overlain by the Kuniutan Formation. Wu et al. (2007) reexamined the Zitai Formation, and suggested it was palaeogeographically distributed along the southeastern margin of the Yangtze Platform. In Shitai County, the Zitai Formation is mainly composed of nodular argillaceous limestone, about 24 m and 76 m thick at Dingxiang and Liushuting, respectively (Figs. 2 and 3), which was deposited in deeper water on the outer shelf.

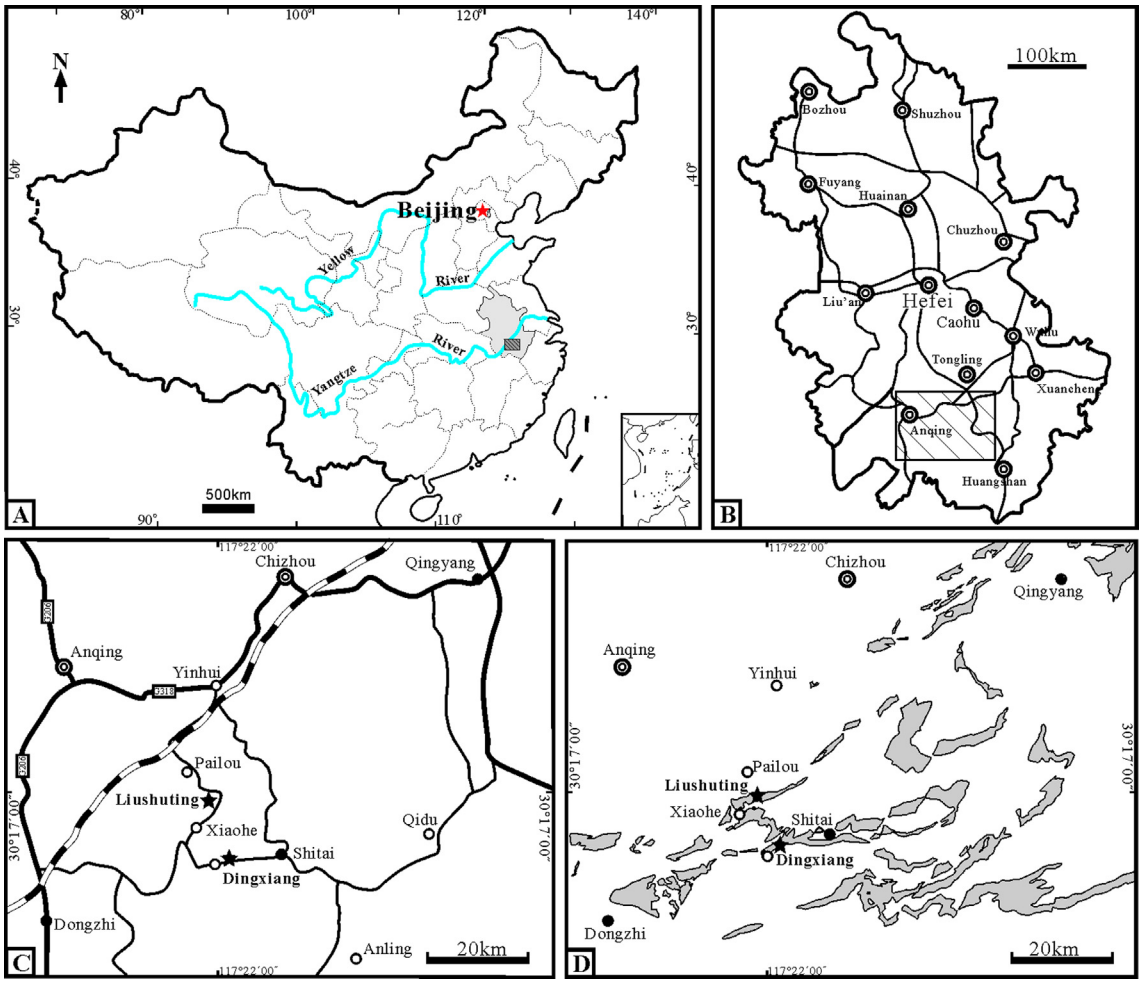

Fig. 1. Location map of the Dingxiang and Liushuting sections in Shitai, Anhui Province. (A) Map of China showing the locations of Anhui Province and the study area (grey quadrangle). (B) Location of the research area in Anhui Province. (C) Detailed map of the study area; Asterisk showing the location of the sections. (D) Distribution of Ordovician outcrops; Asterisk showing the location of the sections.