THE FORAMINIFERAL RESPONSE TO THE EARLY TOARCIAN EXTINCTION EVENT. M.D.Hylton, M.B.Hart & G.D.Price, Department of Geological Sciences, University of Plymouth, Plymouth, PL4 8AA, United Kingdom. (email: mhylton@plymouth.ac.uk, m.hart@plymouth.ac.uk, g.price@plymouth.ac.uk)

In their initial investigation of periodic extinctions Raup & Sepkoski [1] identified an important faunal turnover at, or about, the Pliensbachian-Toarcian boundary. Subsequent work on the palaeontology of the Lower Jurassic successions in Europe, South America and Asia has shown that the most important faunal turnover was in the early Toarcian. By comparison to some of the other events (Permo-Triassic boundary, K-T boundary, etc.) the early Toarcian is clearly of less importance and appears to be both regional (?) and at the species (rather than genus or family) level [2]. As part of our on-going research on Jurassic foraminiferal assemblages [3,4,5,6] the early Toarcian extinction event has been comprehensively investigated in the U.K., Germany and France.

The Early Jurassic was a time of rapidly rising sea-level associated with the extensive spread of anoxic bottom waters. Sea-level rise across the Pliensbachian-Toarcian boundary culminated in the falciferum zone of the Toarcian and is one of the best authenticated eustatic events in the Jurassic. This major transgressive pulse was marked by deeper water marine sequences and was associated with the deposition of organic-rich shales.

The development of anoxia coincides with a notable period of mass extinction of the marine fauna. High resolution sampling and study of the microfaunas through several sequences in the U.K. confirm that benthonic foraminiferal faunas were affected by an early Toarcian falciferum zone event. Samples were analysed from Pliensbachian-Toarcian mudstone, clay and shale sequences of the South Dorset Coast, the East Midlands and the Yorkshire Coast. The sections studied show distinct changes in assemblages across the Pliensbachian-Toarcian boundary and in the basal zones of the Toarcian Stage. Evidence for a foraminiferal extinction event includes the elimination of the important Lower Jurassic Lingulina tenera, Frondicularia terquemi and Marginulina prima plexus groups, initiating a significant period of turnover of the microfauna. A marked change also occurred in the character of associated nodosariid assemblages: the uniserial forms of Nodosaria, Frondicularia, and Lingulina, dominating the Pliensbachian assemblages, were largely replaced by coiled Lenticulina in the Early Toarcian. A reduction in test size and a decline in species diversity, compared with Hettangian to Sinemurian foraminiferal assemblages, reflect the development of low oxygen conditions followed by a subsequent renewal of the microfauna in the Middle Toarcian.

As indicated by Hylton & Hart [5] (fig.5) it is possible to disaggregate the succession of events recorded within the overall extinction event. At the base of the exaratum subzone (falciferum zone) at Tilton (East Midlands, UK), there appears an abundance of very small (~100mm diameter), trochospiral foraminifera. These are similar to the aragonitic genus Conorboides which is also reported from the falciferum zone of the Upper Lias at Empingham, Rutland [7]. Given their extremely low abundance before the Toarcian events and their "bloom" once the environmental conditions markedly declined, this taxon could be described as a "disaster" or "opportunist" species as described by Harries et al. [8].

This species is almost identical to the species described by Wernli [9] as Oberhauserella quadrilobata Fuchs. This was recorded (op. cit.) from the falciferum zone of the Creux de l'Ours, Teysachaux, Swiss Alps. In a recent review of early planktonic foraminifera, Simmons et al. [10] have re-illustrated some of Wernli's material (Simmons et al. [10] pl.2.2, figs 4,7,9). These are virtually identical to our Conorboides and, as they are of identical age, we are certain that our material is the same taxon. Simmons et al. [10], in a lengthy discussion of the origins of the planktonic foraminifera indicate that the earliest species that can be confidently identified are those of the genus Conoglobigerina from the Bajocian of Eastern Europe. These aragonitic, benthonic forms which appear in large numbers during the transgressive event in the earliest Toarcian may, therefore, be the ancestors of the planktonic foraminifera. It is interesting to speculate on whether it was the widespread occurrence of sea floor anoxia at this level that led to the development of a planktonic mode of life.

References