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Early Eocene climatic, volcanic, and biotic events in the northwestern Tethyan Untersberg section, Austria

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Abstract

The 40 m thick Untersberg section (Salzburg, Austria) of the Northern Calcareous Alps comprises the Palaeocene–Eocene transition and spans the upper part of calcareous nannoplankton zone NP9 and the lower part of zone NP10 (sub-zone NP10a). These zones are equivalent to planktonic foraminifera zone P5 and the lower part of zone P6 (sub-zone P6a). The succession was deposited in a lower bathyal slope environment at a palaeodepth of about 2000 m. Within the dominantly marlstone succession, a 5.5-m-thick intercalation of red and green claystone and marly claystone represents the global negative carbon isotope excursion (CIE) which is used to recognize the Palaeocene–Eocene boundary. The CIE was associated with a shallowing of the calcite compensation depth by at least 1 km. Throughout the section, clay mineral assemblages are dominated by smectite, indicating a seasonal climate with alternating wet and dry conditions. A 49% increase in detrital quartz and feldspar within the CIE-interval suggests enhanced continental run-off. This was probably the result of the establishment of a monsoonal setting, in which vegetation was sparse, while periodic high rainfall caused pronounced sediment transport. The increased terrestrially derived input is associated with abundant radiolarian casts indicating high primary productivity. This suggests that seasonal nutrient pulses resulting from intensified precipitation during the wet season have caused high surface-water fertility. The benthic foraminifera faunas of the samples rich in siliceous plankton are strongly dominated by *Glomospira* spp., *Nuttalides truempyii*, *Abyssamina poagi*, *Anomalinoides praeacutus*, *Anomalinoides nobilis*, and *Oridorsalis* spp. We assume that the *Glomospira–Nuttalides* fauna consists of opportunistic species which quickly react to seasonally varying amounts of food. The calcareous nannoplankton assemblage of the CIE-interval is characterized by the first occurrences of the genus *Rhomboaster* and of *Discoaster araneus* and *Discoaster mahmoudii,* whereas *Scapholithus apertus* become extinct at the Palaeocene–Eocene boundary. Within nannoplankton sub-zone NP10a, a series of primarily basaltic ashes give evidence for a major episode of explosive volcanism which can be correlated with the positive ash-series of the Fur-Formation in northern Denmark. The wide

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dispersal distance of the tephras implies Plinian-scale eruptions and multiple ejections of large volumes of pyroclastic material.

Keywords: Palaeogene; Volcanism; Foraminifera; Calcareous nannoplankton; Carbon isotopes; Clay minerals

1. Introduction

The base of the prominent (2–3‰) negative carbon isotope excursion (CIE) in the upper part of calcareous nannoplankton zone NP9 has been proposed by the International Subcommission of Palaeogene Stratigraphy to recognize the Palaeocene–Eocene boundary (Luterbacher et al., 2000). The CIE, which took place 55.5 Ma ago, has been related either to a massive methane release, due to the dissociation of gas hydrates (see Dickens, 2004, for a review) or to a comet impact (Kent et al., 2003). The CIE is associated with a global extinction event within deep-sea benthic foraminifera assemblages (see Thomas, 1998 for a review), a rapid diversification of planktonic foraminifera (Lu and Keller, 1993), a global bloom of the dinoflagellate genus *Apectodinium* (Crouch et al., 2001), a turnover in calcareous nannoplankton (Bybell and Self-Trail, 1994), a major turnover in land mammals (Wing et al., 1991), and a shoaling of the calcite compensation depth (Dickens et al., 1995). Furthermore, in the South Atlantic and Antarctica and in some Tethyan sections, a high influx of kaolinite has been interpreted as resulting from a change to more humid climatic conditions or from enhanced erosion under more arid conditions (Thiry, 2000). Nonetheless, it is generally accepted that the CIE-interval was one of the warmest periods during the Cenozoic.

In the northwestern Tethys (Fig. 1), the Palaeocene–Eocene boundary has been examined in the Rhenodanubian Flysch zone at the 250-m-thick Anthering section (Egger et al., 2000, 2003; Crouch et al., 2001; Huber et al., 2003), which spans the upper part of calcareous nannoplankton zone NP9 to the upper part of zone NP10 (sub-zone NP10d). The CIE in this abyssal turbidite succession coincides with a strong increase in the rate of hemipelagic sedimentation which is interpreted to have been a result of enhanced continental run-off. Due to the associated high influx of nutrients into the basin, primary productivity of marine plankton increased. Closely spaced bentonites within subzone NP10a have been correlated with the main ash-phase of the North Sea basin.

For this paper the Palaeocene–Eocene boundary in the Untersberg section in the Northern Calcareous Alps has been studied (Fig. 1). The Palaeogene deposits of the Untersberg region were examined by von Hillebrandt (1962), who was one of the first authors to recognize the importance of the benthic foraminiferal extinction at the end of the Palaeocene epoch, although the resolution of this early study is low. The studied section exposes part of the bathyal slope deposits (Nierental Formation, Krenmayr, 1996) of the Gosau Group and is located about 18 km to the south of the Anthering section. As the Anthering and

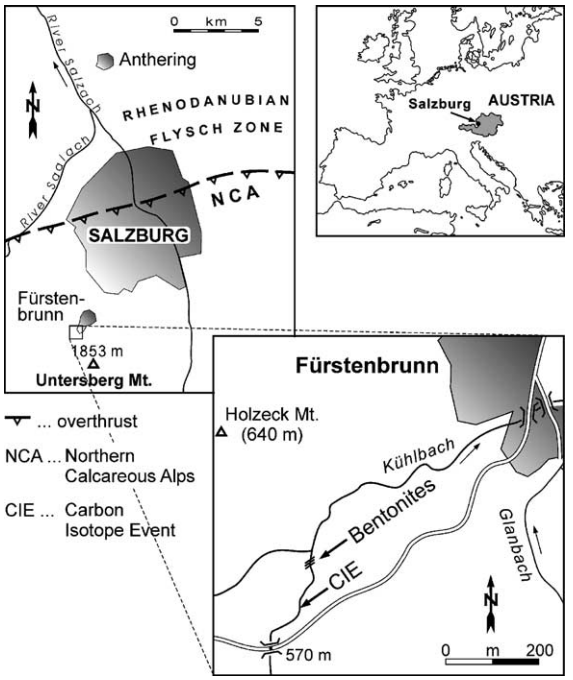

Fig. 1. Location of the Untersberg section and position of the carbon isotope excursion (CIE) at the Palaeocene–Eocene boundary.