RECCCE Excursion Day 1, Saturday, April 25, 2009

STOP 1 Cretaceous/Paleogene boundary at Knappengraben/Gams

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Topic: Cretaceous/Paleogene boundary section Gams 1
Lithostratigraphic unit: Nierental Formation (Upper Gosau Subgroup)
Age: Late Maastrichtian (CC26) – early Paleocene (NP1)
Tectonic unit: Untersberg nappe / Göller nappe (Tirolicum), NCA
Location: Outcrops along an abandoned forest road from Haid to Kronsteiner
Coordinates: Latitude 47^0 39.783 N, longitude $14^0$52.982 E, altitude 813.1 m
Specialities: first K/Pg boundary section recognized in that area; recent findings of geochemistry and mineralogy; discussion on impact and volcanism.
References: Lahodynsky (1988a,b), Grachev et al., 2005, 2007, 2008, 2009

The outcrop is located 700 m south of the abandoned farmhouse Kronsteiner (see: Austrian map 1:50.000, sheet 101, Eisenerz) at the crossing between the forest road and the Knappengraben torrent. It is protected by a fenced shelter.

Scientific background

An overview of the Basin of Gams and the stratigraphy of its late Cretaceous/Palaeogene rocks has been given by Kollmann (1964). Detailed studies on the K/T boundary of Gams have first been performed at the Knappengraben outcrop. The lithological section has been described by Lahodynsky (1988a,b). Nanno- and micropalaeontological work has been performed by Wicher (1956), Stradner & Rögl (1988), Wagreich & Krenmayer (1993), Egger et al. (2004), Grachev et al. (2005) and Korchagin & Kollmann in Grachev (2009).

Geological situation

In the outcrop which is currently protected by a fence, a section of the Nierental Formation across the K/Pg boundary is exposed. Beds are dipping at 40° towards SSE (ss 170/40). The base is formed by pale grey, late Maastrichtian shaly limestones with a well-defined ichnofauna (*Chondrites, Zoophycos, Thalassinoides*). The transitional layer consists of dark grey plastic clay containing small mica particles. It is overlain by grey clays and thin, yellowish to brown fine-grained sandstone layers.

The monolith

The major source of information of Grachev et al. (2005) and Grachev (2009) is the “monolith”, a block cut out from this outcrop by members of the Department of Geology and Palaeontology of the Vienna Museum of Natural History. It represents a section of 23 cm across the K/Pg boundary.

***Mayaroensis* Zone**.The statigraphically lower part (layers A – I) consists of light grey shaly limestones. Dark spots of approximately 1mm in diameter are sections through *Chondrites*. The burrows are filled with dark boundary clay. Comparable traces are known from K/T boundary sections of Italy, France, Spain, Bulgaria and others and indicate an *Abathomphalus mayaroensis* or *Pseudoguembelina hariaensis* zones of the *Globotruncanidae* and *Heterohelicidae* standard zonation. Planktonic foraminifera, especially *Abathomphalus mayaroensis* and and *Globotruncanita stuarti*, suggests a position at the top of the Zone *Abathomphalus maryaensis*. It corresponds well with other East Alpine sections in the Bavarian Alps (Herm et al., 1981) and “Bed 9” in the Rotwandgraben of the Basin of Gosau, Austria (Peryt et al., 1993). Also in Tunisia (Keller, 1988) it was recorded close to the upper boundary of the Abathomphalus maryaensis Zone of the standard scale.

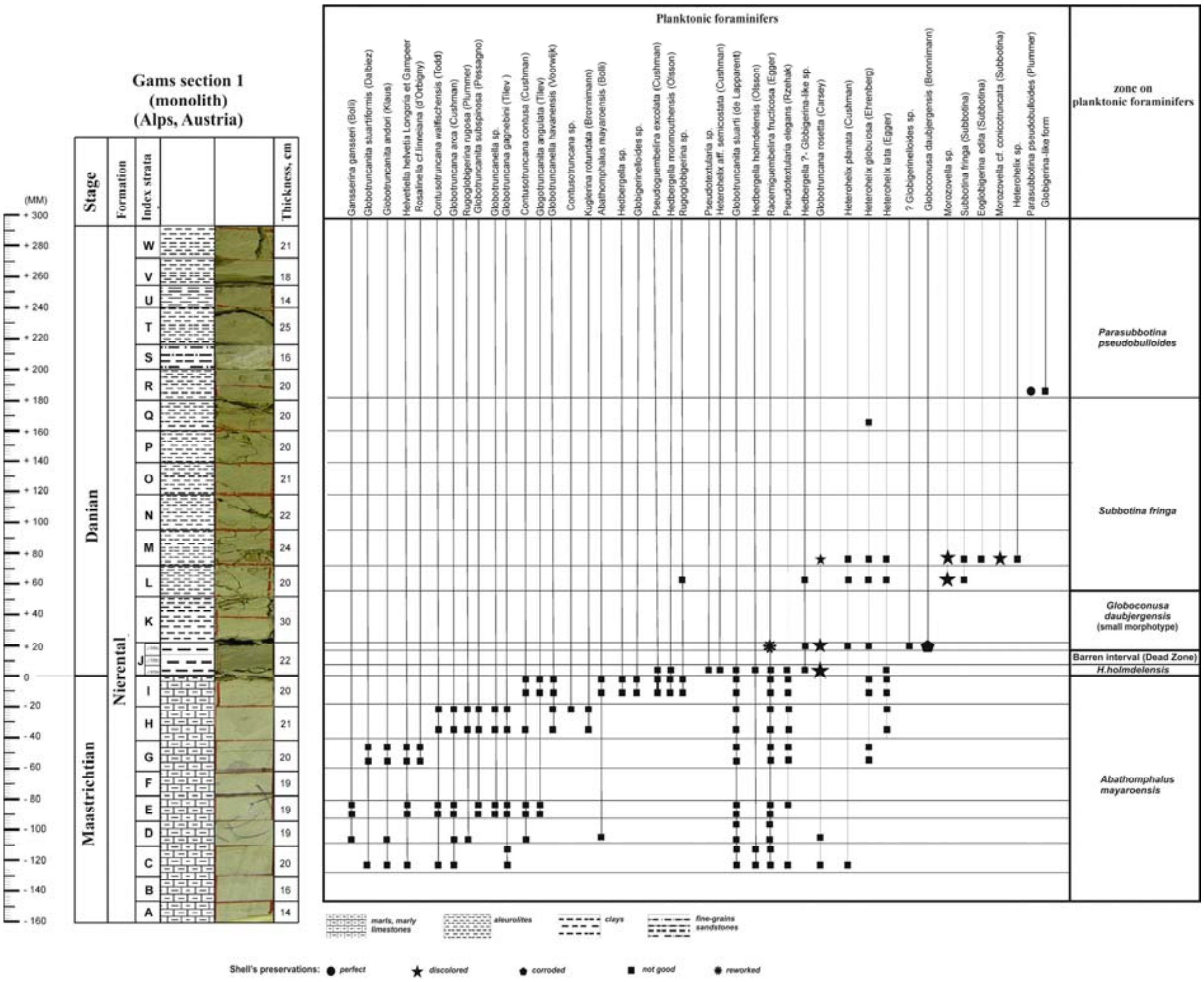

Fig. 3. Distribution of planktonic foraminifera in the monolith (Korchagin & Kollmann in: Grachev, 2009)

The foraminifera assemblage is characteristic for the *Globotruncanita stuarti* Zone, suggesting a position at the top of this zone. While *Gansserina gansseri* LO has been recorded in Gams slightly below the top of the marls underlying the boundary layer J, it extends to the top of the Maastrichtian in the El-Kef section (Tunisia). We therefore infer that the terminal Maastrichtian has been retained in the Gams section.

The K/Pg boundary clay (Layer J) has a thickness of about 2 cm. It is vertically heterogeneous and its texture varies according to its clastic content and the clay matrix distribution. For detailed examination, the layer was subdivided into 6 subunits of 2–3 mm thickness each. The following planktonic foraminifera zones have been recorded:

***Holmdelensis* Zone**. The lower part of the transitional clay of Gams (unit J) contains also an assemblage of small heterohelicids and hedbergellids including *H. holmdelensis* (Grachev, Korchagin, Kollmann et al., 2005). We therefore distinguish the *holmdelensis* Zone also in Gams and correlate it with the boundary clay in Spain. However, the redeposition of *H. holmdelensis* together with other typical Cretaceous planktonic foraminifers cannot be ruled out completely.

Barren interval (dead zone). This interval in the middle part of unit J comprises dark green to black clay. It is approximately 0.2 cm in thickness and lacks foraminifers. It is still premature to speculate about the geographical distribution of this interval because evidence is too scarce.

***Globoconusa daubjergensis* Zone**. Lower boundary defined by FO of index species (= *Globoconusa daubjergensis* Zone in Grachev, Korchagin, Kollmann et al., 2005). The first appearance of *Globoconusa daubjergensis* in Gams is above the barren interval in the unit J.

***Fringa* Zone**. Unit K is a lens of grey, sandy clay with slickensides. It rests on the eroded top of the boundary clay and was produced by a submarine slide. It is overlain by yellow to brownish, fine-grained sandstone and grey clays containing *Subbotina fringa*. Therefore, *Globoconusa daubjergensis* occurs in Gams below the base of the fringa zone and therefore at a lower stratigraphical level.

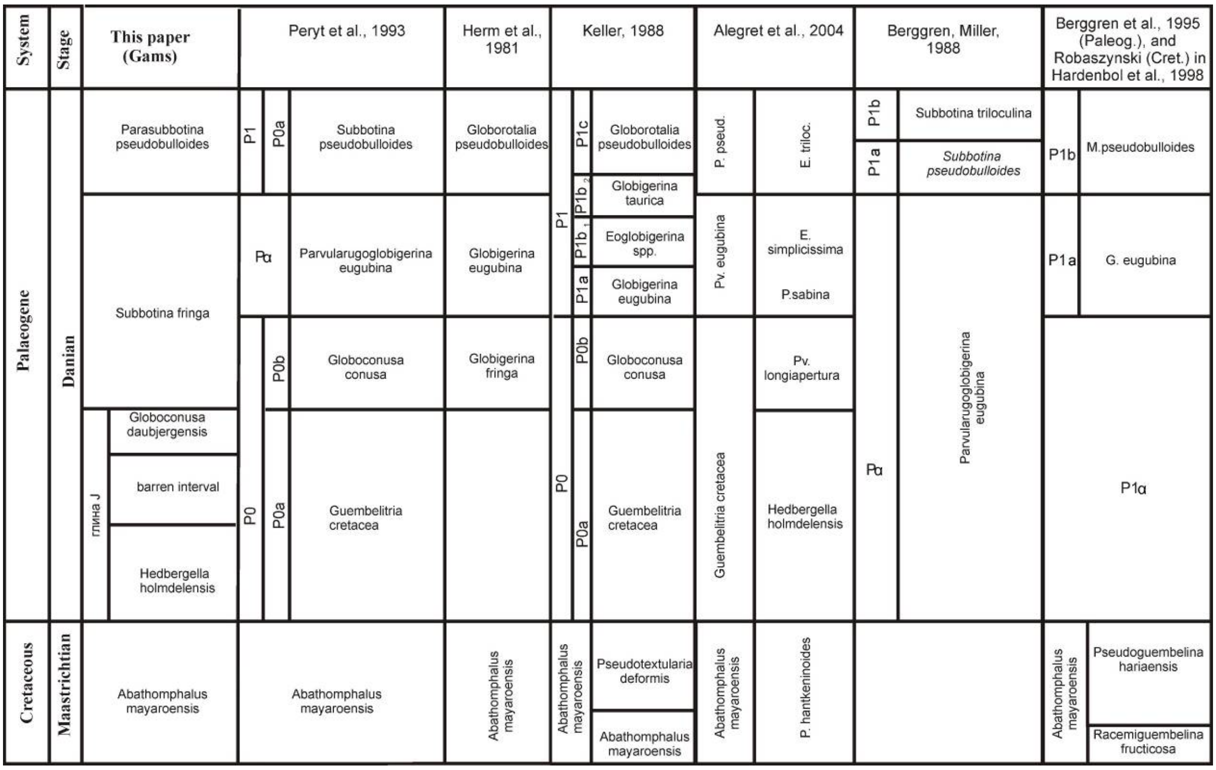

Fig. 4. Correlation chart of Cretaceous/Palaeogene boundary sections (Korchagin & Kollmann in: Grachev, 2009)

Distribution of foraminifera

The distribution chart of foraminifera (Fig. 3) shows that the extinction of genera began well before the accumulation of the boundary clay. The lower part of unit J shows an impoverished fauna of planktonic foraminifera while the benthic foraminifera remained diverse. *Globoconusa daubjergensis* appears first immediately above the barren zone and therefore below the base of the fringe zone (Grachev, Korchagin, Kollmann et al., 2005) and therefore at a lower stratigraphical level.

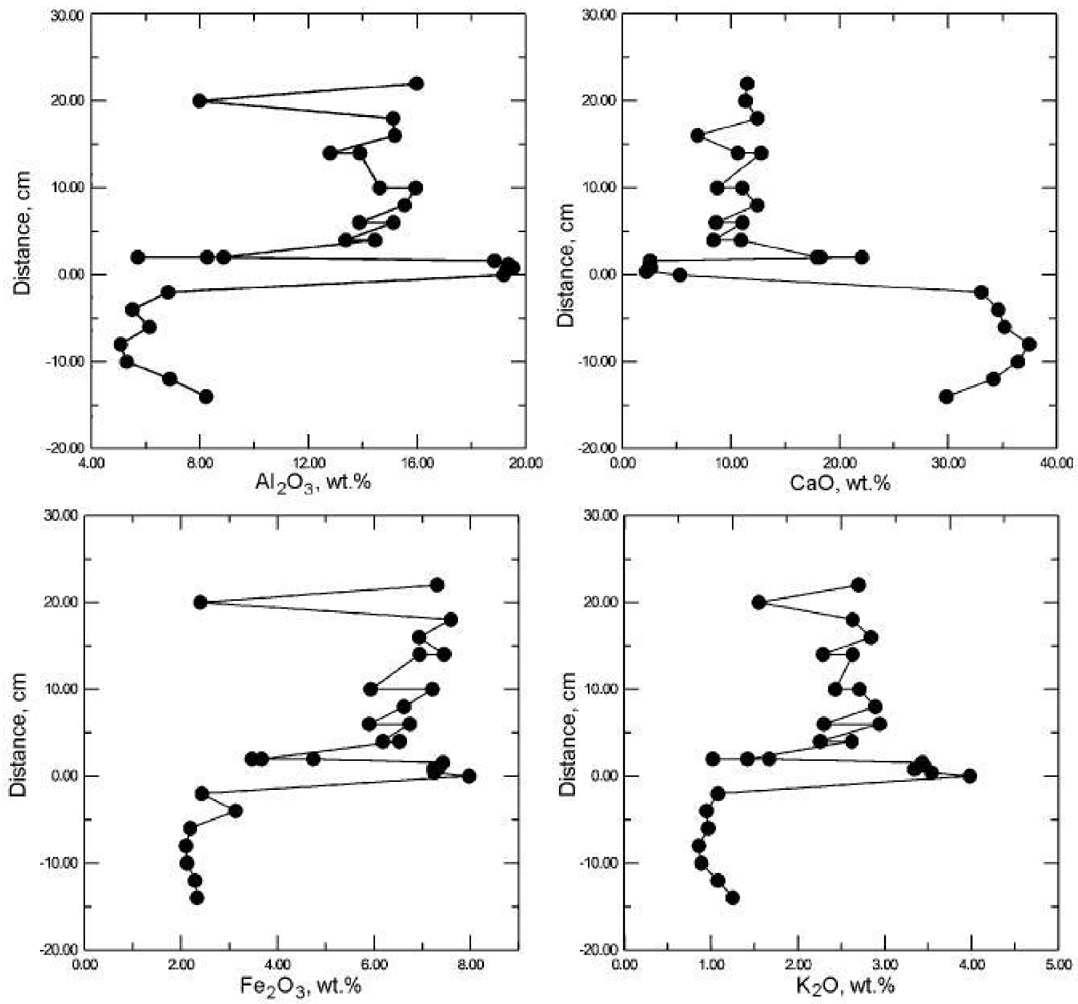

Fig. 5. Distribution of Al_2O_3, Fe_2O_3 and TiO_2 and a very low content of $CaCo_3$ in the monolith (Grachev, 2009)

Composition of the boundary layer

Compared with the underlying and overlying rocks, layer J is characterized by elevated concentrations of Al_2O_3, Fe_2O_3 and TiO_2 and a very low content of $CaCo_3$. In its lower part, the fraction of smectite equals 60% and decreases gradually upwards. The fraction of illite simultaneously increases by 20%. As subunit J1 contains notable amounts of titanomagnetite whose composition is identical to that of basalts, it is reasonable to conclude that smectite developed from volcanic material. The Ir concentration of layer J increases drastically from 5 to 9 ppm up to the barren zone (subunits J1 to J4) and than drops to 3pm in the upper third (subunits J5 to J6). The contents of As, Pb, Ag, Au and Br change synchronously. Above J4, the subunits contain nickel, iron and nickel-iron alloy similar to awaruite (Fe_3Ni) which reach a maximum at J6. The same unit contains beads of practically pure Ni and diamonds ranging in size from submicrons to tens of microns.

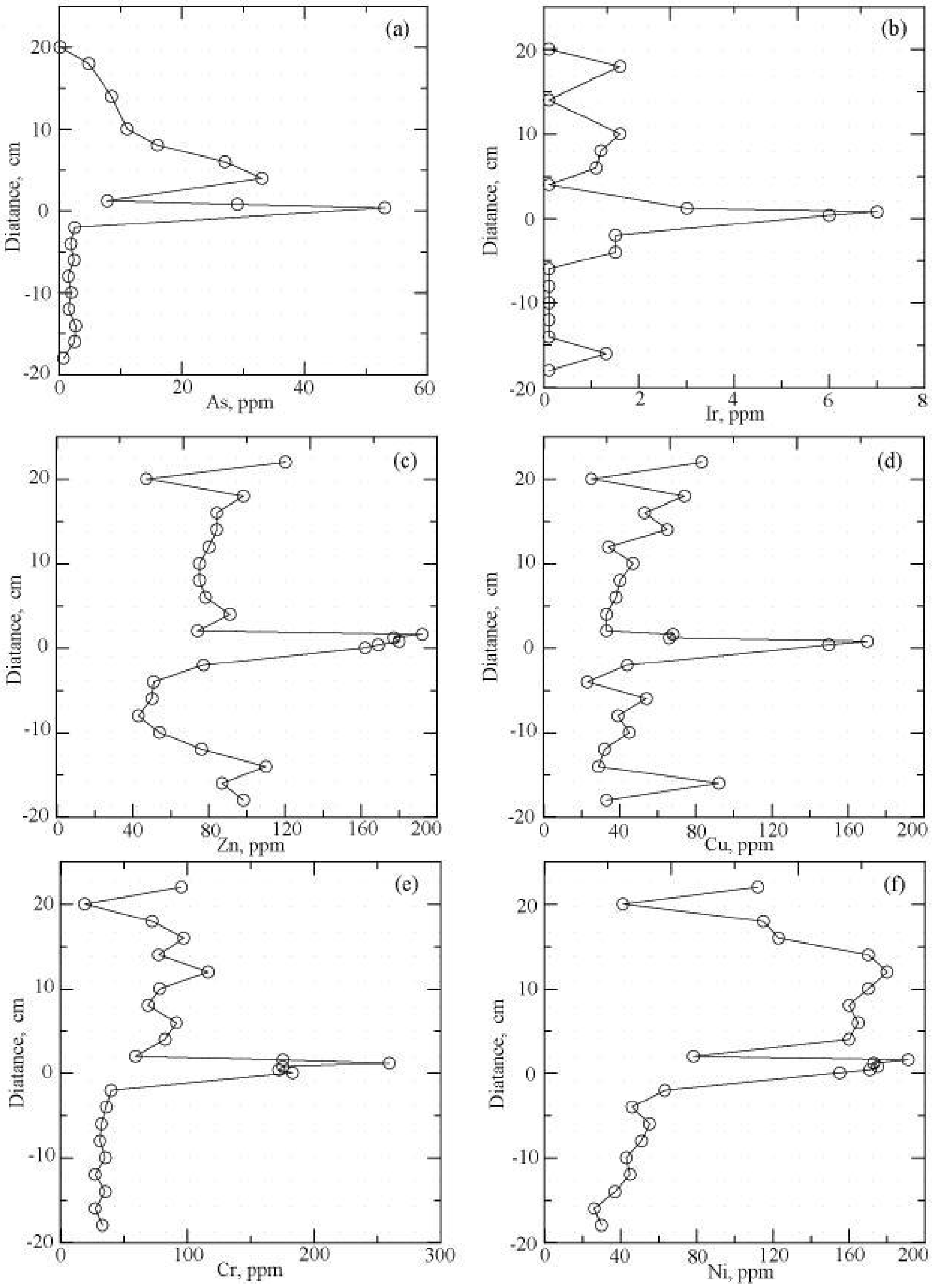

Fig. 6. The distribution of As, Ir, Zn, Cu, Cr and Ni in the monolith (Grachev, 2009)

Conclusions

The distribution of titanomagnetite, As, Pb, Ag, Au and Br in the unit J suggests a volcanic origin of the boundary layer. The subunits J5 – J6 which are characterized by nickel, iron, and an iron-nickel alloy and in J 6 also be diamond crystal were affected by the fall of an asteroid (meteorite).

The **Gams 2** site, a hitherto undescribed outcrop E of the old Haid sawmill (see Austrian Map, 1:50.000, sheet 101, Eisenerz) is a river cut on the right (north) side of the Gamsbach river, just above the alluvial flat (latitude 47°39.47´N, longitude 14°52.05´E). In this outcrop the Nierental Formation with the K/Pg boundary is exposed a a length of approximately 10 m. Besides a larger portion of the calcareous shales below the K/Pg boundary, the section is comparable to the previous one. The rocks dip at 15-30° towards SW. There are subangular fragments of cross-bedded, fine-grained sandstones of 1 cm in size just above the dark brown (rusty) layer of 1-2 mm containing drop-like grains of Ni spinel (Grachev et al., 2006). A neptunian dike extends into the Maastrichtian limestone from the top towards a depth of 1 m. It´s infilling consists of clay with a high mica content. Although it has been formed before the deposition of the transitional layer, the composition of clays in virtually the same.