A DUAL-LAYER CHICXULUB EJECTA SEQUENCE WITH SHOCKED CARBONATES FROM THE CRETACEOUS-TERTIARY (K/T) BOUNDARY, ODP LEG 207, WESTERN ATLANTIC. P. Schulte[1], A. Deutsch[2], T. Salge[3], [1]GeoZentrum Nordbayern, Universität Erlangen, D-91054 Erlangen, Germany (schulte@geol.uni-erlangen.de), [2]Institut f. Planetologie, WWU Münster, D-48149 Münster, Germany, [3]Bruker AXS Microanalysis GmbH, Schwarzschildstr. 12, D-12489 Berlin, Germany.

Introduction: An up to 2-cm thick Chicxulub ejecta deposit marking the Cretaceous-Tertiary (K/T) boundary (Fig. 1) was recovered in 6 holes drilled during ODP Leg 207 (Demerara Rise, tropical western Atlantic [1-3]). High-resolution mineralogical, petrological, and elemental data reveal a distinct microstratigraphy and a range of ejecta components. Prominent features are the uniformity of this deposit over an area of 30 km^2, the absence of bioturbation, allowing documentation of the original sedimentary sequence, and the presence of calcite and dolomite clasts next to shocked tectosilicates in the topmost millimeters. These carbonate clasts show in part exotic features obviously related to the Chicxulub impact event.

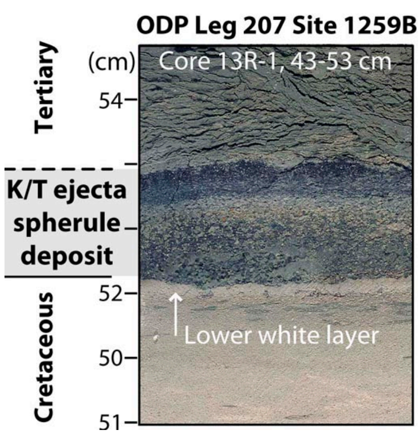

Fig. 1. K/T boundary in ODP Leg 207 Site 1259B.

Analytical techniques: Polished thin sections were generated from cuts normal and parallel to bedding in the K/T spherule deposit as well as from the transition to the Maastrichtian and Danian sediments in ODP Leg 207 Sites 1258B, 1259B, and 1259C. Wavelength-dispersive (WDS) and energy-dispersive (EDS) electron microprobe (EMP) analyses, as well as back-scattered electron (BSE) images of ejecta components were performed with the JEOL JXA-8200 Superprobe (Universität Erlangen). The acceleration voltage was 15-20 kV, the sample current was 15 nA, and counting times were 20-40 s. At BRUKER AXS Microanalysis GmbH, Berlin, fast high-resolution element scans were conducted with a JEOL JSM-6490LV electron microscope equipped with a Quantax EDS system including a liquid nitrogen free XFlash 4030 EDS silicon drift detector (SDD) and the Esprit 1.8 software using 15 kV acceleration voltage, counting rates of 100-220 kcps, and integration times of 10-20 min for a mapping resolution of 1600 * 1200 pixel.

Results: The spherule deposit is normally graded and composed predominantly of rounded, 0.1- to max. 1-mm sized spherules (Figs. 1, 2). In the uppermost 0.5-0.7 mm of the deposit, Fe-Mg-rich spherules, shocked tectosilicates, few lithic clasts (gneiss), as well as abundant carbonate clasts are present (Fig. 2).

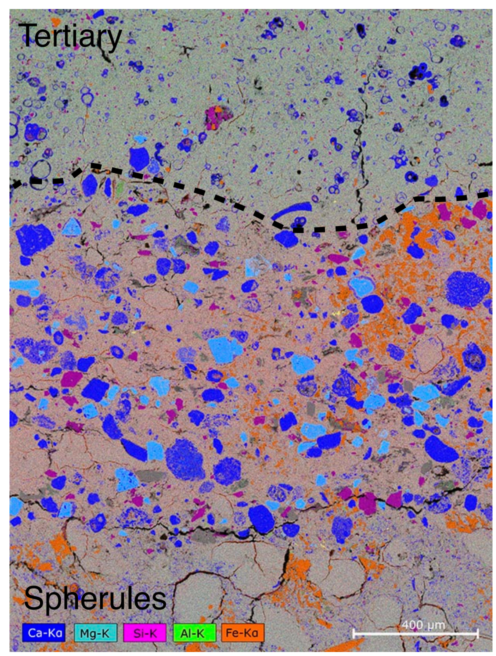

Fig. 2. Combined BSE image and EDS element map showing the relative abundance of Ca, Mg, Si, Al, Fe in the uppermost part of the spherule deposit in ODP Site 1259B and the transition (marked by the hatched line) to the early Tertiary claystone above. Note the presence of large smectite spherules in the lower third and the occurrence of calcite and dolomite clasts as well as tectosilicates in the uppermost 0.5-0.7 mm of the K/T sequence.

Petrology of spherules. The spherules are altered to dioctahedral aluminous smectite, though relict Si-Al-rich hydrated glass is also present, suggesting acidic precursor lithologies. Spherule textures vary from hollow to vesicle-rich to massive; some show in situ collapse, others include distinct Fe-Mg-Ca-Ti-rich melt globules and lath-shaped Al-rich quench crystals.

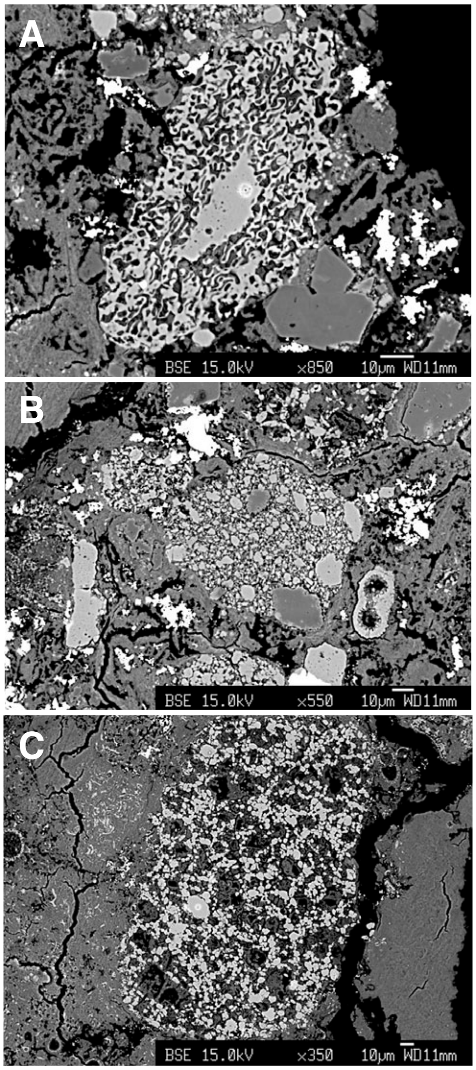

Fig. 3. BSE images of carbonate clasts in the uppermost 0.5 mm of the spherule deposit in ODP Site 1259B. (A) Rounded porous calcite clast, note distinct flow-shaped pores; (B) carbonate clast consisting of accreted µm-sized calcite and dolomite sub-grains; (C) highly porous accretionary calcite clast composed of µm-sized calcite sub-grains and (dark gray) smectite matrix.

Petrology of carbonate clasts. Carbonate clasts display in part very unusual textures as shown in Fig. 3, including (i) rounded porous calcite clasts with flow-shaped pores that are very similar to experimentally shocked decomposed calcites [4], (ii) highly porous accretionary carbonate clasts, composed ofµm-sized calcite sub-grains and smectite matrix, that are similar to accretionary carbonate clasts found in the Texas and Mexico K/T boundary deposits [5], (iii) hollow calcite clasts with thick rims consisting of radially aligned crystallites, and (iv) rounded calcite clasts consisting of equant calcite crystallites that display 120° triple junctions. In addition, several abraded and rounded calcite and dolomite clasts occur that show a distinct Si-Al-Ca-rich phyllosilicate corona (Fig. 4). These textural features are interpreted to indicate impact-induced mechanical and thermal stress (abrasion followed by decomposition due to enclosure by a melt phase).

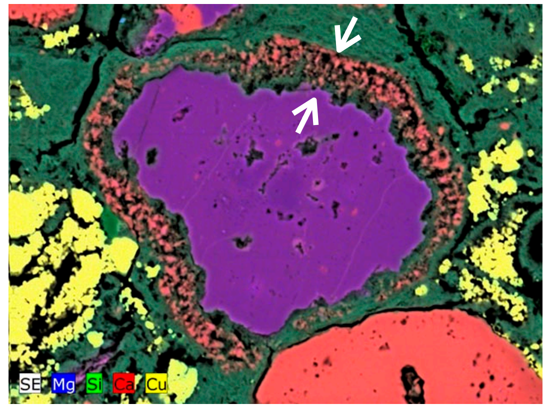

Fig. 4. Combined BSE image and EDS element map for a dolomite clast with Si-Al-Ca-rich phyllosilicate corona (between arrows) from the uppermost 0.5 mm of the spherule deposit in ODP Site 1259B.

Conclusions: The ODP Leg 207 spherule deposit is the first known dual-layer K/T boundary in marine settings [2]. The exotic carbonate textures are interpreted to be in part of shock-metamorphic origin [4]. The preservation of delicate spherule textures, normal grading with lack of evidence for traction transport, and sub-millimeter scale compositional trends provide evidence for this spherule deposit representing a primary air-fall deposit not affected by significant reworking. Its stratigraphy, including the distinct Ir anomaly in its topmost part [3], resembles the dual-layer K/T boundary deposits in the terrestrial Western Interior of North America (although there carbonate phases are not preserved [6]). The layered nature of the deposit may document compositional differences between ballistic Chicxulub ejecta forming the majority of the spherule deposit, and material falling out from the vapor (ejecta) plume, which is concentrated in the uppermost part.

References: [1] MacLeod K.G. et al. (2007) GSA Bull. 119, 101-115. [2] Schulte P. et al. (2009) GCA in press. [3] Deutsch A. et al. (2009) LPSC 40, this volume. [4] Agrinier P. et al. (2001), GCA 65, 2615-2632. [5] Yancey T.E. & Guillemette R.N. (2008) GSA Bull. 120, 1105-1118. [6] Smit J. (1999) Ann. Rev. Earth Planet. Sci. 27, 75-113.

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