ODP Leg 207 - a pristine dual-layer Chicxulub ejecta sequence: dissecting the geochemical K/T anomaly

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Six cores from ODP Leg 207 (Demerara Rise, tropical western Atlantic, ˜4500 km from the Chicxulub crater center; water depth ˜2 km) recovered an about 2 cm thick, slightly graded, apparently complete K/T ejecta deposit that lacks bioturbation (MacLeod et al. 2007;Schulte et al. 2008). The exceptional grade of preservation allows documentation of the original sedimentary sequence and its geochemical characteristics on the sub-μm scale using electron microprobe and La-ICP-MS. Several profiles across the K/T section of core 1259 C resulted in an average SiO_2 content of 43 ± 3 (1σ) wt.% (not normalized to 100) for the spherule layer.

Light Rare earth elements (LREE) in the lowermost Danian are 10 – 20 x C1, and the corresponding $(La/Yb)_N$ range from 17 to 8. A knife-sharp break in the REE distribution patterns occurs at the boundary between the Danian chalk and the smectite spherules which are pseudomorphs after Chixculub-related glass spherules and microcrystites. REE contents are lower, and the patterns flatter with $(La/Yb)_N$ between 10 and 1. This feature may point to a mafic component in the ejecta material. The Ni/Cr ratio in the Danian is ˜3.1, and straddles around 2.6 in the spherule layer, which is clearly less than the average Ni/Cr of 4.05 for CM2 carbonaceous chondrites, the most likely projectile type of the Chicxulub impact event. The altered glass spherules, and the clay rich matrix display unusually low ${\epsilon_{Nd}}^{T=65Ma}$ values. This unradiogenic Nd obviously reflects detrital input from the Guayana craton that was taken by the spherules during alteration.

The concentrations of the platinum group elements (PGE) increase sharply, yet discontinuously from the last spot in the Danian to reach peak concentrations in a $\leq$1 mm distance in the uppermost part of the spherule layer. The measured PGE distribution is best interpreted by an increasing fall-out of discrete nuggets as carrier of the “Ir anomaly” towards to top of the spherule layer. This process may have happened on the order of days after the impact event.

In summary, the K/T boundary in ODP Leg 207 contains chemical components characteristic for the projectile (PGEs), for the ejecta (REE, Ni/Cr), and for the contemporaneous seawater (Nd, part of the Sr) in yet unconstrained proportions. We consider this spherule layer to be a key for understanding the mode of deposition and preservation of the different components that now make up this remarkable K/T boundary.

References

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