CLASTIC POLYMICT DIKES IN THE “MEGABLOCK” SEQUENCE OF THE ICDP-CHICXULUB DRILL CORE YAX-1.

A. Wittmann, T. Kenkmann, R.T. Schmitt, D. Stöffler. Institut für Mineralogie, Museum für Naturkunde, Humboldt-Universität zu Berlin, Invalidenstr. 43, D-10115 Berlin, Germany, axel.wittmann@rz.hu-berlin.de

Introduction: The Yaxcopoil borehole (Yax-1) penetrates below the suevitic units through 600 m of sediments (894.9 m – 1510.9 m). These rocks are most likely of Cretaceous age and are regarded as a displaced “megablock”. The stratified sequence was intruded by suevitic dikes (910 m, 916 m), one impact melt dike (1347 m) and several clastic, polymict dikes. The latter are the focus of this study. We present our preliminary petrographic and structural investigations of the clastic dikes obtained by macroscopical, microscopical and SEM inspection.

Occurrences: Polymict clastic dikes occur at a depth interval of 1300 m to 1400 m. They have a finely recrystallized dolomite groundmass. Host rock lithologies of these dikes are interlayered and intergrown dolomite and anhydrite as well as brecciated dolomites. Well developed examples of dikes are present at depths of 1314-1316 m (Figs. 1a, b, d) and 1341 m (Fig. 1c). The dikes at 1314-1316 m are an assemblage of incoherent, steeply dipping (> 70°) dikes with several veins that branch off. Dikes in this part reach thicknesses of up to 5 cm. Bulk rock geochemical analysis reveal an enrichment in SiO_2, TiO_2, Al_2O_3 Fe_2O_3 MgO and K_2O with respect to the anhydrite-dolomite host rock and systematic decrease in CaO and SO_3 from the outer contact to the center of the dike (Tab. 1).

The dike at 1341 m represents a coherent layer with a thickness of about 40 cm and has a similar composition but is more abundant in coarser clasts than the upper dikes (Fig. 1c). One additional thin dike (< 5 mm) with

Table 1: *Major element XRF-data for sample YAX-1_1315,68 m.*

	Yax-1 1315.68 m a dike fine grained	Yax-1 1315.68 m b dike with clasts	Yax-1 1315.68 m c host rock
Gew.-%			
SiO2	6.0	8.1	1.2
TiO2	0.12	0.15	<0.01
Al2O3	1.9	2.3	<0.2
Fe2O3	1.04	1.30	0.13
MnO	0.01	0.01	<0.01
MgO	18.4	15.5	3.76
CaO	29.4	29.7	39.2
Na2O	0.10	0.10	0.04
K2O	1.34	1.51	0.07
P2O5	0.01	0.03	0.02
SO3	0.5	8.6	45.9
LOI	41.1	32.6	9.9
total	99.92	99.90	100.22

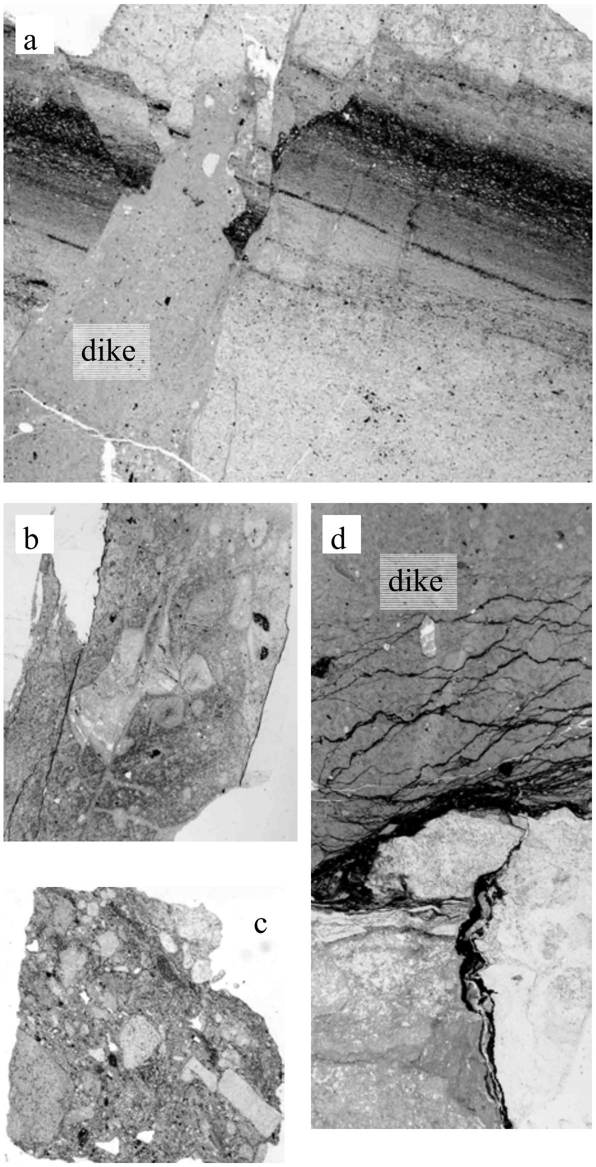

Fig. 1(a) *Grey dolomite dike cuts layered and faulted dolomite anhydrite host rock laced with kerogen -. Sample YAX-1_1316,05 m, thin section b/w photograph, width .2.2 cm. (b)**:** Dolomite dike cuts transparent anhydrite host. Note light grey dolomite clasts cut by faults. Sample YAX-1_1315,61 m, thin section b/w photograph, width 2.3 cm. (c) Sample Yax-1_1341,59 m, width 1.9 cm. (d) Grey dolomite dike at top is fractured by black, anastomosing shear zones. At the contact to host anhydrite - dolomite, black kerogen accumulated. Sample YAX-1_1315,68 m, thin section b/w photograph, width 2 cm.*

Fig. 2: *Brown fluorite – silicate clasts in fine grained dolomite dike groundmass. Sample YAX-1_1314,77 m, thin section, plane polarized light, width 2.25 mm.*

Fig. 3: *Light grey streaks of anhydrite and rounded clasts of dolomite in a fine grained dolomite dike groundmass. Sample YAX-1_1373,95 m, thin section, plane polarized light, width 1.8 mm.*

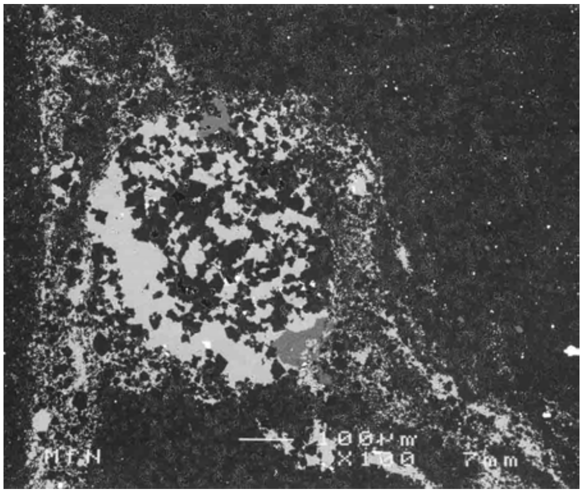

Fig. 4: *Entire micrograph shows the internal structure of a single clast: An anhydrite-dolomite porphyroclast with fine grained wings is embedded in a dolomite matrix. On the left hand side, the wing is cut and disseminated by a fault. BSE - SEM image of sample YAX-1_1315,61 m, width 1,05 mm.*

a fine grained dolomite groundmass occurs at a depth of 1373,95 m and accompanies an anhydrite lens and a potassium feldspar and pyrite-bearing zone. A different dike lithology is present at a depth of 1398-1399 m. Here, coarse grained dolomite breccia dikes with thicknesses of a few cm transsect calcite rocks at dipping angles of > 70°. These dolomite dikes are heavily laced with black kerogen and lack the recrystallized groundmass and rounding of clasts observed in the other clastic dikes. Additional occurrences of clastic dikes are likely.

Structural relationships: All described dikes transsect their host rocks discordantly and sharply (Fig. 1a). Contacts to anhydrite rocks are jagged. The contacts to the dolomite host rocks are brecciated or comminuted. A variety of unsorted, polymict clasts are embedded within the fine grained dolomitic groundmass of the dikes. Clast types are derived from host rock lithologies with dolomite clasts accounting for the largest clasts. Further on, they are accompanied by clasts consisting of dolomite-anhydrite intergrowths and fluorite-K feldspar–pyrite intergrowths (Fig. 2).

Deformation stages: Several stages of deformation can be inferred from the structure of the dikes: The jagged contact to the host lithologies suggests a brittle response of the anhydrite to the sudden emplacement and injection process of the dikes. Indicators for ductile flow within the dikes are present as fine, dark streaks of dolomite (Fig. 3) and thin bands of anhydrite (Fig. 3). These streaks and bands are convoluted suggesting turbulent flow conditions. This indicates a stage of ductile flow, which could have been responsible for the rounding of clasts within the dikes. Many clasts themselves appear to be internally deformed in a ductile manner (Fig. 4). Clasts consisting of dolomite-anhydrite intergrowths, for instance, show an internally developed foliation and contain rounded porphyroclasts with fine-grained wings (Fig. 4).

When the ductile deformation within the dikes had ceased, the dikes must have gained coherence by some sort of rapid, probably thermally activated cementation, because both matrix and clasts were affected by penetrative brittle deformation (Figs.1c, 4). At this stage networks of anastomosing microfaults parallel to the strike directions of the dikes were formed.

Discordant dikes also cut kerogen-bearing layers which bear potassium feldspar and pyrite (Figs. 1a, d) It is obvious that these clastic dikes postdate the kerogen paragenesis. However, the migration of kerogen and oil continued after the emplacement of the dikes [1]. Brittle shear zones, faults and dikes were used as pathways (Fig. 1d) and hosts. The example from 1398–1399 m bears witness to this process.

Conclusions: The formation and injection of polymict clastic dikes into a crater floor is a well-known process occurring during the growth of a transient cavity [2]. The cogenetic nature of dike formation and impact cratering in the Chicxulub structure can be used to unravel the formation time of brittle deformation processes and kerogen mobilization using cross cutting relationships: (1) Layers rich in kerogen are present prior to the impact. (2) Mobilization of kerogen continued after the impact. (3) The first stage of brittle deformation occurs syngenetically with the dike formation (4) The second brittle deformation stage postdates the dike formation and can be genetically linked to displacements of the megablock during crater modification [3].

Acknowledgement: This work is funded by the German Science Foundation (DFG-grant KE732/8).

References: [1] Lüders et al. (2003) *LPS*, submitted. [2] Stöffler et al. 1988, In Boden, A; Eriksson, K.G (eds.) Deep drilling in Crystalline Bedrock.