INTERNAL SHEARING AND SUBSURFACE EROSION FROM THE CHICXULUB EJECTA BLANKET (ALBION FM.), QUINTANA ROO, MEXICO. F. Schönian[1], T. Kenkmann[1] and D. Stöffler[1], [1]Museum of Natural History, Humboldt-University of Berlin, Invalidenstr. 43, D-10115 Berlin, Germany, e-mail: frank.schoenian@museum.berlin.de.

Introduction: Processes leading to far-reaching ejecta outflows and ejecta blanket fluidization on planetary bodies with atmospheres and/or volatiles in the target (i.e. Venus, Mars, and Earth) are poorly understood because of the lack of field control. The Chicxulub ejecta blanket has been considered as a favourable study object for examining these processes because of its preservation by rapid post impact burial on a shallow marine platform. Ejecta material considered as part of the continuous ejecta blanket from the Chicxulub crater have first been described from Albion Island, Northern Belize, at a distance of 4 crater radii (354 km) from the proposed impact center [1,2]. In the Albion quarry the ejecta blanket is represented by a two-fold sequence of a basal spheroid bed, and the Albion diamictite, the ejecta blanket sensu stricto [1,2]. The Albion diamictite has been interpreted as a product of a secondary flow after ejecta curtain collapse and has been compared to fluidized ejecta blankets on Mars and Venus [2,3,4]. The flow has either been discussed of being a secondary turbulent/laminar debris flow [1] or a turbulent atmospheric flow produced by drag-induced ring vortices (ring vortex model, [2,5]). It is considered that most of the Albion Formation is composed of primary ejecta from Chicxulub [2] and 'ablated', polished and striated clasts are thought to represent high-altitude ballistic ejecta [6,7].

Chicxulub ejecta blanket in Quintana Roo: Detailed mapping revealed that west of the Laguna Bacalar / Rio Hondo fault zone the Chicxulub ejecta blanket is irregularly draping a karstified upper Cretaceous land surface, filling paleovalleys and overlying or surrounding hills of upper Cretaceous dolomites (Barton Creek / Sarabia Fm.). The ejecta blanket could be identified at localities within radial ranges of 295 to 365 km from the impact center. In the north (Caanlumil locality) the ejecta blanket is discordantly overlain by the Plio-Pleistocene Bacalar / Felipe Carillo Puerto Fm., whereas in the south it is overlain by the lower Tertiary (Eocene?) Estero Franco Fm. It is a very heterogeneous, chaotic carbonaceous breccia or diamictite with a high variability in particle roundness and shape, sorting, matrix composition, clast populations and internal structures. Its thickness is hardly to determine from the outcrops and is most likely highly variable as well. However, there are some general trends in composition and texture from north to south.

Northern study area. At the northern localities (295-300 km from the impact center) the matrix has a smaller carbonate content and contains less altered impact glasses (< 2%), components are less rounded and display only faint abrasion features. Only rarely larger boulders (> 50 cm) and no matrix-coated boulders were found. Irregular laminations are present, but no shear planes could be observed.

Central study area. In the central part (Chetumal area, 315-325 km from Chicxulub Pto.) the ejecta blanket is covering morphologically elevated upper Cretaceous dolomites (Campanian-Maastrichtian Sarabia Fm.), which are well exposed in the large Sarabia quarries. Carbonate content of the matrix rises significantly as well as the amount of altered impact glasses. Shear planes and shear breccias within the diamictite and at its base become abundant and the first large boulders of the upper Sarabia facies with sheared coatings can be observed. Clasts are more often abraded and some display facets and striations.

Southern study area. Farther south (Rio Hondo region, 330-350 km from the impact center) the upper Cretaceous paleorelief becomes more pronounced, in part with hills elevated above the ejecta blanket (Alvaro Obregon locality) and with paleovalleys filled with ejecta blanket material (Sacxán and Palmar localities). Matrix composition is usually dolomitic, but highly variable. Linear, curved and in part highly chaotic shear planes or zones, often connected with polished and slickensided surfaces, sheared ejecta material, clay rich shear breccias or comminuted matrix material, become a major sedimentological feature. Clasts extracted from such shear zones display strong surface abrasion and striations. Large boulders (up to 12 m) of the lower Sarabia facies become abundant, some with sheared or laminated coatings.

The internal sedimentological structures can best be studied near Sabidos, where close to the upper contact with the Tertiary a major subhorizontal primary and numerous secondary shear planes are present as well as normal bedding planes, slumps and structures related to turbulent flow.

Strong erosion and shearing at the base is evident at Palmar/Ramonal, where an unsheared spheroid rich basal ejecta layer is filling a paleovalley, which towards S becomes heavily sheared around an obstacle of highly recrystallized and brecciated Upper Cretaceous dolomites. The latter display an undulating paleorelief with evidence of erosion and displacement of topographic highs towards the S (brecciated and parautochthonous boulders).

Preliminary macroscopic observations on the clays enriched along shear planes or within shear breccias suggest that they are in part altered impact glasses and in part normal clays derived from erosion. Some shear breccias seem to consist mainly of altered impact glasses (melt), others are almost exclusively locally derived clays. In many cases a distinct layering between different types of shear breccias can be observed. Glasses were obviously still molten during emplacement as is evident from their shaped preferred orientation along shear zones.

A certain difficulty in studying the complex processes that acted during emplacement of the Albion diamictite are the poor outcrop quality due to strong tropical weathering and the scarcity of outcrops with respect to the large study area.

Conclusions: Field observations on sedimentological features of the Albion diamictite and their variability in a larger study area are leading to some new ideas regarding the processes that acted during final emplacement of the Chicxulub ejecta blanket on the southeastern Yucatán peninsula (c.f. [2,3]): The bulk ejecta material of the Albion diamictite moved as a ground-hugging flow of relatively high viscosity with transitions of laminar to turbulent flow and with strong frictional forces within and at the base of the flow. The flow regime and its variability was controlled by the pre-existing upper Cretaceous relief with stronger shearing above and around obstacles. The observations in Quintana Roo argue against atmospheric turbulences (ring vortices) and low viscosity (non-cohesive) debris flows as being responsible for the final ejecta emplacement.

The observed large run-out distance (> 4 crater radii from the impact center) following initial ballistic emplacement (c.f. [8]) might be explained by a decrease of viscosity due to the high amount of molten material and the incorporation of locally derived clays. Both might have acted as lubricants in highly mobile shear zones.

The less sheared succession at Albion Island was most likely deposited within a paleodepression. This is consistent with the preservation of the spheroid bed and paleocaliche on the top of the Barton Creek Fm. [1,2,9]. However, the results suggest that many of the features observed at Albion Island and attributed to primary ejecta processes [2] are related to secondary erosion and internal shearing. These features include: the dolomitic matrix, the large boulders and the matrix-coated boulders (interpreted as 'accretionary blocks' [2]) and the abraded, facetted, striated and pitted (?) clasts, thought to have been formed within the ejecta curtain [2,6,7]. Much of the ejecta blanket consists of material derived from erosion of the Cretaceous land surface. The two grain size populations observed at Albion Island [2] are probably the result of incorporation of locally eroded large boulders (2-8 m) within the flow.

The significance of erosion of local materials in the emplacement of the Albion Fm. suggests that over a wider area the Chicxulub ejecta blanket should display significant variations in composition reflecting the local Cretaceous bedrock lithologies. Polymict breccias with different lithological properties but similar internal structures are widely distributed over the Southern Yucatán Peninsula.

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