FACIES AND ICHNOFABRICS IN THE PALEOCENE OF CHICXULUB: A RECORD OF THE RECOVERY OF LIFE POST-IMPACT. M.T. Whalen[1], K.O'Malley[1], F.J. Rodríguez-Tovar[1], J.V. Morgan[3], S. Gulick[4], C.L. Mellett[5], and Expedition 364 Scientists [1]Department of Geoscience, University of Alaska Fairbanks, Fairbanks, AK 99775 (mtwhalen@alaska.edu), [2]Departamento de Estratigrafía y Paleontología, Facultad de Ciencias, Universidad de Granada, Granada 18002, Spain (fjrtovar@ugr.es), [3]Department of Earth Science and Engineering, Imperial College London, SW7 2AZ, UK (j.v.morgan@imperial.ac.uk), [4]Institute for Geophysics, Jackson School of Geosciences, University of Texas at Austin, TX 78758-4445, USA (sean@ig.utexas.edu), [5]British Geological Survey, The Lyell Centre, Research Avenue South, Edinburgh, EH14 4AP, UK (cmell@bgs.as.uk)

Introduction: IODP/ICDP Expedition 364 recovered core from 505.7-1334.7 m below the seafloor (mbsf) at Site M0077A (21.45° N, 89.95° W) atop the peak ring in the Chicxulub impact structure. The core penetrated Paleogene sedimentary rocks, impact-related suevite, melt rock, and granitic basement [1]. Approximately 110 m of post-impact, hemipelagic and pelagic sedimentary rocks were recovered, ranging from middle Eocene (Ypresian) to basal Paleocene (Danian) in age [1]. The transition between suevite and basal Paleocene sedimentary rocks is a remarkable succession of fining upward gravel to sand-sized suevite (Unit 2A) overlain by laminated carbonate-rich siltstone (Unit 1G, "impact boundary cocktail" [2]) that records the settling of fine-grained material post-impact [1]. This study concentrates on the carbonate-rich Paleocene sedimentary rocks of overlying Unit 1F [1]. The degree of bioturbation, or ichnofabric index (II) [3, 4], provides a semiquantitative estimate of the density of burrowing within sedminentary facies. Collection of II data within the context of facies analysis thus yields insight into the initial and then continued disturbance of sediment by burrowing organisms recording the return of life to the crater (Fig. 1).

Unit 1G: The unit extends from 616.58-617.33 mbsf (Fig. 1) and consists mainly of dark brown to dark grayish brown calcareous siltstone but is complex with several different lithologies and post-depositional pyrite nodules that disrupt bedding. The base of the unit is a sharp, stylolitized contact overlain by two ~1 cm thick, normally graded beds. Overlying, up to 617.17 mbsf, the siltstone contains internally finely laminated cm-scale beds that alternate between dark brown and grayish brown. Above, up to 616.97 mbsf is a package with mm bedded couplets of dark brown and grayish brown calcareous siltstone that grade upward into similarly colored cm bedded couplets that then thin upward into mm bedded couplets again. Above this interval bedding is indistinct and appears to be obscured by soft sediment deformation from 616.66-616.97 mbsf. The upper part of the unit is slightly deformed with greenish marlstone and interbedded lighter gray siltstone displaying a distinct downwarp from 616.58-616.66 mbsf. Rare oval structures, that are potential individual burrows, occur down to 616.65 mbsf.

Unit 1F: The unit records the remainder of the Paleocene and extends from 607.27-616.58 mbsf (Fig. 1). The base of the unit is a sharp contact at the base of a greenish claystone (II 2) that overlies Unit 1G [1]. It consists dominantly of interbedded light gray to light bluish gray wackestone and packstone (II 3-5) and light to dark bluish gray marlstone (II 2) at cm-dm-scale. All lithologies contain wispy stylolites. The lower portion of the unit (616.58 and 607.74) is cyclic with cm-dm-scale bedding and light greenish-blue to bluish marlstone bases (II 2-3) that grade upward into light gray or light bluish gray wackestone and packstone (II 3-5). Contacts between lithologies are usually gradational due to burrowing. The upper portion of the unit from 610.25 to 607.74 mbsf is a light yellowish brown burrowed packstone (II 4) intercalated with gray marlstone (II 2). The uppermost 7.5 cm is calcite cemented with 1 cm wide burrows (II 3-4). Clasts are fine to coarse sand size and include foraminifera. The upper surface of this unit is a hardground and minor unconformity overlain by Eocene rocks [1].

Ichnofabric Index: II data provides a window onto the return of life post-impact (Fig. 1). Rare structures in the upper most sandy suevite (Unit 2A) and in Unit 1G (Core 40R-1) resemble bioturbation structures but may also represent fluid escape [1]. The first well-defined oval structures that appear to be burrows occur in the upper part of Unit 1G (Fig. 1, 616.58-616.65 mbsf). Unequivocal burrows (II 2) that disturb sedimentary facies occur just above, at 616.56 mbsf in Unit 1F (Fig. 1). II of 3-4 are reached 5-6 cm above indicating significant disruption of original sedimentary strutures. An II of 5 is first documented at 616.16 mbsf (Fig. 1). Above this level through the Paleocene succession II largely varies between 2 and 5 with rare laminated intervals (II 1). Bioturbation intensity correlates well with facies changes and more marly facies display lower levels of bioturbation than more carbonate-rich facies. This correlation implies a depth and/or paleoredox control on the distribution of bioturbating organisms.

Discussion: II and the return of life: The II data indicate that burrowing organisms were likely re-established in the crater before the end of deposition of Unit 1G. Biostratigraphic analyses document a mix of Late Cretaceous and earliest Danian taxa within Unit

1G and lowermost Danian zone P**α** documented in the lowermost part of Unit 1F down to 616.58 mbsf [1]. P1a taxa occur down to 616.29 mbsf with P1b-P4 recorded upward through 607.27 m [1]. Burrowing organisims were thus active by earliest Danian indicating a rapid return of life to the crater. Hydrocode modeling implies that much of the deformation and peak ring formation was completed within minutes of the impact [5]. Deposition and reworking of impact breccia by tsunami and seiches likely extended for several days [6]. More refined estimates for the return of life to the crater may be possible with more detailed analysis of the deposition of laminae within Unit 1G that records marine settling of fine-grained material that may have taken days to months.

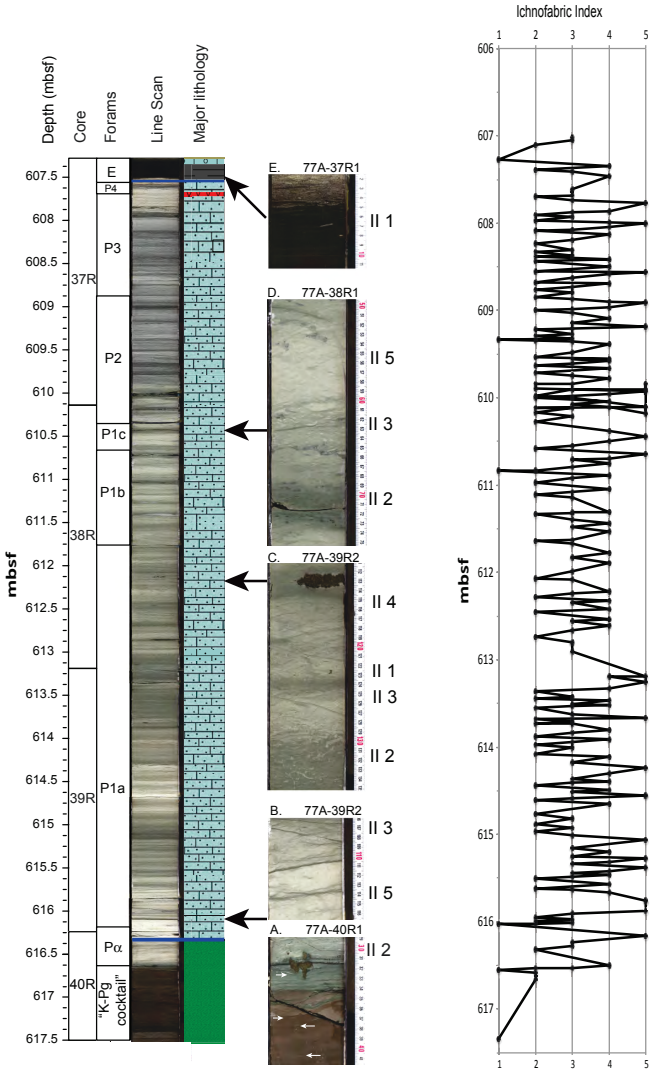

Figure 1. Stratigraphy of the Paleocene of Core M0077A with photos illustrating various ichnofabrics and a plot of ichnofabric index.

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Acknowledgements: The Chicxulub drilling expedition was funded by the International Ocean Discovery Program as Expedition 364 with co-funding from the International Continental scientific Drilling Program. The European Consortium for Ocean Research Drilling implemented Expedition 364, with contributions and logistical support from the Yucatán state government and Universidad Nacional Autónoma de México. Additional support provided by the US National Science Foundation.

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