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Chicxulub revealed with new Seismic and Gravity Data

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Experiment: In early 2005 we acquired a new high-resolution grid of seismic and gravity data across the Chicxulub impact crater. These data include ∼1500 km of reflection profile, ∼36500 airgun shots that were recorded on 28 ocean bottom seismometers and 87 land seismometers, and ∼7600 km of gravity data. Some targets of the experiment are: to map the extent and asymmetry of the slumped Cretaceous blocks around the crater, to determine the extent of the anomalous low velocity zone beneath the peak ring, to map the extent and shape of the stratigraphic uplift, to investigate changes in ejecta thickness around the crater, and to collect site survey data for two proposed IODP drill holes.

Background: Chicxulub is a unique natural laboratory and assumes a crucial role in providing information on the cratering process and the global effect of a large-scale impact event. However, the crater is buried ∼1 km beneath the Earth's surface, and thus the only way to map this crater is through geophysical investigations and drilling. After initial disagreement about the size of the crater, a 1996 seismic survey led to a consensus that Chicxulub was 180-200 km in diameter. In 2002 Chicxulub was drilled onshore at Yaxcopoil-1 under the ICDP. Although outer crater structure is now reasonably well constrained, current lithological and structural models of the central crater remain diverse. This diversity is partly due to the inherent ambiguity of interpretations of geophysical data, and partly because there are no deep drill holes that can ground-truth our models. We will use our new seismic and gravity data to produce a more accurate model of the crater; the accuracy of which will be greatly improved with a new deep drill hole in the center of the crater.

Results and future work: We present new tomographic velocity data across the peak ring, and new marine gravity data. To-date we have high resolution seismic reflection data only offshore, and drill holes only onshore – hindering past efforts to map crater structure from offshore to onshore. The new gravity data shows the offshore rings more clearly, and the new reflection data allows us to determine the relationship between structures identified on the reflection data and their velocity, gravity and magnetic signature. Hence, for the first time, we can confidently map features from onshore to offshore. We see a clear relationship between the innermost slump block and the gravity data, and the peak ring and the potential field data. A proposal exists to drill through the entire melt sheet and/or peak ring, and is a possible joint venture between ICDP and IODP. Some aims of these holes are to characterize the melt rocks within the central basin, determine the total volume of melt, and to test competing models for peak-ring formation.

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