

## Expedition Co-Chief Scientists

### Professor Sean Gulick

Sean Gulick has been at The University of Texas at Austin since he completed his post-doctoral fellowship in 2011. He was Co-chief Scientist on a 2005 seismic study of Chicxulub and received the Jackson School Outstanding Researcher Award in 2014. Current projects include tectonic and climate interactions in the St. Elias Mountains and Surveyor submarine fan, geohazards and margin evolution of subduction and transform faulting in Alaska, Sumatra, and Japan, and the geologic processes and environmental effects of the Cretaceous-Paleogene Chicxulub meteor impact. Gulick served as Co-chief Scientist on the Integrated Ocean Drilling Program (IODP) Expedition 341 Southern Alaska Margin.



### Professor Joanna Morgan

Joanna Morgan is a Professor of Geophysics at Imperial College London. She first became involved with Chicxulub when she co-led a seismic experiment across this impact structure in 1996 to map crater size and structure. Subsequently, she has been involved in the onshore drilling of Chicxulub, and running simulations of ejecta travelling around the globe, including its potential to ignite surface fires. She is part of the full-waveform inversion group at Imperial who have developed a high-resolution imaging technique for the petroleum industry to improve images across reservoirs. Joanna has used this novel technology to obtain fine-scale images of the peak ring at Chicxulub, mid-ocean ridges and subduction zones, and is currently working on imaging magma storage beneath the Santorini volcano.



### Expedition Operator

Mission-specific platform operations are conducted for IODP by the European Consortium for Ocean Research Drilling (ECORD), which represents the ocean-drilling efforts of 16 European countries, plus Canada and Israel. Operations are undertaken by the ECORD Science Operator comprising the British Geological Survey (BGS), the University of Bremen and the European Petrophysics Consortium comprising the universities of Leicester, UK, Montpellier, France, and Aachen, Germany.



During the expedition regular updates are posted on the expedition webpage at:

[www.eso.ecord.org/expeditions/364/364.php](http://www.eso.ecord.org/expeditions/364/364.php)

### International Ocean Discovery Program

The International Ocean Discovery Program (IODP) is an international marine research programme supported by 26 countries, which explores Earth's history and structure recorded in seafloor sediments and rocks, and monitors sub-seafloor environments. Through multiple platforms - a feature unique to IODP - scientists sample the deep biosphere and sub-seafloor ocean, environmental change, processes and effects, and solid earth cycles and dynamics.

### International Continental Scientific Drilling Program

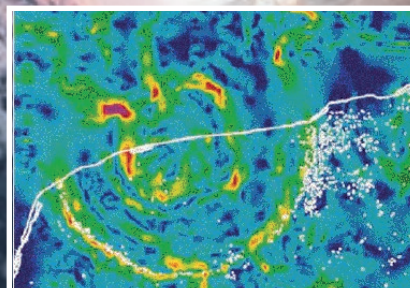
The International Continental Scientific Drilling Program (ICDP) is the international platform for scientific research drilling in terrestrial environments to explore the workings of planet Earth and gaining insights into environmental change, natural hazards, natural resources, and the deep biosphere. ICDP was founded in 1993 by USA, Germany, and China and is financed through the annual contributions of its 24 members. ICDP brings together scientists and stakeholders from 23 countries and the UNESCO, which serves as a Corporate Affiliate to work together at the highest scientific and technical level. More than 30 drilling projects and 75 planning workshops have been supported to date by ICDP.

**Credits:** front cover, Astro-Virginia.edu; inserts: top, Chicxulub Bouguer anomaly map (Hildebrand et al, 1995). Inside, map and logo: ECORD Science Operator (ESO).



**IODP**  
INTERNATIONAL OCEAN  
DISCOVERY PROGRAM

## The Chicxulub K-Pg Impact Crater Expedition



*Uncovering evidence of  
mass extinction*

**IODP Expedition 364**



[www.iodp.org](http://www.iodp.org)  
[www.ecord.org](http://www.ecord.org)  
[www.icdp-online.org](http://www.icdp-online.org)



The **Chicxulub impact structure**, Mexico, was formed when a large asteroid hit the Earth around 66 million years ago. The impact is linked to the end-Cretaceous mass extinction, and is widely renowned due its association with the demise of the dinosaurs. Chicxulub is the best-

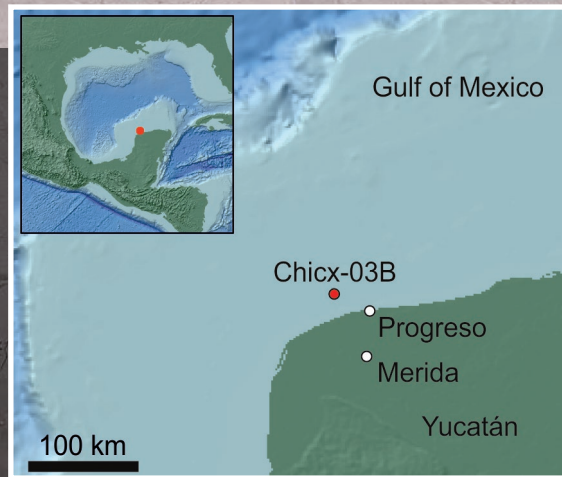
preserved large impact crater on Earth, and the only one with an intact, topographic peak ring - a ring of hills that stand above the otherwise flat crater floor.

Peak rings are a common feature of large craters on rocky bodies, but there is no consensus on their formation. Expedition 364 will drill into the peak ring to understand how hypervelocity impacts temporarily change rock behaviour in a way that allows them to flow large distances and form features such as peak rings.

The hypothesis that impacts may be beneficial to some life will also be investigated, with the idea that they could have sustained biospheres in the early Earth. Also of interest is how ocean life recovered after this impact, and what changes occurred across the Paleocene-Eocene Thermal Maximum (PETM).

The team will specifically address questions on these three themes:

- **Peak-ring formation:** What is the nature of the rocks that form a peak ring? Are they from the upper, mid or lower crust? Why do they have such a low density and seismic velocity? What are the kinematics and dynamics of peak-ring formation? What rock-weakening mechanism controls large crater formation?
- **Habitability:** Was there intense hydrothermal activity in the rocks that form the peak ring and how long did it last? What microbiological life colonised the peak ring, was it diverse and/or exotic, and was it shaped by the post-impact hydrothermal system?
- **Recovery of life:** After the impact, how long did it take for the ocean to return to normal conditions? Did diversity gradually recover, or



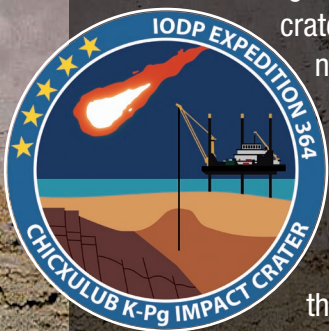
did the whole assemblage return simultaneously once the environment stabilised? What is the relationship between the survivors of the K-Pg event and newly evolved taxa, and the mass survival at the PETM 10 million years after?

The expedition will last for two months and involve penetrating beneath the seabed from an offshore platform. The core will be the first complete sample of the rock layers from near the crater's centre.

Thirty scientists from the USA, Mexico, Japan, Australia, Canada, China and six European countries, will participate in the expedition Science Party, which is planned and conducted by the European Consortium for Ocean Research Drilling (ECORD) as part of the International Ocean Discovery Program (IODP). The expedition is also supported by the International Continental Scientific Drilling Programme (ICDP).

As only a minimum number of measurements will be carried out on the cores while at sea, only thirteen members of the science team will participate offshore. The entire team will meet for an onshore phase (the 'Onshore Science Party') at the IODP Bremen Core Repository and MARUM laboratories in Germany later in 2016. Here, the core will be split in two and one half will be immediately analysed by the team of scientists. The

other half will be saved at a core repository at Texas A&M University for future research needs by the international community. The initial results of the expedition will be published in peer-reviewed journals and in the ICDP-IODP Program Journal *Scientific Drilling* and other peer-reviewed journals. After a period of one year, the cores may be used by any scientific researcher who wishes to study them for new research.



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