the risk that adult bears will come into contact with humans, including livestock owners and hunters seeking elk, he says. For young bears, it may increase the frequency of potentially deadly interactions with aggressive adult male bears and wolves.

Critics also argue that the government is basing its decisions on flawed population estimates. A study published last July suggests that the government's figure of 741 bears is inflated (D. F. Doak and K. Cutler *Conserv. Lett.* http://doi.org/q3d; 2013). The number of survey flights used to count bears has tripled since the mid-1990s, but, the study argues, the model used to extrapolate population figures from the flights' tallies does not account for increased observation time. Further distortion may arise because the model assumes that female bears will reproduce consistently throughout their 30-year lives, with no decrease in fertility as they age.

Mattson says that population estimates have in the past jumped by more than 100 bears when the statistical method has shifted. "There is no clean and simple way to estimate the size and trend of the Yellowstone population," he says.

But those criticisms are rejected by Frank van Manen, a wildlife biologist with the US Geological Survey in Bozeman, Montana, who led the diet study. Observation time has increased, he says, but so has the grizzly bears' range (see 'Home on the range'), which cancels out any observer bias from increased search hours. And although the government's official estimate of the population did jump from 629 to 741 bears this year, van Manen says that the new number is better. That is in part because the revision takes into account a 2011 demographic study of bear survival rates based on radio-collar tracking data — the first such study since 2002 — that gives biologists more confidence in their population surveys.

Servheen says that if the government were to decide to pursue delisting, as many expect, the decision would not be announced until late spring at the earliest. At that point, the Fish and Wildlife Service would open a 60-day public-comment period to seek reaction.

But even that is unlikely to be the last word on the grizzlies: conservation groups are already gearing up to sue. Perhaps the only point on which the US government and its opponents agree is that there will be more legal wrangling over the Yellowstone bears' future. "It's sad that it's come to this," says Servheen. "What it should be is a celebration." ■

EARTH SCIENCE

Sea drilling project launches

International expedition hopes to unravel mysteries of the South China Sea, one of the world's most geologically important seas.

BY JANE QIU

The South China Sea is well known for its geopolitical tensions, but less is known about its many geological stresses and strains. That is set to change.

On 28 January, an international team of scientists — from countries including China, the Philippines, India and the United States — is due to set sail from Hong Kong on board the research vessel *JOIDES Resolution*, marking the first expedition of the International Ocean Discovery Program (IODP), formerly known as the Integrated Ocean Drilling Program. Its aim is to determine the age of the South China Sea, and to resolve ongoing controversy over how it formed.

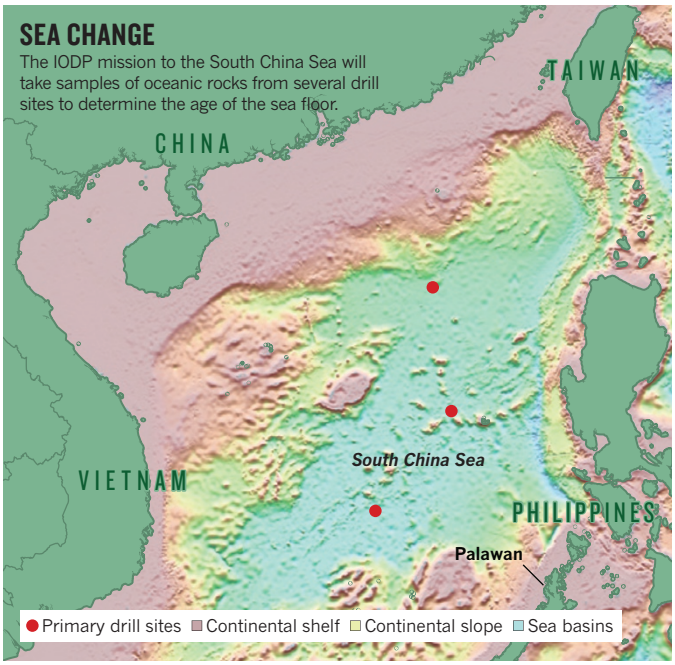
With an area of more than 3 million square kilometres and thousands of islands and reefs, the sea occupies a scientifically interesting position between the world's highest mountains, the Himalayas, and the deepest point on Earth's surface, the Mariana Trench in the western Pacific Ocean.

It is "a natural laboratory for studying continent break-ups and sedimentary-basin formation", says Dieter Franke, a geologist at the Federal Institute for Geosciences and Natural Resources in Hannover, Germany, who is not involved in the expedition. The sea's relatively small size and young age (between 25 million and 42 million years old) compared with major ocean basins (the Pacific plate can be traced back at least 200 million years) mean that it is possible to probe its entire history through just a couple of IODP expeditions, Franke says.

Little is known about the formation of the South China Sea. The crust beneath it was created after a part of Eurasia that once stood in its place began to stretch in a north–south direction. As the stretching continued, the continent became progressively thinner. At some point it broke apart, releasing magma that solidified and moved away from the eruption sites — a process called sea-floor spreading. The land mass drifted south, breaking into pieces and giving rise to islands such as Palawan in the Philippines and Borneo.

But for decades, geologists have been debating what triggered the continent to stretch and break up in the first place. Among the ideas proposed are that it was caused by the collision between Eurasia and the Indian subcontinent; that the continent buckled as an ancient oceanic plate slid beneath present-day southern China; or that the Pacific plate pulled away from the the Eurasian coast.

"The hypotheses are based only on circumstantial evidence," says Jian Lin, a marine geophysicist at the Woods Hole Oceanographic Institution in Massachusetts and co-chief scientist on the drilling project. "Much of the controversy stems from different estimates of how old the sea floor is." Until recently, scientists have had to make age estimates by towing



SEA CHANGE
The IODP mission to the South China Sea will take samples of oceanic rocks from several drill sites to determine the age of the sea floor.

CHUN-FENG LI

PER-ANDRE HOFFMANN/PICTURE PRESS/ALAMY

The break-up of Eurasia tens of millions of years ago led to the formation of islands such as Palawan.

a device called a magnetometer along the sea surface. Oceanic rocks capture the direction of Earth's magnetic field at the time they formed, and this information can be used to date them.

But "there are different ways to interpret the data, and the results can vary wildly", says Paul Tapponnier, a geologist at Nanyang Technological University in Singapore, who is not involved in the trip. The sea-floor spreading of the south-west sub-basin, for instance, is thought to have begun between 25 million and 42 million years ago, and to have ended between 16 million and 35 million years ago. "The only way to resolve the controversy is to measure the age of the ocean crust directly," he says.

Over the next two months, the team will drill up to 2 kilometres into the seabed to collect rock samples (see 'Sea change'). Geochemical and geophysical analyses will then allow the researchers to determine the rocks' ages and characteristics. These should yield clues to their origins. By drilling at different sites, the scientists should be able to tell precisely when the sea floor started to spread and when the process ended.

"This is a fundamental question that needs to be addressed before we could even begin to piece the puzzle together," says Chun-Feng Li, a marine geophysicist at Tongji University in Shanghai, China, and the other co-chief scientist on the project. Once the precise age of the sea floor is known, researchers will be able to make correlations with the timing of other events associated with the creation of the South China Sea, such as the retreat of the Palaeo-Pacific plate. Identifying the origin of the rocks will also help to pinpoint which of the continental break-up hypotheses is the most likely.

The expedition "will be just the first step towards a comprehensive understanding of how the South China Sea and other marginal seas opened", says Li. A plan for a follow-up project to investigate the rifting process in more detail has already been submitted to the IODP.

The importance of unravelling the geological history of the South China Sea "goes beyond academic curiosity", says Franke. Oil and gas normally accumulate at the continental margins at which rifting takes place, and a better understanding of when and how the basins formed will help to locate new reserves, he says. It could also facilitate earthquake research of the Manila Trench in the Pacific Ocean, says Alyssa Peleo-Alampay, a marine geologist at the University of the Philippines Diliman in Quezon City and a project member. The trench came into being as the oceanic crust of the South China Sea began to sink beneath the Philippine Sea plate — a process that continues today and causes frequent quakes. "A proper understanding of the South China Sea is long overdue," she says. ■

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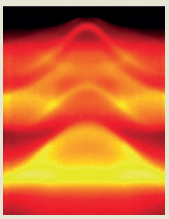

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