Forecasting earthquake forces

STONY Brook University researchers have devised a numerical model to help explain the linkage between earthquakes and the powerful forces that cause them, according to a research paper scheduled to be published in the journal Science on Feb. 17. Their findings hold implications for long-term forecasting of earthquakes

William E. Holt, Ph.D., a professor in the Geosciences Department at Stony Brook University, and Attreyee Ghosh, Ph.D., a post doctoral associate, used their model to help explain the stresses that act on Earth's tectonic plates. Those stresses result in earthquakes not only at the boundaries between tectonic plates, where most earthquakes occur, but also in the plate interiors, where the forces are less understood, according to their paper, "Plate Motions and Stresses from Global Dynamic Models."

"If you take into account the effects of topography and all density variations within the plates -- the Earth's crust varies in thickness depending on where you are -- if you take all that into account, together with the mantle convection system, you can do a good job explaining what is going on at the surface," said Dr. Holt.

Their research focused on the system of plates that float on Earth's fluid-like mantle, which acts as a convection system on geologic time scales, carrying them and the continents that rest upon them. These plates bump and grind past one another, diverge from one another, or collide or sink (subduct) along the plate boundary zones of the world. Collisions between the continents have produced spectacular mountain ranges and powerful earthquakes. But the constant stress to which the plates are subjected also results in earthquakes within the interior of those plates.

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"Predicting plate motions correctly, along with stresses within the plates, has been a challenge for global dynamic models," the researchers wrote. "Accurate predictions of these is vitally important for understanding the forces responsible for the movement of plates, mountain building, rifting of continents, and strain accumulation released in earthquakes."

Data for their global computer model came from Global Positioning System (GPS) measurements, which track the movements of Earth's crust within the deforming plate boundary zones; measurements on the orientation of Earth's stress field gleaned from earthquake faults; and a network of global seismometers that provided a picture of Earth's interior density variations. They compared output from their model with these measurements from Earth's surface.

"These observations -- GPS, faults -- allow one to test the completeness of the model," Dr. Holt said.

Drs. Ghosh and Holt found that plate tectonics is an integrated system, driven by density variations found between the surface of Earth all the way to Earth's core-mantle boundary. A surprising find was the variation in influence between relatively shallow features (topography and crustal thickness variations) and deeper large-scale mantle flow patterns that assist and, in some places, resist plate motions. Ghosh and Holt also found that it is the large-scale mantle flow patterns, set up by the long history of sinking plates, that are important for influencing the stresses within, and motions of, the plates.

Topography also has a major influence on the plate tectonic system, the researchers found. That result suggests a powerful feedback between the forces that make the topography and the 'push-back' on the system exerted by the topography, they explained.

While their model cannot accurately predict when and where earthquakes will occur in the short-term, "it can help at better understanding or forecasting earthquakes over longer time spans," Dr. Holt said. "Nobody can yet predict, but ultimately given a better understanding of the forces within the system, one can develop better forecast models."

Source: Science Daily

POLLENS OF PAST

Gardens of Judah bloom

An aerial view of the Ramat Rahel site, where the gardens were discovered.

AN ancient royal garden has come back into bloom in a way, as scientists have reconstructed what it would've looked like some 2,500 years ago in the kingdom of the biblical Judah.

Their reconstruction, which relied on analyses of excavated pollen, reveals a paradise of exotic plants.

The luxurious garden had been discovered at Ramat Rahel, an archaeological site located high above the modern city of Jerusalem, about midway between the Old City of Jerusalem and Bethlehem. This site was inhabited since the last century of the Kingdom of Judah (seventh century B.C.) until the early Muslim reign in Palestine (10th century), a period that saw many wars and exchanges of power, with the garden evolving under each civilization.

Since excavators discovered the garden, they could only imagine its leafy, flowery inhabitants. That is until now.

The garden relied on an advanced irrigation system, which collected rainwater and distributed it using artsy water installations, including pools, underground channels, tunnels and gutters.

These water installations ended up being the key to the team's new discovery; the researchers found grains of pollen that likely got trapped in plaster when the installations were renovated and the plaster still wet. The result was preserved pollen grains.

In samples dating back to the Persian period (between the fifth and sixth centuries B.C.), the team found grains from local fruit trees, ornamentals and imported trees from distant lands.

"This is a very unique pollen assemblage," study researcher Dafna Langgut, a pollen expert at Tel Aviv University, said in a statement.

For instance, they found evidence of willow and poplar trees, which would have required irrigation to survive in the garden. They also found pollen associated with ornamentals, such as myrtle and water lilies; native fruit trees, including grape vine, common fig and olive; and imported citron, Persian walnut, cedar of Lebanon and birch trees. The researchers think the ruling Persian authorities likely imported these exotics from remote parts of the empire to flaunt their power.

Source: Live Science

GOING NATURAL

Nepal's biogas success

Nepal will expand its successful biogas programme.

NEPAL is looking to scale up its flagship household biogas programme, which has made forays into other developing countries in Asia and Africa.

Initiated in 1992 with support from the Netherlands Development Organisation (SNV), Nepal has installed over 240,000 household biogas plants with a thermal energy capacity of 444 megawatts and greenhouse gas savings of 367,409 tonnes of carbon dioxide equivalent per year.

Biogas plants break down biodegradable matter to produce mainly methane. In Nepal, they are fed with cow dung and human waste and the output burned in cooking stoves, while the solid residue is used as farm fertiliser.

Nepal country director for SNV, Rem Neefjes, attributes the success of the programme to simple, uniform biogas technology and coordination among government, private sector and microfinance institutions.

Nepal's model has been replicated in various Asian countries, including Cambodia, Vietnam, Laos, Bhutan, Pakistan, Bangladesh and Indonesia, according to Khagendra Nath Khanal, assistant director at the Biogas Sector Partnership (BSP-Nepal).

"We are the second largest power generator in Nepal after hydropower," said Khanal.

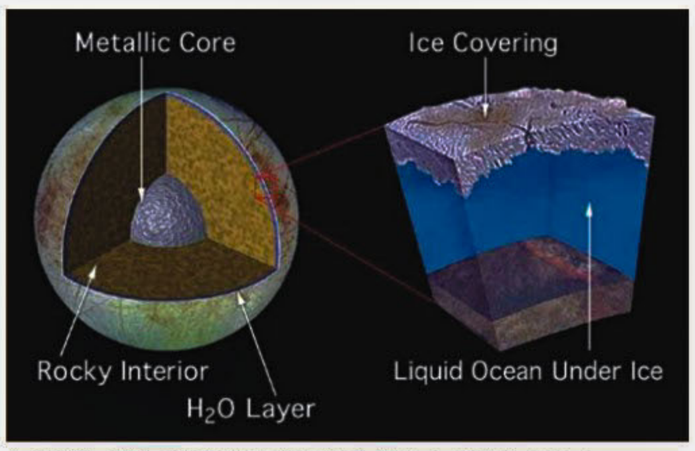
Several African countries are benefiting from Nepal's experience, said Paul Hassing, senior advisor of the African initiative, Biogas for Better Life. "In terms of the level of marketing of the biogas sector, it is fair to say that Nepal is still some 10 years ahead of developments in certain African countries," Hassing said.

SOURCE: SCIDEV.NET

ET HOPE

Possibility of life on Europa

OBAIDUR RAHMAN



A model of Europa's interior, including a global ocean.

SCIENTISTS are strongly speculating (backed by the 1995 Galileo Spacecraft mission's findings) that Europa, the smallest of the four Galilean satellites and the 6th closest moon of the planet Jupiter house a liquid ocean underneath its solid icy crust. That cosmic mission discovered that underneath the icy crust of Europa, lies salty ocean which is kept warm by tidally generated heat and volcanic activities. It is believed that the biggest of Europa's craters are surrounded by concentric rings and these rings are likely to be filled with ice. And there is a possibility that this outer crust of ice is approximately 100km thick where only the top 10km are frozen solid which ushers the great possibility of the existence of a global ocean in a liquid form and at least 62 miles deep beneath these icy crust. And chances are, wherever there is water, there will be life. But what kind of life it would be in Europa that is a matter of great research. But some ideas are already there.

Since Europa's ocean lies quite a few miles beneath the icy crust, it is perceived that the way oxygen influences our existence here on Earth, is perhaps not the case with Europa due to liquid water's separation from atmospheric oxygen by several miles of chilling ice. But it has been proved that without oxygen, life could conceivably exist at hot springs deep in the ocean floor. Life in Europa could exist in its under-ice ocean, perhaps in a similar fashion to that of Earth's deep-ocean hydrothermal vents or the Antarctic Lake Vostok, the largest of more that 140 sub-glacial lakes found under the surface of Antarctica. Up until 1970's, it was believed that Sun was absolutely essential for the existence of life. But in 1977, during a deep-sea exploration in the Galapagos Rift, scientists discovered flocks of giant tube worms, clams, crustaceans, mussels, and other various creatures gathered around undersea volcanic features known as black smokers and these aquatic creatures were found to have thrived despite having no access to sunlight, depending on an entirely independent food chain! Instead of usual plants, it was found that these unique species depended on a form of bacterium that itself gains its energy from oxidization of reactive chemicals, such as hydrogen o hydrogen sulfide, that bubbled up from the Earth's interior. And all of these provide a great deal of idea regarding how life could survive in Europa's ocean. If life can thrive here on Earth, without the aid of sunlight and in harshest of environments, then why not in Europa?

According to experts, life on Europa could exist clustered around hydrothermal vents on the ocean floor, or below the ocean floor, where endoliths (an organism, e.g. lichen, alga or amoeba that lives inside rock, coral, animal shells or in the pores between mineral grains of a rock) are known to inhabit on Earth. Alternatively, it could exist clinging to the lower surface of the moon's ice layer, much like algae and bacteria in Earth's Polar Regions, or float freely in Europa's ocean. On the other hand, if Europa's ocean were too cold, biological processes similar to those known here on Earth, perhaps won't take place. Volcanic activity provides some of the heat necessary to keep the water on Europa from freezing and provides key dissolved chemicals required by the living organisms. If the water is too salty, only extreme halophiles (organisms that thrive in environments with very high concentrations of salt) could survive in its environment.

CO2 THE CULPRIT

Marine ecosystems threatened

IF carbon dioxide emissions don't begin to decline soon, the complex fabric of marine ecosystems will begin fraying and eventually unravel completely, two new studies conclude.

The diversity of ocean species thins and any survivors' health declines as the pH of ocean water falls in response to rising carbon dioxide levels, scientists from England and Florida reported February 18 at the annual meeting of the American Association for the Advancement of Science. What's more, affected species aren't restricted to those with shells and calcified support structures features particularly vulnerable to erosion by corrosive seawater.

Jason Hall-Spencer of the University of Plymouth, England, and his colleagues have been collecting data from marine sites off Italy, Baja California and Papua New Guinea, where high concentrations of carbon dioxide percolate out of the seabed from volcanic activity below. Directly above these CO2 seeps, pH plummets to at least 7.8, a value that is expected to occur widely by 2100 and which is substantially lower than the normal level for the area, 8.1. These sites offer a preview of what may happen to seafloor ecosystems as CO2 levels continue to rise, causing ocean water pH to drop.

Compared with nearby normal-pH sites, species richness in low-pH zones was diminished by 30 percent, Hall-Spencer reported. "Coral and some algae are gone. And the sea urchins are gone," he said. Fish may be present, but unlike in areas with a normal pH, they won't deposit their eggs there.

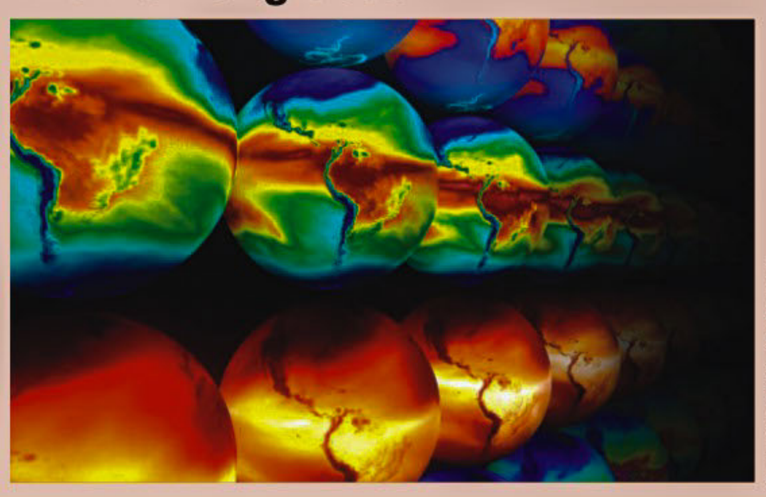
Although seagrasses appear to survive just fine in the low-pH seawater, close inspection showed that fish had nibbled the fronds, Hall-Spencer found. He identified one likely explanation: At low pH, these grasses no longer produced the phenolic defense compounds that typically deter munching by grazing animals.

Source: Science News

CO2 bubbling up from seafloor seeps lowers the pH and species diversity in surrounding areas.

WATER WORLDS

The wall of globes



Where in the world is all the water vapor? It may be hard to tell at first glance, but this wall of globes represents a simulation of monthly averaged distribution of total column water vapor on the planet. Such simulations are important, because understanding the distribution of water vapor on Earth is critical for understanding our planet's climate.

Source: Live Science

DID YOU KNOW?

What does lightning do to the atmosphere?

There are lightning strikes somewhere on earth 100 times a second. And every time lightning strikes, it generates Ozone gas. This strengthens the Ozone Layer in the upper atmosphere you know, the one with the big hole that heightens our need for sunscreen.

A cloud to ground bolt of lightning carries between 100 million and 1 billion volts. It can reach 50,000 degrees Fahrenheit 3-4 times hotter than the surface of the sun!