Unlocking Deep Secrets of Earth

Dialogue

By LONG Yun & CAO Xiuying

Imagine peering into Earth as if it were a patient undergoing a CT scan. That's essentially what Danish geophysicist Hans Thybo does, except that instead of X-rays, he uses seismic waves and other advanced imaging techniques to explore the planet's deep secrets.

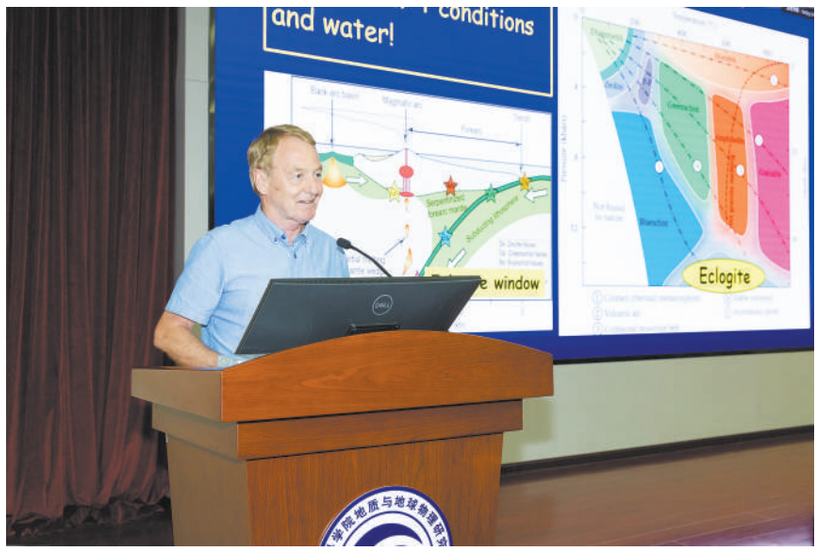
As a full-time distinguished professor at the Chinese Academy of Geological Sciences (CAGS) and a member of both the Danish Royal Academy of Sciences and the European Academy of Sciences, Thybo has made groundbreaking contributions to our understanding of Earth's structure. He discovered the mid-lithospheric discontinuity and was the first to identify deep structures linked to over 1.5 billion years of plate tectonics. With more than 60 international projects under his belt and a long-standing collaboration with Chinese scientists, Thybo's work spans continents and minds.

A curious mind's journey

Thybo's scientific journey began in the classroom of a passionate natural history teacher who taught him how to observe nature closely. Yet, despite his early interest in biology and geology, he initially pursued mathematics and physics, acquiring a PhD in theoretical seismology. It wasn't until his postdoctoral research that he applied this theoretical knowledge to image Earth's crust and lithosphere, which he calls "the wonders of tectonics."

"I've made a long journey regarding scientific interest," he says reflectively. "My experience tells me that science improves when we maintain a broad overview while mastering technical skills."

To many, studying Earth's interior might seem abstract or even fantastical.



Professor Hans Thybo. (COURTESY PHOTO)

But Thybo emphasizes its "profound societal importance": "All geoscience ultimately has importance for society." His imaging techniques are not just academic exercises. They are tools used to locate natural resources, understand earthquake mechanisms, and reduce the risks of volcanic eruptions.

"Imaging fault planes helps us understand earthquakes," he explains. "And the same methods used to study one geological phenomenon often lead to insights into another. That's the beauty of science, it connects everything."

Power of international collaboration

Having initiated over 60 large-scale international projects, Thybo is a great collaborator. His secret? Ask the right questions and find the right people.

"Geological processes don't stop at national borders," he says. "International collaboration is essential." For him, successful global projects hinge on creating a shared identity among the team members. "When collaborators feel they belong to one large team with a common goal, they can overcome any challenge."

His latest endeavor, EarthProbe (formerly known as Earth CT), embodies this collaborative spirit. Initiated in 2017 and inspired by China's SinoProbe program, EarthProbe aims to bring together scientists from every continent to address major geoscientific questions through integrated geophysical, geological, and geochemical studies.

"The pandemic was frustrating. We couldn't meet in person," he admits. "But it gave us time to rethink and plan better." Now, EarthProbe is ready to launch a new organizational framework, enabling large-scale, cross-continental projects that will train a new generation of scientists and deliver insights with global relevance.

Thybo speaks highly of his experience in working with CAGS. "CAGS is a wonderful place for doing research," he says. "The facilities are top-notch, and the funding for SinoProbe is unprecedented on an international scale."

He also praises the focus and efficiency of Chinese scientists. "They're very well prepared and come to discussions with clear ideas," he observes. Over the past two decades, he has witnessed a dramatic shift in China's scientific landscape from publishing mostly in domestic journals to leading in international publications. "It's a fascinating transformation," he adds. "China's scientific community has taken a huge step forward."

Building bridges

Beyond research, Thybo values mentorship deeply. He has personally mentored many Chinese PhD students, fostering a culture of mutual trust and intellectual curiosity.

"I treat all my students the same way, whether they're from Europe or China," he says. "It's only when a young colleague finds something out for themselves that the learning lasts."

"Each student is unique. Mentoring is about building on their strengths and asking questions that help them reach their conclusions," he says. For him, mentoring "must always be in a pleasant atmosphere of mutual trust." He still maintains contact and collaboration with all his former Chinese students who are now playing an active role in the sci-tech field.

Even during the pandemic, when regular travel came to a halt, Thybo maintained weekly virtual meetings with his former students across China. Today, those meetings continue to maintain the academic bond.

As EarthProbe gains momentum and CAGS continues to push the boundaries of deep Earth exploration, Thybo remains optimistic. "I'm confident that this new organization will allow us to initiate new large-scale integrated geoscientific projects on all continents," he says.

The CAGS also contributed to this article.

TCM Restores Health Through Balanced Qi

Traditional Eastern Wisdom

By BI Weizi

Acupuncture and moxibustion are traditional Chinese medicine (TCM) practices commonly used in China, representing a healthcare system that has developed over millennia for disease prevention, diagnosis, and treatment. The principles of acupuncture and moxibustion suggest that the human body functions like a miniature universe linked through energy channels or meridians, and that by physically stimulating these channels, the practitioner can enhance the body's self-regulating abilities and restore health to the patient.

This stimulation includes inserting needles at specific points along these channels or using moxa or moxibustion, intended to bring back the body's equilibrium and both prevent and address illness.

In acupuncture, sterile stainless needles are inserted into the skin to deal with health issues, such as lower back pain and fatigue. The needles can be adjusted by hand or activated with minor electrical impulses.

TCM holds that the body's essential energy, known as qi, moves through designated pathways or meridians. When the qi is in harmony, the individual experiences spiritual, emotional, and physical well-being. However, when the qi is out of balance, illness can arise. Qi may be obstructed, leading to an imbalance between yin and yang — opposing but interconnected forces. Acupuncture is a method of restoring balance between yin and yang. Acupuncturists assert that the human body contains over 2,000 acupuncture points, interconnected via different meridians. Applying acupuncture to specific points along the meridians is thought to enhance the circulation of obstructed or stagnant qi.

Another key aspect of the stimulation is the use of moxibustion. Moxibustion is typically categorized into direct and indirect types, where burning moxa cones are directly placed on specific points on the body, or burning moxa sticks are held away from the skin to heat the targeted region. Moxa cones and sticks are created from dried leaves of mugwort.

Acupuncture and moxibustion are learned via spoken guidance and demonstrations, passed down through master-disciple relationships or by clan members. The skills of acupuncture and moxibustion are now also taught through official academic programs. In 2010, acupuncture and moxibustion from traditional Chinese medicine were included on UNESCO's Representative List of the Intangible Cultural Heritage of Humanity.

How Spacecraft Reenter into Space

Science Outreach

By Staff Reporters

China recently launched the Tianzhou-9 cargo spacecraft to deliver supplies to its Tiangong space station in orbit. This routine yet crucial "delivery" mission has once again captured the public's attention.

During its journey into space and back to Earth, the spacecraft travels through the atmosphere at speeds exceeding 7 km/s — 30 times faster than a civilian airliner. These astonishing speeds cause air currents to cascade over the spacecraft's surface, rapidly increasing its temperature to between 2,000°C and 3,000°C. So how did Tianzhou-9 complete its mission in space and land safely back on Earth under such extreme circumstances?

According to Yuan Yuan, an engineer at the China Academy of Launch Vehicle Technology, Tianzhou-9's safe re-entry from the Tiangong space station is ensured by a combination of thermal protection systems and controlled atmospheric entry.

Generally, this involves a three-step approach: a heat shield, an aerodynamic design to provide stability, and precise trajectory control to manage heat loads and avoid structural damage during atmospheric passage. To begin with, heat shields made of specialised materials that can withstand extreme temperatures during atmospheric re-entry are attached to the metal hull of the spacecraft. These materials are designed to burn away in a controlled manner, dissipating heat and protecting the interior of the spacecraft.

However, this passive heat shielding approach has its limitations. Although a thicker heat shield offers better thermal protection, it also increases the weight of the spacecraft. Therefore, engineers have considered active heat dissipation. They designed the spacecraft's structure to have numerous tiny holes, similar to human pores, and filled it with a special liquid. When the temperature rises, the liquid absorbs heat and evaporates, dissipating some of the heat — the same principle that makes us feel cool when we sweat. This biomimetic heat dissipation method enables the spacecraft to regulate its temperature more effectively in high-temperature environments.

In addition to heat shielding and dissipation, the spacecraft's trajectory is meticulously planned to minimize the duration and intensity of exposure to high temperatures during re-entry. For example, the Chang'e-6 returner reached a speed of 11 km/s when entering the atmosphere. If it were to pass directly through the atmosphere and land, the maximum temperature could reach 10,000° C — twice the temperature of the Sun's surface — and the return capsule would likely be severely damaged. Therefore, engineers optimized the flight path using a method similar to skipping stones on water, slowing the returner to 7 km/s before passing through the atmosphere. This design significantly reduced the severity of the heat and ultimately ensured a safe landing.

Addressing the thermal protection problem for aircraft may seem as simple as improving the heat resistance of materials, but in reality it requires the coordinated efforts of various disciplines, including structural and trajectory design. This is the beauty of aerospace systems engineering: every system and every discipline interacts with and relies on each other to ultimately achieve system optimisation, said Yuan.

Tech+Culture

Ancient Treasures at Mabucuo Site in Xizang

By Staff Reporters

Over 4,000 years ago, a small lakeside settlement thrived in what is now Kangma in Xizang autonomous region, southwest China. Its people fished in clear lakes, hunted along the shore and led a life following the cycle of nature. Today, their story is re-emerging through fish bones, ancient DNA, and rare imported treasures thanks to one of the most significant archaeological discoveries of 2024.

At Lanzhou University, Professor Yang Xiaoyan and her team are using advanced instruments to analyze growth patterns in fish bones found in this ancient site, reconstructing how early people fished across the seasons.

"The spring growth ring is about 0.1 millimeter wide, corresponding to a period of rapid fish growth," Yang told *Science and Technology Daily*. "This suggests spring was likely a peak fishing season."

The Mabucuo site has yielded over a thousand fish bones, from which researchers infer that the early inhabitants engaged in year-round fishing and hunting along the lakeshore.

Further insights come from ancient DNA (aDNA) research led by Professor Fu Qiaomei from the Institute of Vertebrate Paleontology and Paleoanthropology at the Chinese Academy of Sciences (CAS).

Professor Fu's team found that individuals from the early Mabucuo period, dating between 4,400 and 4,000 years ago — shared key genetic traits with later populations in the southern highland regions. This indicates that distinct highland populations were already widely distributed along the Yarlung Zangbo River basin by this time.

Some individuals also carried minor genetic contributions from the lowland populations in northern East Asia, revealing complex genetic interactions between highland groups and outside communities.

Located on the northern slope of the central Himalayas, the Mabucuo site was discovered in 2019. Since 2020, a joint archaeological team led by the Institute for Cultural Relic Conservation of the Xizang autonomous region and including Lanzhou University, the Institute of Tibetan Plateau Research of CAS, the National Archaeological Research Center, and Peking University, has conducted five consecutive seasons of scientific excavation.

The team applied a multidisciplinary approach: analyzing aDNA, identifying animal bones through morphology and aDNA, conducting carbon and nitrogen stable isotope studies, and examining plant remains. This comprehensive research has been published in *Nature Ecology & Evolution*.

Professor Yang said the findings reveal the indigenous populations of the Qinghai-Xizang Plateau had established a settled lifestyle centered on lake resources at Mabucuo as early as 4,400 years ago. This discovery provides crucial evidence about the timing and nature of human adaptation to high-altitude environments, underscoring the importance of interdisciplinary collaboration in environmental archaeology.

Shargan Wangdue, deputy head of the Institute for Cultural Relic Conservation of Xizang autonomous region and field director of the Mabucuo excavation, who oversaw the entire project, said radiocarbon dating has established a continuous chronological sequence across different excavation areas, indicating that the early settlements were deliberately planned.

Due to its location at the crossroads between the Qinghai-Xizang Plateau and South Asia, the Mabucuo site served as a vital cultural exchange hub. Excavations uncovered a range of foreign artifacts in well-defined archaeological layers, including rice, seashells, ivory, sheep, bronze items and red carnelian. These finds fill critical gaps in our understanding of long-distance cultural interactions and offer valuable context for studying the development and continuity of local cultures.

The Mabucuo site in Xizang autonomous region. (PHOTO: XINHUA)

Zhejiang's Path to Independent Innovation

From page 1

Living up to this saying, Zhejiang University was one of the first universities in the country to conduct research on implantable brain-computer interfaces. In April 2024, the university established the Institute of Basic Interdisciplinary Studies and gathered over 20 disciplinary fields.

Over the years, Zhejiang has continuously made efforts in developing talent, consolidated the foundation of sci-tech innovation, and injected strong impetus into promoting high-quality development.

In 2024, the total number of professionals in Zhejiang exceeded 15 million, with the number of R&D personnel per 10,000 laborers reaching 165.3 person-years, and the proportion of highly skilled personnel among skilled workers reached 33.7 percent.

Technology transfer is key

Adhering to the integrated development of education, sci-tech innovation, and developing talent, Zhejiang has achieved impressive results in fields such as AI, carbon reduction, new materials, and shield equipment, and has become a major force for China's participation in the global market.

The in-depth integration of sci-tech innovation and industrial innovation has generated a series of prominent products such as the X30 quadruped robot, the Qwen3 coder, and high-conductivity graphene-copper composite materials.

Meanwhile, Zhejiang has given full autonomy to the leading role of enterprises in innovation. By the end of 2024, it had 47,500 national high-tech enterprises, ranking third in the country. A number of technology enterprises such as Wanxiang Group, Alibaba, Hikvision and Deep Robotics have emerged, becoming a solid foundation for Zhejiang's high-quality development.

From slow beginnings, Zhejiang has now become a shining example of independent innovation, ensuring this remains among the province's most important modernization efforts.