Scientific Expedition to the Earth Summit — A Closer Look at the Atmospheric and Glacial Marvels of Mount Qomolangma

By YAN Fusheng (Staff Reporter)

Mt. Qomolangma scientific expedition base camp.
Altitude: 5,200 meters
Oxygen: 54% of that at sea level

On May 4, China's scientific mountaineering expedition team reached the summit of Mount Qomolangma, marking the successful conclusion of the "Earth Summit Mission." Led by Dr. YAO Tandong, CAS Member from the Institute of Tibetan Plateau Research of the Chinese Academy of Sciences, the mission, involving over 270 participants from five expedition groups and 16 research groups, has achieved breakthroughs in multiple research areas.

Setting up the world's highest weather station at the altitude of 8,800 meters.

An Alarm System for the Glacier

Primary objectives of this Earth Summit Mission included studying westerly-monsoon interactions, global warming at high altitudes, snow and ice melting processes, and monitoring water vapor and greenhouse gas levels. A key accomplishment was the construction of gradient-linked weather stations at various altitudes, with the highest at 8,800 meters. These stations will offer invaluable data for climate research and environmental monitoring.

"The most obvious changes on the Qinghai-Tibet Plateau are to the temperature and humidity. The scale of warming is around two or three times that of the global average, or China's low-altitude areas. These new weather stations would form an alarm system for the glacier," says Dr. YAO Tandong, commander-in-chief of the Earth Summit Mission 2022.

Ice and Snow

"The expedition to the summit completed many scientific tasks. Taking samples [ice and snow] at the summit is just one of them. But of all the scientific tasks, this one is iconic. So, successfully completed it means a lot for us, which is important for the remaining tasks. It has laid a great foundation," said Dr. YAO Tandong, commander-in-chief of this mission.

Ice core drilling was challenging due to the rising altitudes required for uncontaminated samples. This mission demanded higher levels of physical fitness and overall ability from the mountaineering team members.

"We have designed ice core drilling at three different altitudes of 8,848 meters, 7,028 meters, and the ice core drilling at the northern depression (about 6700 meters)," said Dr. XU Baiqing at the CAS Institute of Tibetan Plateau Research, who leads the high-altitude ice core drilling team. "Through ice core drilling at these three locations, we have a very important goal, which is to study the impact of global warming on glacier melting process at different altitude gradients."

However, the helicopter could not climb to the designated altitudes because of the thin air. In the end, the mission settled to manually carry the ice core drilling equipment along with other investigating gears.

Previously, the climbing team members only needed to be responsible for their own oxygen supply, but this year they have equipment that includes a weather station, radar for measuring ice thickness, and ice core drilling, totaling nearly 60～70 kilograms. Therefore, this scientific expedition put higher demands on the physical fitness and overall abilities of the mountaineering team members, according to AN Baosheng, frontline commander of the Earth Summit Mission.

"Why are we always looking for and studying ice cores? That is because ice cores are vital to global research on environmental change, especially on the Qinghai-Tibet Plateau with extreme altitude or in other high-altitude areas. The ice itself is an important climate indicator. It contains information about human activity in the form of various soluble and insoluble substances. And it offers other ways for us to understand atmospheric changes. For example, the air trapped in the ice can show changes in the atmospheric composition, especially in the greenhouse gases, and so on. So, it [ice core] contains a lot of information," said Dr. XU Baiqing from the who leads the high-altitude ice core drilling team.

"Before we start drilling, we imagined that the ice and snow samples from the summit would be very dry firn. The surface layer would be fresh snow with dry firn

underneath. But we discovered a vast quantity of ice – very thick ice layer, some as thick as 1~2 centimeters. The firn is very wet, indicating serious melting," said Dr. XU Baiqing with concerned look in the eyes.

"Qinghai-Tibet Plateau is often referred to as the Water Tower of Asia. But where does the water come from? Or how does it replenish itself to maintain such water capacity? For that, we want to use the isotopic tracing to distinguish the different origins of water and figure out the proportions of various origins," says Dr. GAO Jing at the CAS Institute of Tibetan Plateau Research, who also leads the aerostat vertical observation team in this expedition.

For the first time in history, the expedition team members also successfully collected ice core and snow samples from altitudes of 6,500 meters, 7,028 meters, and 8,848 meters respectively.

These collected ice and snow samples would certainly be a great asset for answering these questions, through which scientists may revisit the frozen data preserved in the ice and snow.

The Measurements Are not the End but the Beginning

The mission also employed high-precision radar to measure the ice and snow thickness at the summit of Mt. Qomolangma for the first time. Advanced techniques were used to obtain ground-to-39-kilometer altitude atmospheric ozone concentration data and three-dimensional wind fields. Furthermore, the researchers gathered high-altitude physiological adaptation data for both permanent and short-term residents on the plateau for the first time.

The "Jimu-1" tethered aerostat, a cutting-edge piece of equipment used in the expedition, was 55 meters long, 19 meters high, and had a volume of 9,060 cubic meters. This impressive machine set a new record for *in situ* atmospheric environmental science observations at an altitude of 9,050 meters.

"The advantage of an aerostat is that it relies on buoyancy to gain lift. It's not driven by any external or manmade power source. So, the data that's obtained is free from human contamination. What we see is what's in the atmosphere," said Dr. GAO Jing, leader of the aerostat vertical observation team. "Our team's main responsibility is observing the changes of water vapor in the atmosphere. During this Mt. Qomolangma scientific expedition, we used the aerostat platform to monitor the water vapor content in the air at different altitude."

Members of the scientific expedition team are sampling ice and snow at the summit of Mt. Qomolangma.
Altitude: 8,848.86 meters
Oxygen: 28% of that at sea level

After nerve-wracking waiting for the ideal conditions for inflating and release the aerostat, aerostat vertical observation team successfully concluded this expedition by floating up to "Jimu-1" aerostat to the altitude of 9,032 meters from the ground at altitude of 4,300 meters.

"I thought if we didn't act, we would be waiting for ever. But once we have taken the first step, we could quickly move on to the second step," recalled Dr. GAO.

The successful completion of the "Earth Summit Mission" represents a series of vital breakthroughs in the field of scientific investigation in the region.

Just like the expedition team says, the records and altitudes are not an end. They are just a starting point.

These discoveries will contribute to a better understanding and protection of the area' environment, providing valuable data for future scientific research and benefiting both the scientific community and the general public.