

Special Topic: The Tibetan Plateau

A sky-high view of the Third Pole: an interview with Tandong Yao and Weiming Fan

By Jane Qiu

The Tibetan Plateau and surrounding mountain regions covers 5 million square kilometres—nearly half the China's landmass—with an average elevation of over 4000 metres. It's often regarded as the Third Pole because it has the largest stock of ice outside the Arctic and the Antarctic. Tibetan Plateau research is one of China's Strategic Pioneering Programmes that was launched in 2012 with a budget of 300 million yuan (US \$47 million) over 5 years and is led by Chinese Academy of Sciences (CAS)' Institute of Tibetan Plateau Research (ITP) in Beijing. In January 2014, CAS set up the Centre for Excellence in Tibetan Plateau Earth Sciences, headquartered in ITP, aiming at providing long-term support for this area of research and raising academic standards. NSR recently talked to glaciologist Tandong Yao and geologist Weiming Fan—ITP's director and deputy director, respectively—about why Tibetan Plateau research is important, what it is like to work there, how the region is faring in face of climate change and why international collaboration is important.

NSR: Why is Tibetan Plateau research important?

Yao: The importance of the Tibetan Plateau can be illustrated from scientific and social aspects. From a scientific point of view, it's primarily driven by a curiosity about how Earth has evolved. The plateau is the one of the best places to address this issue: since the collision between Eurasia and the Indian subcontinent, there have been a whole series changes in the region, largely due to the rise of the plateau—ranging from glaciation, river formation, monsoon evolution to the emergence of cold-adapted animals and ecosystems. It's an ideal place to study all these processes.

Fan: In the past decades, Earth science has evolved from focusing on individual research fields to an emphasis on multi-disciplinary approaches. This is also the direction of Tibetan Plateau research. It's an excellent and unique natural laboratory for the Earth system science. From geological point of view, the Tibetan Plateau is a certainly unique place in the world. One of the biggest puzzles of the Tibetan Plateau is why it's so expansive and how it came up with very little deformation: in contrast to the rugged Himalayas, for instance, the topography of most of the plateau surface is pretty smooth and flat.

Yao: Indeed. The initial interests were in different disciplines such as geology, geophysics, geography and biology. Now we are trying to understand the region from the perspective of the Earth system science, with emphasis on the interaction between various spheres, including atmosphere, cryosphere, lithosphere, hydrosphere, biosphere and 'the anthrosphere'. Among these spheres, changes in the cryosphere have attracted a lot of attention in recent decades because it's highly sensitive to climate change.

From a social point of view, human activities, or 'the anthrosphere', have increasingly impacted the plateau since the second

half of the 20th century, and have become an important topic, especially from the policy perspective. The Tibetan Plateau and the surrounding mountain ranges—also known as the Third Pole because it has the largest stock of ice outside the Arctic and the Antarctic—affects over 1.5 billion people directly by



Tandong Yao, glaciologist, and the director of the Institute of Tibetan Plateau Research, Chinese Academy of Sciences in Beijing, China. (Courtesy of Jane Qiu)

affecting monsoons, providing precious water resources and ecosystem services, but is much less studied than the actual poles.

“

The Tibetan Plateau and the surrounding mountain ranges – also known as the Third Pole because it has the largest stock of ice outside the Arctic and the Antarctic – affects over 1.5 billion people.

—Tandong Yao

”

Fan: The Tibetan Plateau also affects humans through earthquakes and landslides—as exemplified by the Wenchuan Earthquake in 2008, which killed over 80,000 people. It also has a regional and global importance: it gives rise to 10 of Asia’s largest rivers and is widely known as Asia’s water tower; it also impacts atmospheric circulation, affecting Asian monsoons, flood and drought patterns in Asia and even climate in North America. Moreover, mountain building across the plateau should give rise to rich resources, but the underlying processes are little understood. Nor is the region’s mining potential, an aspect of great academic and practical interests, though we should also take into consideration the practicality of large-scale mining in the region and its environmental impact.

NSR: What is it like to work on the plateau?

Yao: The Tibetan Plateau is one of the most beautiful places on Earth. I’m yet to meet anyone who is not awestruck by its beauty and tranquillity. But it’s very challenging to work there: we often work in remote places at very high elevations, with low levels of oxygen and atmospheric pressure, which have direct physiological impact; it can be extremely cold and windy as well, with snowflakes hitting our face like hundreds of little knives.

Fan: It’s certainly much more challenging than most mountainous regions. We have to camp, cooking our own food, and may have cars broken down or stuck in muds. This is why we try to get more financial support from CAS to ensure our researchers are well equipped, the vehicles are good enough, satellite phones are used when necessary—so we could minimize the risks. The situation is a lot better in recent years compared to a few decades ago, but there is much room for improvement.

Yao: In my view, how you feel about working in such an environment really depends on how much you enjoy this type of research. If you like it enough, none of these really matters. If not, then, of course, you could be easily put off by these challenges. I know many researchers who are absolutely passionate about Tibetan Plateau research to the extent of obsession. For them, going to field work on the plateau is great fun, and the physical challenges and the harsh environment are nothing to them.

This is similar to mountaineering, which can be extremely dangerous, challenging and physically demanding, but many people spend a lot of money and several years in preparation

to climb the Everest and other magnificent peaks. Having said that, people do vary greatly in their responses to altitudes, so this can affect how they meet the challenges of working on the lofty plateau.

NSR: What’s China’s focus in Tibetan Plateau research?

Yao: The key focus is embodied in the research priorities of the Strategic Pioneering Programme and the CAS Centre of Excellence in Tibetan Plateau Earth Sciences, which were launched in 2012 and 2014, respectively. It centres on systematic, multi-disciplinary studies of the characteristics, processes and mechanisms of interactions between the plateau’s six spheres mentioned above. There are four focus areas: first, the timing and processes of collision and plateau uplifting; second, how deep processes affect the structure and processes on the surface; third, the interaction between surface spheres and its impact on surrounding regions; fourth, geohazards, such as earthquakes and landslides, on the plateau. There have been some fascinating insights into these processes in recent years.

Fan: Indeed. For instance, new studies have made an important contribution to the debate regarding the process of collision and plateau uplifting, which has been a point of contention for decades. Some suggest that the collision took place in the West, others argue it first happened in the East. Now a series of studies using new dating methods suggest that the two continents might have first collided in the middle, around 65–60 Ma million years ago. But nothing is set in stone yet and many of the issues are still very contentious. One thing is certain: it’s a lot more complicated than we thought.

Yao: Another area of development addresses the question of when the plateau got high enough to affect surrounding regions, and when it reached the current height. It’s also highly contentious with wide-ranging opinions. A few years ago, isotope studies suggested that the plateau reached the current height about 35 million years ago, but many people disagree. Our latest studies show that the plateau reached at least 2500–3000 metres between 30 million years ago, and reached current height about 4 million years ago.



Weiming Fan, geologist at the Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing, China. (Courtesy of Weiming Fan)

“

The timing of collision and plateau uplift is not just of interest to geologists: it's the key to understanding a whole series of surface processes and environmental changes in the region.

—Weiming Fan

”

Fan: It's worthwhile stressing that the timing of collision and plateau uplift is not just of interest to geologists: it's the key to understanding a whole series of surface processes and environmental changes in this region, such as geomorphology, river formation, the evolution of Asian monsoons and ecosystem changes. Our long-term goal is to understand the mechanisms enough to develop models that are able to simulate all these processes and project what will happen in the future.

Yao: Indeed, plateau uplift had a series of consequences on surrounding regions. For instance, the Yangtze evolved its current course around 23 million years ago, which is closely related to plateau uplift. When the plateau reached its current height, it became the centre of evolution for many animals, such as the woolly rhino, Arctic fox and snow leopards. A high plateau also has important effects on atmospheric circulation: it's a physical barrier for the westerlies and triggered the evolution of Asian monsoons. Without the plateau, southern and eastern China would have been a desert rather than a fertile ground as they are now today.

Fan: An area that is understudied is geological evidence before the collision. There was no plateau before India crashed into Eurasia, though there might be a mountain range at the southern edge of Eurasia due to subduction of the Paleo-Tethys Ocean Plate—similar to the Andes resulted from the subduction of the Pacific Plate under the South America plate. There should be geological evidence in forms of mineral resources, but most the mineral resources we know resulted from the collision between Eurasia and the Indian subcontinent. This is puzzling because subduction of ocean plates is a key process of mineral formation.

NSR: How has the Tibetan Plateau been changing in a warming world?

Yao: A key finding is that the vast Tibetan Plateau, which are under the influence of different climate regions, experiences large regional variations in its response to climate change. The plateau can be broadly divided into regions affected by the westerlies, areas affected by Asian monsoons, and those affected by both—which show different characteristics in the response of the cryosphere, hydrosphere and biosphere to global warming. While the temperature rises everywhere, changes in precipitation patterns vary greatly. Overall, the westerlies are getting stronger and bring more winter precipitation, and the monsoons are getting weaker. In regions dominated by the Asian monsoons, glacial retreat is very se-

vere, lakes are shrinking and ecosystems are deteriorating. In places dominated by the westerlies, most glaciers are either static or even advancing, lakes are expanding and ecosystems improve.

NSR: Why is international collaboration important for Tibetan Plateau research?

Yao: The Tibetan Plateau and surrounding mountain ranges are a unique geological and geographical region that shares many characteristics with the Arctic and the Antarctic. It has evolved many polar characteristics largely because of its elevations, averaged 4,000 metres, and covers a vast area of 5 million square kilometres—half the China's landmass. It involves 12 countries and impacts over 1.5 billion people. To truly understand this Third Pole, we must take a holistic approach and collaborate with neighbouring countries. This is also in line with the philosophy of the Earth system science. In these day and age, one cannot be a good geoscientist without both regional and global perspectives. This is what we should aim for and how we should educate our students and scientists.

NSR: How has international collaboration been going?

Yao: It's this holistic philosophy that prompted us to initiated the international programme the Third Pole Environment (TPE) in 2009. In addition to me, the scientific committee also consists Volker Mosbrugger, director of Senckenberg World of Biodiversity, a coalition of research institutes and museums in Frankfurt, Germany and Lonnie Thompson of the University of Ohio in the USA. We work closely with scientists in neighbouring countries—undertaking joint expeditions, organising conferences and training workshops and engaging in exchange programmes – as well as international institutions such as the International Centre for Integrated Mountain Development in Kathmandu, Nepal.

The TPE programme, headquartered in Beijing, is expanding: CAS now has a research and education centre in Kathmandu; a Third Pole research centre is to be launched in the USA next year, and another branch in Germany is being considered. Our institute now has dozens of PhD students from neighbouring Third Pole countries, such as Nepal, Pakistan, Tajikistan and Myanmar—over 10 of them have already graduated. This is going to be a long-term effort. It's also a very important way to promote cooperation and good relationship with neighbouring countries at the grassroot level.

NSR: What are the main challenges in Tibetan Plateau research?

“

To truly understand this Third Pole, we must take a holistic approach and collaborate with neighbouring countries.

—Tandong Yao

”

Yao: From research point of view, the main challenges are the development of new methodologies and techniques that can be applied at high altitudes—including helicopters, unmanned aerial vehicles and automated equipments for field observation. China lags much behind developed countries, especially the USA, and this has hindered Tibetan Plateau research. For instance, helicopters are commonly used in polar research, which would greatly boost the transport efficiency in large regions like the Tibetan Plateau. But none of our domestically manufactured helicopters are able to fly over 4000 metres.

Fan: There are also challenges to get scientists to collaborate across disciplines. Researchers within the same discipline often get to know each other through specialised conferences. When they need to find collaborators in a different field, they don't know where to look. And there is often a gap between people with different education background, perspective and expertise. It's even more challenging to incorporate social sciences in our research programmes.

Yao: I think this is partly related to education, which is too narrowly focused and students are not encouraged to have wide interests and perspectives. Scientists also tend to specialise too early and are rarely interested in research fields other than their own.

“

From the policy perspective, the government should have long-term strategic plans for Tibetan Plateau research – rather than focusing on supporting short-term projects.

—Weiming Fan

”

Fan: From the policy perspective, the government should have long-term strategic plans for Tibetan Plateau research—rather than focusing on supporting short-term projects. Most research questions need long-term observation and field experiments. This is supposed to be the philosophy that underlies the establishment of the CAS Centres of Excellence, but we are still struggling with long-term funding.

Yao: There are, however, some encouraging developments. CAS, for instance, provides long-term funds for the Alpine Observation Network—a series of observatories and research stations across the plateau—but the level of support is far from enough.

Fan: International collaboration is a buzz word in China, but I don't think the country is ready for the globalisation of science. A lot of policies are not conducive for international collaboration. For instance, a lot of excellent researchers in neighbouring

countries are keen to come to study or work in China, but face many hurdles once they are here in areas ranging from accommodation, schooling to medical insurance. And it's very difficult to take equipments or use research funds abroad even if they are dedicated to international collaboration. So it's very tricky to help set up observatories and research stations abroad.

Yao: Politics is also a main challenge. Political instability in Pakistan and Afghanistan has affected research collaboration. A few years ago, some mountaineers were kidnapped and killed in the Karakoram, so we had to stop sending researchers to the region for quite some time. The unresolved border issues between China and India have also affected collaboration between the two countries. There are a lot of potential for collaboration in the border regions—ranging from glaciology, hydrology to biodiversity—but such research is rather limited. We do, however, have active academic interaction with Indian researchers through conferences and exchange programmes. Collaboration with other countries in the region has been going on much better. It's a long-term process. We can't expect things to change overnight, and we will keep trying.

NSR: What do you have to say to students and young scientists who are considering to do research on the Tibetan Plateau?

Yao: The key is interest. The Tibetan Plateau is a truly unique and fascinating place in more than one ways. It's a magnet for researchers in diverse disciplines around the world. It's also one of the most beautiful places on this planet. I'd encourage young people interested in Earth sciences to try it out. As I mentioned before, if you are passionate about something, then no challenge could scare you away. It's a privilege to be able to making a living out of something you are passionate about.

Fan: Young people probably need to have some insight into Tibetan Plateau research before they can develop a passion. Senior scientists have the responsibility to communicate the fascinating science of the plateau to young people and to cultivate their interest. This is an area we haven't done enough. As I mentioned before, the Tibetan Plateau is an ideal natural laboratory to study Earth system science, which is a relatively new concept and will attract increasing interest worldwide, so it's a good time to get into this area of research.

Yao: I agree: I don't think we have done enough in educating young people about Tibetan Plateau research. There've been some workshops and summer camps aimed at undergraduates, including seminars and visits to research stations on the plateau, but we need to do much more. Tibetan Plateau research is now at its gold age, so the timing is great to choose this as a lifelong endeavour. And if the passion is there, then you will have the most rewarding experience on Earth.

Jane Qiu writes for NSR from Beijing.