ONWARDS AND UPWARDS

Known as China's flagship of geoscience for **THE SCOPE, DEPTH AND SIGNIFICANCE OF ITS DIVERSE RESEARCH ACHIEVEMENTS**, IGGCAS is spearheading extraordinary discoveries across space and time.

Leading the design of China's first satellite, initiating the nation's Mars exploration project, discovering the world's largest rare-earth ore deposit, and supporting national major engineering projects such as the Three Gorges Dam, are among the many successes of the Institute of Geology and Geophysics, Chinese Academy of Sciences (IGGCAS). The institute has played a pivotal role in China's strategic development and in fuelling national socioeconomic growth. Benefitting from a well-established research system, state-of-the-art experimental platforms and an excellent interdisciplinary talent team, IGGCAS researchers are leading cutting-edge research that explores from the Earth's innermost core to the fringes of galaxies.

IGGCAS's century-long history can be traced back to the Geological Survey of China in 1913, China's first national institute for geoscience. It has since become the pioneer in geochemistry, seismology, geomagnetism, sedimentology, mineralogy, petrology and engineering geology research in China. Around 60 out of the 200-plus CAS members in geoscience are current or former staff of IGGCAS.

In 1999, the merger between the Institute of Geology, CAS and the Institute of Geophysics, CAS led to today's IGGCAS. The union enhanced the institute's research capacities, making it better equipped to address sustainable development challenges.

Scrutinising the Earth to its very core

As the first to introduce plate tectonics theories to China, IGGCAS scientists are deeply engaged with the mechanisms underlying plate movement and the formation of lithosphere. They have elaborated on the geological evolution of the Tibetan Plateau, but a more seminal contribution is their study on the North China Craton, the large block of the Earth's crust forming the ancient North China continent.

The North China Craton has long attracted the academic interest for its unique properties. This 1,500,000 km² stretch of continental block has been unstable since an abrupt thinning and destruction in the Mesozoic era, a phenomenon known as 'craton destruction' or 'decratonization', a geological process essential in the Earth's evolution. IGGCAS researchers showed that the vigorous crust deformation and magmatism of the North China Craton can be associated with the thinning lithosphere. Its loss of stability has been considered as a possible cause for the 1976 Tangshan earthquake in the region. IGGCAS has also uncovered the link between this defining episode and the genesis of various mineral resources in the region.

With the establishment of the State Key Laboratory of Lithospheric Evolution in 2005, IGGCAS has led a series of international collaboration projects, exploring geology, geophysics and geochemistry of the Alps, the Iranian Plateau, the Tibetan Plateau, the India–Myanmar Range, and northwest Australia along the ancient Tethyan region.

Understanding habitable environments

A habitable environment is what makes the Earth unique among planets, and a better understanding of ancient climate and ecological systems will inform our understanding of future climate change. Improving this understanding has traditionally come from research on deep-sea sediments and ice cores. Loess, or sediment formed by wind-blown silt has been added to the list of research resources, due to fundamental contributions by IGGCAS researchers.

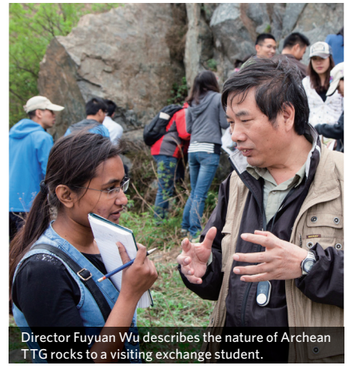
Covering roughly 10% of continental surface, loess is now seen as providing the most complete records of terrestrial environmental changes.

A team led by IGGCAS researcher, Tungsheng Liu, a CAS member, has traced the history of aeolian dust sediments in northern China to tens of millions years ago by surveying the Loess Plateau and other parts in the region. This has allowed improved understanding of the development of East Asian monsoons and the evolutionary history of arid inland landscapes.

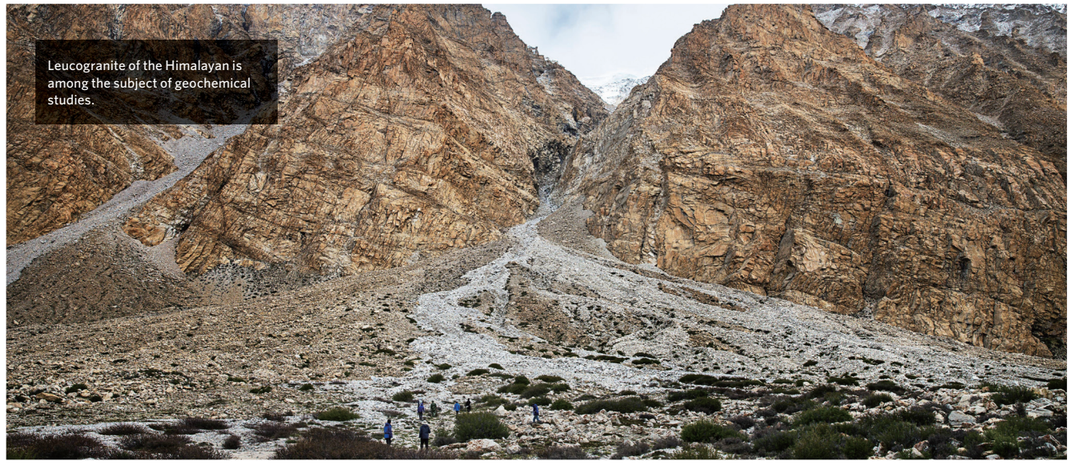
Liu's team was also one of the first connecting the dots between environmental changes and human welfare, and establishing the field of environmental geology in China. They detailed the correlation between local mineral composition and disease occurrence in northeast China, unlocking the causes of high prevalence of Kashin–Beck and Keshan diseases in the region. For his work that promoted disease prevention, disaster relief, and research on past climate changes, Liu won the Tyler Prize for Environmental Achievement in 2002, and the State Preeminent Science and Technology Award in 2003.

Another benefit of IGGCAS research comes through the unlocking of mineral, petroleum and gas resources. With a long history in the studies of geology and geophysics, coupled with cutting-edge technologies and equipment for prospecting deeply buried resources, IGGCAS has made substantial contributions to the discovery and exploration of the Pugang gas field in Sichuan, Qulong copper deposit in Tibet, Jiaodong gold ore field in Shandong, Chalukou molybdenum deposit in Heilongjiang (the third-largest in the world), and Bayan Obo in Inner Mongolia (the world's largest rare earth deposit). For national engineering projects, such as the construction of the Three Gorges Dam and the South-to-North Water Diversion Project, IGGCAS leads site evaluation and geohazard prevention; in the process, also forming a theory of rock mass geomechanics.

Miocene loess in Qin'an, Gansu Province



Director Fuyuan Wu describes the nature of Archean TTG rocks to a visiting exchange student.



Leucogranite of the Himalayan is among the subject of geochemical studies.

From deep Earth to deep space

According to the agenda for space exploration in China's 13th five-year plan, Moon landing, Mars exploration, and asteroid sampling were among the top priorities. IGGCAS plays a critical role in all these missions by providing key support and leveraging its existing strengths in space environment research, planetary physics, and planetary chemical analyses.

In addition to the construction of coordinated observing platforms (on the ground, in balloons, or deep in space), IGGCAS also set up multiple large-scale telescopes across the electromagnetic spectrum. The holistic data sets will provide critical implications for habitability and existence of life beyond the Earth. A blueprint for international collaborations has been in place, helping to promote Chinese participation in deep space explorations for the upcoming decades.

IGGCAS's ambitions are also backed by a number of the world's most advanced field observation stations, capable of minute measurements of the geomagnetic field, the ionosphere, and the upper atmosphere.

It also houses the World Data Center for Geophysics, Beijing and Center of Big Data & AI for Earth Science, allowing big data analysis on geoscience.

Collaborations between international groups are increasingly important for scientific investigations, particularly on planetary sciences. IGGCAS's international breakthroughs, together with generous scientific investment at home, will pave the way for future geologists and geophysicists. ■

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