



Some buildings at Tohoku University are too damaged to be entered safely.

JAPAN

Quake shakes Japan's science

Natural disaster leaves researchers struggling with broken equipment and a crippled infrastructure.

BY ICHIKO FUYUNO

The magnitude-9.0 earthquake that struck northeastern Japan on 11 March trashed Koji Tamura's laboratory and office, flinging books, microscopes, sequencers and samples to the floor. The geckos, *Xenopus* frogs and zebrafish that the Tohoku University researcher uses to study organ development survived the quake but now face a slow death, because disrupted water supplies mean their tanks may run dry. "Without water, I am worried how long our animals can survive," he says. "But I cannot think about research at a time when many suffering people need water to live."

Like many scientists in Japan, Tamura is both anxious over disrupted research plans and heartbroken at the human toll of the earthquake and the ensuing tsunami, which killed thousands of people and left nearly half a million homeless. No casualties have been reported on campus at universities and research institutes so far. But more than a week after the event, scientists taking stock of the damage foresee a long, difficult recovery, as disrupted infrastructure and power outages in

Tokyo and other eastern parts of Japan add to the physical damage at labs and other facilities.

The earthquake hit hardest at Tohoku University, a materials-science, engineering and biomedicine powerhouse in the city of Sendai, close to the epicentre. At the university, which is expected to remain closed until late April, an emergency team is assessing the damage, but scarce electricity, gas and water, coupled with intermittent aftershocks, are making inspections extremely difficult. The tsunami flooded one building at a field station of the Graduate School of Agricultural Science on the coast north of Sendai, and six buildings on the main campus are too dangerous to enter.

The university's WPI-Advanced Institute for Materials Research, renowned for its work on metallic glasses, polymers and nanodevices, has lost ¥1 billion (US\$12.5 million) of equipment, and the cost is likely to increase when the damage is assessed in detail, says Yoshinori Yamamoto, the institute's director. Broken instruments include some of the world's best electron microscopes and instruments for studying the atomic arrangement of surfaces.

Farther from the epicentre, the Japan Proton Accelerator Research Complex (J-PARC),

south of Sendai on the coastline of Ibaraki prefecture, has been shut down. Its three accelerators seem to be intact, and the facility escaped damage from the tsunami. But the earthquake cut off the water supply, buckled nearby roads and damaged computer servers. This week researchers will begin switching on the facilities for preliminary inspections.

The High-Energy Accelerator Research Organization in Tsukuba has also seen its Photon Factory synchrotron crippled. "The linear accelerator has seen some substantial damages," Soichi Wakatsuki, director of the Photon Factory, wrote to the international community on 15 March. But he noted that "five protein crystallography beamlines have been spared of major damages".

Meanwhile, the shutdowns of the Fukushima Daiichi reactor complex and other nuclear plants after the earthquake have led to electricity shortages in Tokyo and neighbouring prefectures, where temporary outages are planned every day. Many institutions in the region, including the University of Tokyo and some RIKEN institutes, have been forced to drastically reduce electricity use and shut down large facilities such as supercomputers.

Uncertainty resulting from the disrupted infrastructure and the nuclear crisis is prompting foreign nationals to decamp for cities farther south or overseas. "That is the major problem," says Adrian Moore, a unit leader of the Brain Science Institute at RIKEN in Wako. Five out of his six non-Japanese postdocs and students have left and will not return until the situation improves. At J-PARC, all foreign researchers have flown home or are being housed in dormitories in Tsukuba, where the infrastructure held up better. The government is considering emergency funding for rebuilding universities and research institutes.

Amid the depressing circumstances, there are bright notes. On the day of the earthquake, Japan's research vessel *Chikyu*, capable of drilling seven kilometres into the sea floor, was docked in Hachinohe, north of Sendai, preparing for a voyage to sample coal beds deep under the sea floor.

Within 30 minutes of the quake, the ship undocked with 200 people aboard, including 48 elementary school pupils on a tour, because a ship at sea is safer than the shore during a tsunami. The tsunami arrived almost immediately afterwards, spinning the 57,000-tonne vessel 2.5 times but causing no injuries. The only damage was to one of the ship's six thrusters. "It was almost a miracle that no life was lost," says Fumio Inagaki, co-chief scientist of the coal-bed expedition at the Japan Agency for Marine-Earth Science and Technology. The upcoming voyage was cancelled, however.

Yukihiisa Kitamura, executive vice-president of Tohoku University, says students and faculty members are encouraged by support messages from around the world. "We are regaining our enthusiasm rather than giving in," he says. ■