Paper Number: 2531

Karst Collapse Occurrences and Investigation in China

Mingtang LEI [1], Yongli GAO [2], Xiaozhen JIANG [1]

[1]Institute of Karst Geology, CAGS, Guilin, China, mingtanglei@hotmail.com.
[2] Department of Geological Sciences, University of Texas at San Antonio, TX 78249, USA

Karst land covers a total of 3,650,000 km^2 area in China and 600,000 km^2 of those areas are at high risk of sinkhole collapses. Sinkhole collapse has increasingly becoming a major geohazard in karst areas in China. According to the most recent statistics, more than 1,500 karst collapsing events were recorded in China and these events formed more than 45,000 sinkholes. These sinkholes were mainly distributed in covered karst areas in southern, southwestern, and central regions of China. More than 30 metropolitan areas and large cities including Guangzhou, Wuhan, Guiyang, Kunming, Tangshan, Hangzhou, and Guilin, 328 cities and counties, 14000 km highways and 9000 km railways were at risk of sinkhole collapses. Over 40 mines, 25 railways, and hundreds of dams were severely impacted by sinkhole collapses.

More than 75% of sinkholes were triggered by human activities (induced sinkhole). Human induced sinkholes are mainly caused by drastic water level fluctuations in karst aquifers. These activities include water pumping, mine drainage, foundation engineering, and tunnel constructions. More and more sinkhole collapses occurred in metropolitan areas and big cities such as Guangzhou, Wuhan, Guilin, and Liuzhou. Sinkhole hazards have greatly impacted urban development in these cities. Sinkholes in urban areas were primarily caused by tunnelling of subway construction and foundation piles for residential buildings. For instance, 5 collapsing events occurred recently in Guangzhou which is located in Guanghua basin since 2007. All these karst collapses were caused by tunnelling of subway construction and installations of foundation piles. In the past 5 years, sinkhole collapses have becoming increasingly severe in 16 major mines. Sinkhole collapse has been a major hazard in the mining cities. For example, 99 collapsing events have occurred in Meitanba coal mine in Ningxiang, Hunan Province, which are induced by Long-term drainage of groundwater for the mine. Severe sinkhole collapses have been associated with constructions of major highways and railways. These sinkhole collapses were triggered by substantial declining of karst water level due to highway and railway construction especially water and mud inrush to tunnels.

Natural sinkholes have also increased in recent years due to extreme weather conditions and hazardous events. These sinkholes are primarily cave collapse types forming hazardous chain events such as storm-collapse-flooding or earthquake-sinkhole collapse events. A series of sinkholes collapsed at Jili village, Laibin Guangxi, China on June 3 2010. More than 22 sinkholes collapsed and the largest sinkhole was 80 m long, 30m wide and 30 m deep. It is considered the extremely heavy rainfall between May 31 and June 1 2010 may have triggered this collapse event. The precipitation, as high as 469.8 mm within one day, was a record high in the study area. The collapses also triggered 1.7 magnitude earthquake activities.

Since 2012, the project of karst collapse investigation and risk mapping convened in important karst areas including Guangdong, Wuhan, central Hunan, and central Guangxi supported by China Geological Survey (CGS). By year 2015, 68 geologic quadrangle maps have been completed in a total area of 30,000 km^2 at 1:50,000 scale. The investigation content includes positon, dimension, types, induced factors,

occurrence date, and the condition of hydrogeology of sinkholes and collapsing events. Risk assessment is based on characteristics of karst geology and hydrogeology, formation and evolving mechanisms of sinkhole collapses, and types of human activities especially major constructions and engineering projects. Geological and hydrological data will be assembled guide policy development aiming at hazard mitigation or preventing the damage caused by sinkhole collapses.