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Exploring the Hazard of Cave Roof Collapse Sinkholes using the National Corvette Museum Sinkhole Case Study

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In recent years, the prevalence of sinkhole (doline) activity around the world, such as cover collapses, cave collapses, subsidence sinkholes, urban sinkholes, and other related processes and mechanisms that cause landscape failure in karst areas, have gained increasing attention. Many areas are now also considering changes to building codes, policies, and insurance regulations that address sinkhole threats. In 2014, a major collapse of a cave roof occurred at the National Corvette Museum (NCM) in Bowling Green, Kentucky, USA and received international media attention. Over a two-year period, investigation of the sinkhole included multiple lines of study, including geophysical, cave survey, drilling, and hydrogeologic techniques, to determine the cause, extent, and best remediation course for the sinkhole. The geophysical study was confirmed by cave survey results and remediation involved a micropile-supported concrete floor to prevent future risk in case of additional collapse. Talus and breakdown are abundant in the cave in which the sinkhole formed and the progression of the roof failure likely occurred over geologic time, eventually giving way due to a variety of conditions, including speleogenetic and climatic factors that influenced the collapse. Subsequently, an examination of other sinkholes in the area produced more than a dozen examples of major cave collapse sinkhole entrances in a variety of landuse settings; thus, indicating cave roof collapses may be more common than previously realized and the speleogenetic mechanisms influencing the timing, occurrence, and proclivity of these types of sinkholes may be improved in determining future areas of risk. Beam length of limestone beds and location of breakout domes in relation to the surface should be considered when evaluating known cave passages for possible risk of future collapse, particularly in developed areas.
Following remediation of the NCM sinkhole in 2016, an educational exhibit was opened to improve public understanding of karst and sinkhole formation processes, including a focus on cave roof collapses. Since then, cave collapses and development issues are still occurring and the lack of understanding and regulation promulgate further likelihood of these in the future. Additional emphasis on this type of sinkhole risk and related surface failures should be included when discussing the potential loss of property and reduce the risk of sinkhole impacts. Outcomes of the National Corvette Museum sinkhole study and outreach efforts provide a model for future methods by which scientists and the public may improve sinkhole prevention and reduce risk factors.