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Genetic variety of sinkholes and their reconaissance and classification for the derivation of hazards and to forecast of collapses

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The term "sinkhole" covers a lot of depressions on the earth's surface, caused by very different geological processes and anthropogenic activities. The speed of the origin of the depressions is different and leads to different hazards. The forecast look for hazards and the introduction of preventive measures gets safer if type and cause of the depressions are known of.
First aim of the lecture is the classification of sinkholes in different types. Geogenic depressions develope in karst landscapes as well as in plain areas of detrital sediments on soluble rocks.

The depressions are in karst landscapes localized directly in the soluble rocks like limestone or sulphate rocks (anhydrite, gypsum). It results there for solution dolines and collapse dolines in these rocks themselves..
In other cases the soluble rocks often are in large depth under overlaying claystones, siltstones, sandstones or clays, silts, sands. A cave deeply is formed under the earth's surface and when a roof failure happens, the overburden sinks after. A depression of caldera shape with abrupt slopes suddenly forms in the non-karst rock at the surface. Such erdfall-collapses in Triassic claystones develop flatter walls in the course of the time.
In German such depressions are called "Erdfall" to distinguish them of dolines. Because in English the term "earth fall" has an other meaning, I will further call such depressions "erdfall-collaps".
The solution of limestones and sulphate rocks results with the formation of caves and following emergence of collapse dolines and erdfall-collapses. The underground dissolution (subrosion) of rock salt is as opposed to without formation of caves. It leads to a slow lowering of the earth's surface in flat depressions.
Subsurface mining of layers or stocks of ores and other minerals may cause caving with the same results as by natural processes: collaps dolines and erdfall-collapses, in German "Tagebruch". After swallets in salt mines originate such large collapses too. Dewatering of mines with contact to rock salt can accelerate the natural dissolution of salt and also produce depressions.
Another aspect of the problem is the age of these processes.
We know a large number of brown coal deposits in Germany, formed already in the Tertiary in water filled karst depressions. Today there is a large bog of Holocene age in a rock salt subrosion depression in the northern foreland of Hartz mountains.
The main problem of geohazards in Central Germany is the karstification of rock salt and sulfate rocks of Permian age.
By rock salt subrosion originate long grabens and large depressions with - relatively - rising up ground water table and declined slopes. Buildings and streets destroyed slowly are the result.
The roof failure of anhydrite and gypsum caves in 100 m depth in the overlying claystones of Triassic causes wide and deep caldera-shaped erdfall-collapses. Buildings and streets in the collapses and in its surrounding during aging were destroyed by gravity sloping, as the "Oberkirche" in the town Bad Frankenhausen/Kyffhäuser Mountains, a street in Schmalkalden/Thuringian Forest in the last years or a vanadin plant in the town Eisleben in the 70ties.
As opposed to the limestone solution such processes proceed very fast; hundreds of erdfall-collapses form in Germany every year.

There are specialists which mean, the collapses have a random distribution and occurrence.

In application of methods of the geologist Bruno Sander I have examined in gypsum areas of the Southern Hartz Mountains depressions regarding its symmetrology and temporal development. In such way it is possible to find tectonical fractures with active karstification prozesses. The extrapolation of such elements allows finding of intersection points of such elements with a higher probability and danger of the origin of new collapses.