



Natural and anthropogenic hazard: mine sinkholes in Sicily (Italy)

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The topographic surface of the southern and the central side of Sicily is affected by depression and chasms, like the phenomena of sinkholes. The presence in the territory of these morphologies closely linked to the collapse, it highlights through analysis of aerial and satellite photographs performed with geological and geomorphological relief. The formation of chasms is almost always preceded by morphologies similar to the nature of karst dolines: the appearance of the hill, it seems marked by depressions localized, with sub circular form, with diameters since 5 to 10 m and variable depth and size. At the bottom, at the centre of them often can be seen areas more depressed of preferential absorption. The formation of these depressions cause inevitably changes of the flow of water in surface and underground circulating, the general hydrogeology changing of the area and sometimes modifying the stability of near sides. In winter depressions, are usually full of water forming small lakes, while to the contrary, during the summer are dry completely. The sicilian sinkholes are concentrated mainly in areas where the mining took place and their location is always depending on the development of the underground mine. In southern and in the central side centre Sicily there are a lot mines, which once (1950-1960) were included among the most important european and extraeuropean producers of salts. Indeed here since antiquity were born different centers mining for the extraction of potassium salts and / or rock salt, and more of them are in the provinces of Enna, Caltanissetta and Agrigento. In this area of Sicily emerge the most complete messinian evaporitic successions, present in the Mediterranean. They are known as "Series Gessoso Solfifera" (Messinian upper) and emerge extensively in the central basin Sicilian known as "Basin of Caltanissetta,

extended NE-SW direction for approximately 140 km, with a width of approximately 80 km. The evaporites are represented here by several lithologic types such as evaporitic limestone (with including sulphur mineral), gypsum and salts (Halite, Silvite and Kainite). The evaporites are extremely soluble and easily modelling by rainwater and those of infiltration. Particularly gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and alkali chlorides, such as sodium chloride (NaCl) and potassium chloride (KCl) suffer dissolution processes extremely high. In Sicily, many of abandoned mines, have a structure rooms and pillars, the waters that infiltrate inside they cause a thinning of the pillars that not doing more to support their actions determine collapse phenomena and forming sinkholes. In other cases, sinkholes are linked to structural weaknesses of the tunnel of mines. Commonly the location where sinkholes can occur, are the meeting points of tunnels where the distance between support elements is the longest. These influences the collapse of the vaults. The Mines: Montedoro (Clatanissetta), Muti Coffari (Agrigento), Racalmuto (Agrigento) and Cattolica Eraclea (Agrigento) all abandoned for some time and strongly degraded, suffering of the phenomena described above, interacting with the surrounding area. The sinkholes in many cases are object of damage to homes and the activities in neighbouring, so rise the need to evaluate the risk caused by these phenomena, for a correct management of the territory in the central and in the southern side of Sicily.

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