

Salt subsidence

Geohazard legacy and future problem?

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Map of the UK showing the locations of former and present salt mines or extraction areas.

Salt (NaCl) is essential for life, necessary for cooking and a basic mineral for the chemical industry. It also contributes to winter road safety. Within Britain it is present as rock-salt mainly within Permian and Triassic strata from which it has a long history of exploitation. The main saltfields lie beneath Cheshire, Staffordshire, Worcestershire, coastal Lancashire, coastal Yorkshire, Teesside and parts of Northern Ireland. Salt, however, is a highly soluble mineral that can dissolve and cause severe subsidence problems induced either by mining or natural causes.

British salt derived from underground rock-salt deposits has been exploited since early Roman times, and possibly before. Place names ending in "wich" or "wych" indicate natural brine springs, and it is around such springs that the towns of Droitwich, Nantwich, Northwich and

Middlewich developed in Cheshire and the West Midlands. Coincident with these near-surface salt deposits, areas of natural subsidence occur, but these are slight when compared with historical subsidence caused by over-zealous exploitation.

In the late 19th and early 20th centuries the salt deposits were worked by two main methods: traditional mining and wild brine solution mining. Most of the conventional mining was in shallow "pillar and stall" mines with networks of tunnels commonly separated by insubstantial salt pillars. Wild, or uncontrolled, brine solution mining involved sinking boreholes and shafts down to the wet rock-salt surface and pumping the brine out. This wild brine method induced the flow of brine towards the extraction boreholes and linear subsidence belts spread out from the boreholes. In some situations, mine owners even pumped the

brine from flooded pillar and stall mines. Around Northwich and Middlewich, the resulting subsidence was catastrophic on a grand scale. Subsidence caused new lakes to appear on an almost daily basis, and "meres" or "flashes" many hundreds of metres across were formed by collapse after salt extraction. The subsidence in Cheshire was so severe that an Act of Parliament was passed placing a levy on all local salt extraction. This levy, which funded building reconstruction and compensation payments, is still made, but collected at a lower rate to reflect the reduced risk from modern extraction.

Modern salt extraction now takes place mainly in deep dry pillar and stall mines, or by controlled brine extraction leaving large deep underground chambers that are left flooded and filled with saturated brine. Current planning procedures ensure that the modern exploitation lies largely outside of urban areas so that risks are considerably reduced. However, there is still a legacy of problems related to the salt deposits. These include old salt mines that have not yet collapsed, and compressible or unstable collapsed ground over former salt mines. In addition, natural salt dissolution at the rockhead interface, between the salt deposits and the overlying superficial deposits, can cause ground engineering problems and aggressive saline groundwater. The accurate mapping of the rock-salt and associated deposits, and an understanding of their dissolution and collapse characteristics, help development and planning in these subsidence-sensitive areas.



Aerial view of the large subsidence crater formed by the collapse of Tennant Mine, Carrickfergus, County Antrim, NI. The mine was worked conventionally from the 19th Century until the 1920s and brine was extracted from it in the 1980s. It collapsed at 11.59 hours (BST) on 19th October 1990.