

CO₂-emanating thermal springs as potentially lethal geohazards in the Dallol region, Danakil Depression, Ethiopia, and the Hierapolis-Pamukkale region, Turkey

Sharad Master*

EGRI, School of Geosciences, University of the Witwatersrand, Johannesburg, RSA

*E-mail: sharad.master@wits.ac.za

Volcanoes and associated volcanic springs and emanations are potential human and animal health hazards which have been documented in many places since ancient times (Master, 2016). Carbon dioxide (CO₂) is an abundant volcanic gas, which is emitted during volcanic eruptions and in geothermal areas, and is particularly insidious and dangerous because it is odorless, and denser than air. The Afar region of northern Ethiopia is one of the most tectonically active regions in the world, and is the site of abundant recent volcanic activity and seismicity. The hot springs at Dallol in the northern Danakil Depression, Afar, are well known for their hydrothermal deposits of brightly coloured iron-rich salts. The source of the springs is probably from meteoric waters, which have interacted with magmatic rocks and magmas, from which their abundant contained gases, including CO₂, are derived. Near Dallol, the Black Water and Gaet'ale thermal springs have been observed with fountaining jets of hot hypersaline Fe-rich brines, especially after the seismovolcanic crises of 2005 (Master, 2016). Many dead birds were observed around the Gaet'ale springs and lake (and also Black Spring), and locals have observed the birds dying due to gas emanations from the lake. The thermal springs and lakes near Dallol may pose a dangerous (and even potentially deadly) health hazard for human visitors (Master, 2016).

In SW Turkey, the Pamukkale springs and travertine terraces of the non-volcanic Denizli basin are situated next to the ancient Phrygian town of Hierapolis, which was famed for its thermal springs, first described by the classical geographer Strabo (c.65 BCE- c.24 CE). In 2013, an Italian archaeological team led by Francesco d'Andria announced the discovery, in Hierapolis, of the Ploutonion, a temple dedicated to Pluto, Greek god of the underworld, and regarded in ancient times as the gates of Hades. Strabo, describing the Ploutonion, reported that "this space is full of a vapor so misty and dense that one can scarcely see the ground. Any animal that passes inside meets instant death. I threw in sparrows and they immediately breathed their last and fell" (Master, 2016). D'Andria reported that "several birds died as they tried to get close to the warm opening, instantly killed by the carbon dioxide fumes" (Master, 2016). As a safety precaution, d'Andria's excavations at the Ploutonion have subsequently been covered up again (as observed by the author in June 2016), because of the risk of CO₂ exposure to tourists, who are free to wander around the ruins of Hierapolis, one of Turkey's top tourist attractions. In 2016, a local excavator in Hierapolis, who had illegally dug into an ancient grave while searching for artefacts, was overcome with carbon dioxide poisoning, and died in the local hospital, most likely from the effects of acute carboxyhaemoglobinaemia. Although birds and small animals are known to have succumbed to the CO₂ from the Ploutonion at Hierapolis since antiquity, this is the first recorded human casualty, and serves as a warning about the potentially lethal nature of the thermal springs at Pamukkale-Hierapolis.

Keywords: Afar, Gae'tale, Ploutonion, dead birds, human casualty

Reference

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