Chapter 2
Advances in Forensic Geophysics:
Magnetic Susceptibility as a Tool for Environmental Forensic Geophysics

Elhoucine Essefi
University of Gabes, Tunisia

ABSTRACT

Traditionally, forensic geophysics involves the study, search, localization, and mapping of buried objects or elements within soil, buildings, or water using geophysics tools for legal purposes. Recently, with the evolution of environmental crimes, forensic geophysics gave special care to detection, location, and quantification of polluting products. New techniques including the magnetic susceptibility have emerged to investigate this type of crimes. After discussing the state of the art of forensic geophysics, this chapter proposed the magnetic susceptibility as an efficient tool of environmental crimes detection. A case study of pollution detection was proposed from Tunisia. Being a fast and cheap technique, magnetic surveys represent a real promise for environmental forensic geophysics.

1. INTRODUCTION

Traditional crimes may damage a person or a small group while environmental crimes threaten the whole humanity. These newly emerging crimes were not given the worthy care. Instead, governors remain tolerant with wrongdoers. In this vein, forensic investigations would pave the way for the applications of laws in face of

DOI: 10.4018/978-1-7998-8386-9.ch002

these new emergent crimes. In terms of criminal issues, to elaborate a successful criminal conviction, locating forensically important evidence is of great importance (Alajmi et al., 2020; De Giorgi et al., 2020; Jakubec et al., 2021; Malejko et al., 2020; Pringle et al., 2021; Wallace et al., 2021). Searched objects for forensic investigation are variable including landmines (Madzunya et al., 2021) and improvised explosive devices (Baldaino et al., 2021; Vanderheyden et al., 2020) or improvised explosive devices (IEDs) (Franceschetti et al., 2021), illegally buried explosives (Shvedchikova et al., 2021) and weapons (Harvey and Sekulla, 2021), mass genocide graves (Ekštajn et al., 2021), drugs and weapons caches (Cadwell, 2020) and clandestine graves of murder victims (Colledge, 2020). With less than 3 m under the ground level (Koşaroğlu et al., 2021; Różycki et al., 2020), burials are generally not quite deep in these cases. In terms of environmental crimes, toxic waste present in illegal dumps has become a serious growing issue (Davis et al., 2021; Qasim et al., 2020; Morrison, 2020). Along water bodies with poor visibility or large search areas, water-based forensic geoscience surveys prove vital to assist police and environmental divers (Burnier et al., 2020; Kootker et al., 2020). Variable forensic techniques are currently in use; in many countries; a search strategist is by obligation involved in a case at an early stage to decide upon the highest probability of search success (Swain, 2020). The use of geoscientific methods has been increasingly adopted and reported to locate of clandestinely buried material (Mansegosa et al., 2021; Molina et al., 2020). Investigations start from the large-scale remote sensing methods (Sharma et al., 2020; Pensieri et al., 2020), surface geomorphology changes (de Bruin and Schmitz, 2021), aerial (Rocke et al., 2021) and ultraviolet photography (De Angelis et al., 2020; Mia et al., 2021), to ground-based observations of vegetation changes (Finkelstein et al., 2020), thermal imaging (Listos et al., 2021; Deveci et al., 2020), soil type and depositional environment (Xu et al., 2020; Hachem et al., 2020; Sangwan et al., 2020), near-surface geophysics (Weiss and Roy, 2020), diggability surveys (Lockwood, and Masters, 2021) and probing of anomalous areas before topsoil removal and finally controlled excavation and recovery. Near-surface geophysical methods are based on the contrast detection between the signal of the target and the and the noise of the host materials. Although the use of ground penetrating radar or GPR (Amran et al., 2020; Damiata et al., 2020; Elis et al., 2020; Schneider et al., 2020; Kelly et al., 2021; Berezowski et al., 2021) as the dominant geophysical method, recent studies suggested multi-methods approaches (Osbourne et al., 2020). For example, both Electro-Magnetics or EM (Mankoff et al., 2020) and its reciprocal electrical resistivity techniques are relatively fast to acquire and resulting anomalous areas can then be further investigated by higher resolution methods. Concerning the limitations of the GPR method, other studies showed that the GPR is not relevant in certain search environments including clayey material (Canata et al., 2020) and heterogeneous soil types (Dong et al., 2020), which are significantly