Chapter 3
Advances in Forensic Sedimentology

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ABSTRACT

Forensic sedimentology is a relatively recently realized field. Sedimentological methods used to solve cases have evolved as the field has developed, beginning with simple identification of minerals and progressing to the examination of individual grains using highly advanced scanning electron microscopes. More simple methods, such as color analysis, are still used today, but in addition, forensic sedimentologists look at surface textures and grain size distribution. For instance, quartz grains were used in a forensic technique as sediment fingerprint. The particle size distribution is one of the important tests when analysing sediments and soils in geological studies. For forensic work, the particle size distribution of sometimes very small samples requires precise determination using a rapid and reliable method with a high resolution. FRITSCH laser granulometer offers rapid and accurate sizing of particles in the range 0.04–2000 µm for a variety of sample types, including soils, unconsolidated sediments, dusts, powders, and other particulate materials.

1. INTRODUCTION

Although the idea of using sediment for forensic purposes has been popular in fiction for more than a century (Lanier, 2017), forensic sedimentology had remained a novel field of study (Douglas et al., 2020; Madureira-Carvalho et al., 2020). Simple methods such as color analysis are still used today. In addition, forensic sedimentologists also examined the surface and grain structure via binocular (morphosocopy), optic

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microscope and SEM (exoscopy). Several analytical techniques have been used such as high-tech scanning electron microscope which is used to examine individual crystal grains. Cases handled by sedimentologists involve environmental violations, murder, theft or kidnapping. The most famous cases are related to the prevention of war victims (Inkret et al, 2020). The application of forensic expertise or science in criminal investigation (Ruffell and McKinley, 2005) has long been at the forefront of research and development of scientific technology and methods. Geology plays a vital role in any forensic environmental survey (Hashmi et al, 2020). In spite of recent criticisms (Melo et al, 2020), sedimentology in particular can establish connections between people, objects, and places to determine the facts and possibilities of these connections. With the development of analytical techniques, forensic sedimentology has become a leader in scientific criminology (Frankl et al., 2021).

Historically speaking, the first known idea of forensic geology may have come from Sir Arthur Conan Doyle (1887). Then, geology was used to decipher real cases in 1904 (Ruffell and McKinley, 2005). In some cases, we can judge how long a person has been in a given site by the color and density of the sediment on his clothes. Other theoretical applications of geology in solving crimes, as well as other forensic techniques were recently discussed such as ballistics (Ruffell and McKinley, 2005; Sydow et al., 2020). The spread of crime and the spread of geography quickly became popular methods in well-known organizations, rather than just for personal use. In the early 20th century, governments and educational institutions recognized the potential of forensics and used their advantages. They established specialized forensic laboratories and trained scientists to use their expertise to fight crime (Ruffell and McKinley, 2005). The university has developed a forensic science plan, and national organizations such as the FBI have begun to use forensic science to regularly investigate cases. The importance of using sediment as evidence is still used today to establish connections between people, places and objects. Forensics sedimentology is basically applied on soil rather than rocks (Sangwan et al, 2020). Soil forensics research, studies and analyzes of traces of soil connected to a crime (Xu et al, 2020). In the context of forensic analysis, the term soil is referred to any of the material of geological origin that consists of removable elements, such as a sandy beach, mud or soil (Profumo et al., 2020). The ground can provide important information to tie a person to a place and clarify the dynamics of a crime, as it can be transferred from one place to another for filing on moving surfaces, such as shoes, tires or work tools. Many crimes are committed in the open where the ‘environment, which is not a closed system, it is able to exchange items with those who participated in. Soil is a system made up, at the microscopic level, of several components that have been formed and developed during its long process of formation. This process is affected by many factors: the nature of the mother rock, the climate, the topography, the micro-organisms and vegetation and the current time. Under

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