



D3 An Environmental Forensic Analysis at the Doce River Estuary: A Tool for Damage Assessment in a Major Tailings Dam Break in Brazil

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After attending this presentation, attendees will better understand the important aspects of environmental forensic examinations as applied to industrial disasters of major proportions.

This presentation will impact the forensic science community by illustrating modern techniques and an integrated approach to geoprocessing and environmental chemistry.

The goal of this presentation is to present the forensic examinations used to assess the extent of environmental damage at the mouth of the Doce River in Brazil, caused by mining tailings discharged by the disruption of the Fundão dam.

Estuary, a coastal environment of transition between river and sea, is considered an area of high environmental sensitivity, since it is a breeding and feeding area for several river and marine species. On November 21 2015, the Doce river estuary was affected by a plume of tailings originating from a mining company dam that had broken 16 days earlier. Some consider this the greatest dam collapse in mining history.

To assess the damage to the estuarine ecosystem, a forensic team from the Brazilian Federal Police conducted environmental examinations at the mouth of the Doce River. The examined site consisted of an area of natural occurrence of various endemic species of mangroves, typical wetlands plants, and endangered animal species. The marine zone adjacent to the mouth of the river is a reproduction and migration area of marine cetaceans and turtles, many of them endangered.

Forensic experts monitored the area before and after the arrival of the tailings plume, using boats, aircraft, and Unmanned Aerial Vehicles (UAVs). Field inspections and laboratory analyses were conducted to check water quality indices. Experts measured the dispersion of the tailings plume through the sea by daily helicopter overflights arranged using photographic and Global Positioning System (GPS) data. The plume advance was also tracked by images produced by orbital sensors (WorldView 02, WorldView 03, GeoEye-1, and Landsat 8, the latter having a specific band for sediment analysis in water). UAVs were used to obtain high-resolution images of a nearby coastal Federal Conservation Unit, another highly sensitive area in the region.

Normally, turbidity levels of the mouth of the Doce River were lower than five Nephelometric Turbidity Units (NTUs). The tailings plume resulted in the turbidity of mouth waters exceeding 2,000 NTUs, with peaks exceeding 5,000 NTUs and well above the legal Brazilian limit (100 NTUs). Water pollution resulting from mining tailings caused serious environmental damage, such as modification or elimination of wildlife niches, refuges, and breeding sites. Mortality of aquatic animals and migratory marine birds was also observed. Socioeconomic activities in local villages were affected due to the interruption of the drinking water supply and the decrease of tourism and fishing.



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Expert examinations allowed a precise characterization of the site before and after the arrival of the tailings plume, thus enabling quantification of the environmental and socioeconomic damage caused by dam break. The current forensic examinations were crucial for proving the environmental crime caused by the dam break, revealing the deleterious effects of pollution on the Doce River estuary.

Dam Break, Estuary, Pollution