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# Presence of thallium in the environment: sources of contaminations, distribution and monitoring methods

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**Abstract** Thallium is released into the biosphere from both natural and anthropogenic sources. It is generally present in the environment at low levels; however, human activity has greatly increased its content. Atmospheric emission and deposition from industrial sources have resulted in increased concentrations of thallium in the vicinity of mineral smelters and coal-burning facilities. Increased levels of thallium are found in vegetables, fruit and farm animals. Thallium is toxic even at very low concentrations and tends to accumulate in the environment once it enters the food chain. Thallium and thallium-based compounds exhibit higher water solubility compared to other heavy metals. They are therefore also more mobile (e.g. in soil), generally more bioavailable and tend to bioaccumulate in living organisms. The main aim of this review was to summarize the recent data regarding the actual level of thallium

content in environmental niches and to elucidate the most significant sources of thallium in the environment. The review also includes an overview of analytical methods, which are commonly applied for determination of thallium in fly ash originating from industrial combustion of coal, in surface and underground waters, in soils and sediments (including soil derived from different parent materials), in plant and animal tissues as well as in human organisms.

**Keywords** Thallium · Toxicity · Laser excited atomic fluorescence spectrometry (LEAFS) · Inductively coupled plasma mass spectrometry (ICP-MS) · High-resolution inductively coupled plasma mass spectrometry (HR-ICP-MS) · Electrothermal vaporization inductively coupled plasma mass spectrometry (ETV-ICP-MS) · Atomic absorption spectrometry (FAAS and GFAAS) · Zeeman effect electrothermal absorption spectrometry (ZEETAS) · Differential pulse anodic stripping voltammetry (DPASV)

## Reviewing method

The data for this review was collected from the available literature including reports, scientific articles, books, book chapters and databases. The reviewing method was focused on data regarding determination of thallium in environmental samples as well as the employed analytical methods, which were obtained from the following databases: Scopus, Elsevier, Wiley, Springer and Web of Knowledge. The search was conducted using the keywords listed above. After the initial search, the gathered data was further checked in order to evaluate its relevance to the topic and matching positions were selected for review.

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## Introduction

Contamination with heavy metals is considered as a major environmental issue and threat to human health. Thallium-based compounds exhibit a high tendency to accumulate in the environment. Alleviated level of thallium emissions as well as its deposition over time may lead to major environmental pollution. Prolonged