# Bioaccessibility of trace elements associated with beached plastic debris in New Zealand

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**Abstract**

Plastics are discharged from land into the coastal zone where they are commonly found washed up on beaches. These plastics have to potential to have environmental contaminants, trace elements, associated with them. Trace elements may be inherent as additives, and non-intentionally added substances (NAIS), or adsorbed from the surrounding environment. With changing environmental conditions, including ingestion by organisms, these trace elements have the potential to be released from the plastic. The concentrations of trace elements that are associated with beached plastic may change depending on urbanisation, industrialisation, geological characteristics, polymer type, item function and even colour.
There is a lack of knowledge around the concentrations of trace elements associated with beached plastic debris from New Zealand, and their bioaccessibility is under-studied worldwide. This study utilised citizen scientists to collect beached debris from 20 locations around New Zealand. Inductively coupled plasma – mass spectrometry was used to analyse 14 trace elements (arsenic, barium, cadmium, cerium, cobalt, chromium, caesium, copper, mercury, molybdenum, nickel, lead, antimony, and zinc) that are known environmental pollutants or common plastic additives. The proportion of trace elements bioaccessible to marine invertebrate and vertebrates using gastric fluid simulants was determined using two commonly collected items; lollipop sticks and firework casings.
All 14 trace elements were detected and at a wide range of concentrations, with pigments identified as the dominant source of elevated concentrations. A varying proportion of trace elements were made bioaccessible depending on the item, simulant, and trace element. This pioneering study of contaminants associated with plastic beach debris in New Zealand has identified that trace elements used as pigments may pose a risk to wildlife due to the very high concentrations present, and their ability to disassociate from the plastic under simulated gastric conditions.

**Keywords:** Plastic, debris, trace elements, bioaccessibility

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