Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35090

Temperature-Dependent Particle Formation During Biomass Combustion: A Combined spICP-TOFMS and Magnetic Susceptibility Study

SELENE CALVEL[1], AUDE ISAMBERT[1], MICKAEL THARAUD[1], CHAD CUSS[2], JULIE CARLUT[1] AND **MARC F. BENEDETTI**[1]

[1]Université Paris Cité, Institut de Physique du Globe de Paris, CNRS

[2]Grenfell Campus, Memorial University of Newfoundland

Wildfires increasingly threaten ecosystems worldwide, yet their impact on nanoparticle formation and environmental mobility remains poorly understood. This study investigates how combustion influences the production, composition, and magnetic properties of inorganic nanoparticles through controlled laboratory experiments on heather biomass. Combining nanoparticles analyses in leachate single-particle inductively coupled plasma time-of-flight mass spectrometry (spICP-TOFMS) and magnetic bulk susceptibility measurements, we characterized samples formed across a range of combustion temperatures (400–800 °C) and durations (5–30 min). Fresh, organic-rich samples exhibited predominantly diamagnetic behavior. Progressive heating marked increases in saturation magnetization (Ms), suggesting transformation of iron oxide phases with significant changes emerging at 400 °C and intensifying above 550 °C. Leaching experiments revealed pronounced shifts in particle composition: fresh samples released predominantly iron-rich particles (>50%), whereas high-temperature combustion (800 °C) yielded leachates dominated by manganese nanoparticles (>95%). At intermediate temperatures (550 °C), a distinct population of Fe–Mn bimetallic nanoparticles appeared, indicating redox-driven coalescence or intermetallic interactions. Particle concentrations ranged from 3.0×10^7 to 2.7×10^9 particles g^{-1}, with complex release patterns reflecting competing processes of enhanced mobilization, particle coarsening, and aerosolization at extreme temperatures. Together, magnetic and leaching data provide complementary constraints on fire-induced transformations.