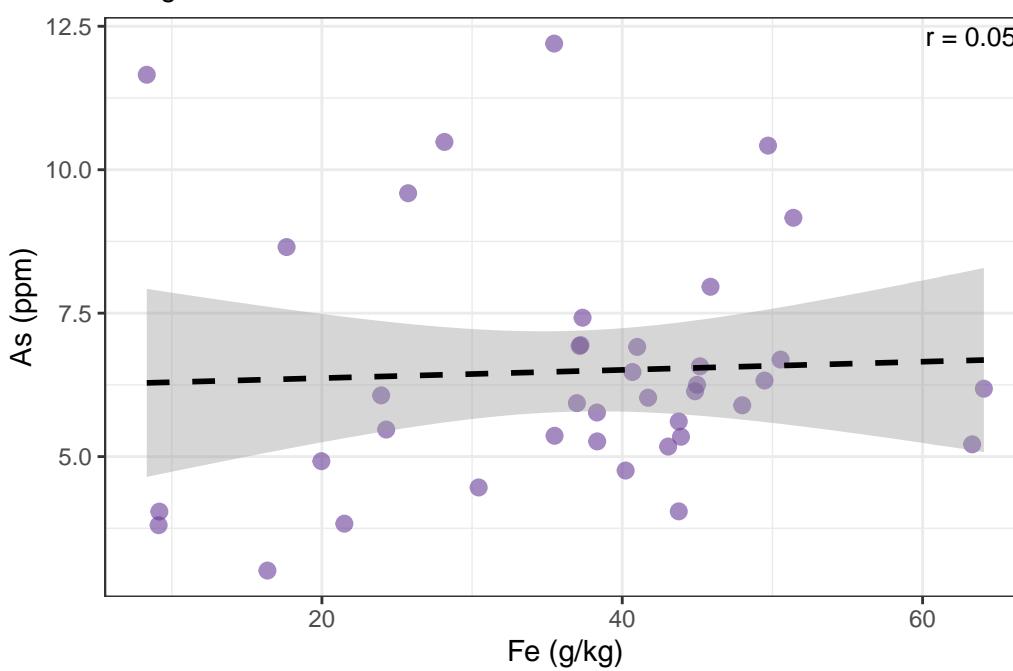**Geogenic Metal Characterization via Elemental Ratio Proxies**

As, Cr, Ni show matrix-controlled distributions consistent with crustal sources
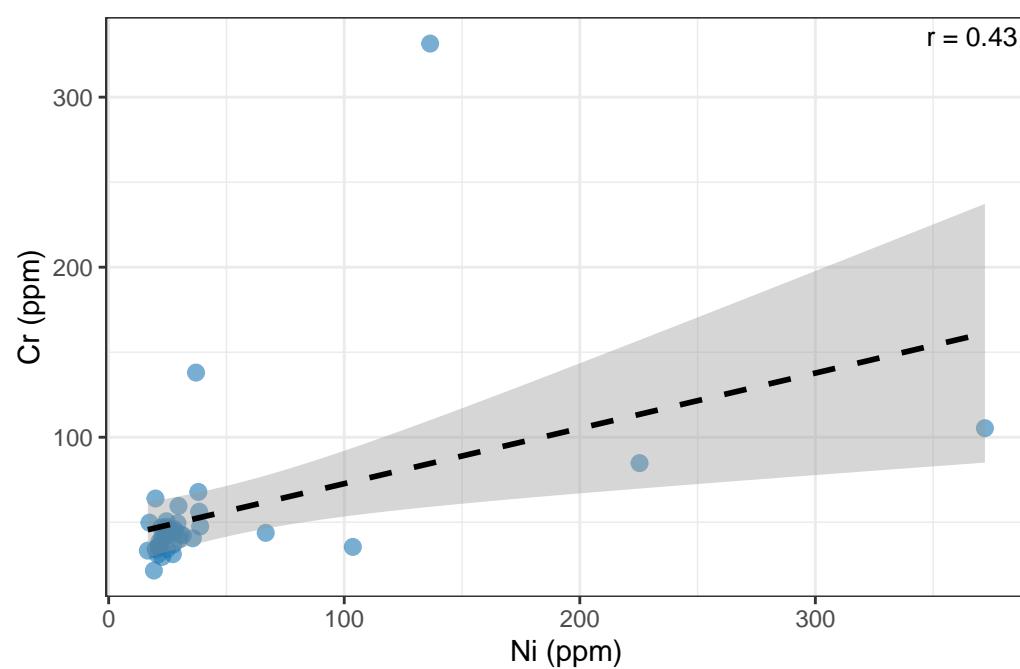
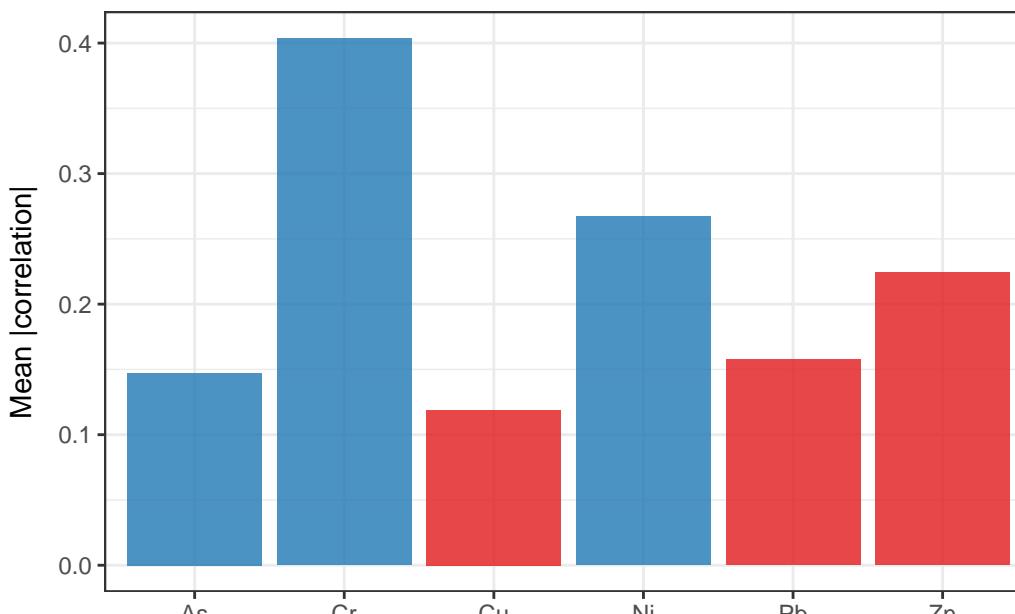A) Arsenic vs Iron
Geogenic As-Fe association
r = 0.05

As (ppm) vs Fe (g/kg)

B) Chromium vs Nickel
Ultramafic source indicator
r = 0.43

Cr (ppm) vs Ni (ppm)

C) Mean |r| with Matrix Ratios
Geogenic metals correlate better with matrix proxies

Mean |correlation| for As, Cr, Cu, Ni, Pb, Zn

D) Al-Normalized Geogenic Metals
Consistent ratios indicate crustal source

Metal/Al (ppm per 1000 ppm Al) for As, Cr, Ni

Metal Class: Fire-enriched, Geogenic