

These digestions were designed to solubilize specific components of soil samples (*e.g.*, those components transported from depth through exotic overburden to the surface) so that high geochemical contrast allowed reliable recognition of transported element anomalies. Unfortunately, the reception these proprietary digestions received from geoscientists has been highly variable: some geoscientists ‘believe’ in their worth as effective exploration tools, whereas others pan them as ‘snake oil’. Furthermore, the performance level of these techniques has generally been disappointing, partly because no exploration technique is infallible, and partly because proper data interpretation is virtually impossible when the reagent chemistry used to solubilize a sample is unknown.

Factors that typically must be considered when evaluating what component of a soil sample has been put into solution, and thus providing insight into how to interpret geochemical anomalies, are: (i) the geochemical behavior of the pathfinder element, (ii) the stability and adsorptive behavior/characteristics of the mineral in/on which it resides, (iii) the equilibrium *pH* and *pe* of the soil in deionized water, (iv) the *pH* and *pe* of the reagent before and after digestion, (v) the presence of buffers in the reagent, (vi) the behavior of exchangeable ions in the reagent, and (vii) the presence of ligands in the reagent. Obviously, last four factors are not known when using a proprietary leach, but need to be to properly data process and interpret the cause of a soil geochemical anomaly.

For example, if Zn is adsorbed onto the surfaces of poorly crystalline Fe-oxy-hydroxides (*e.g.*, ferrihydroxide, goethite and hematite) in a soil, and a weak solubilizing reagent (say, MgCl_2) merely causes cation exchange of Mg^{+2} for the adsorbed Zn^{+2} , then two factors could control the Zn concentration in the resulting solution: the amount of Fe-oxy-hydroxide in the soil, and the amount of soluble Zn available for adsorption to the soil (a factor probably related to the presence of mineralization). More Fe-oxy-hydroxide could produce a Zn anomaly merely because more adsorption of Zn could take place. Consequently, dividing the Zn concentration by the amount of readily soluble Fe would remove (standardize) these variations, leaving the variations caused by differing amounts of soluble Zn available for adsorption. However, if Pb occurs in clastically dispersed galena grains, and an oxidizing agent (say, nitric acid) oxidizes the sulphide, breaking down galena and liberating Pb, then examining the Pb concentration as an individual variable represents an appropriate data processing and interpretive strategy. Obviously, understanding the mineralogical and geochemical properties of soil samples and the behavior of partial digestion reagents are both required to identify the appropriate manner in which to evaluate and interpret geochemical soil anomalies.

**Partial digestions in soil geochemical exploration:
How buffering, adsorption, and mineral stabilities
influence data processing and interpretation**

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In the 1990s, many commercial geochemical laboratories introduced ostensibly new, proprietary partial digestions for the analysis of soil samples from mineral exploration programs.