

A Blind Comparison of Multiple Analytical Methods for Soil Comparison in a Home Invasion Robbery Double Shooting Case in Urban Phoenix, AZ

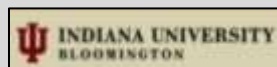
By Gwyneth Gordon, PhD,¹ Laura Wasylenki, PhD,^{1,2} Carina Arrua, MS,³ Det. Dave Hurt⁴ and Ariel Anbar, PhD¹

¹School of Earth & Space Exploration, Arizona State University, Tempe, AZ

²now at Department of Geology, Indiana University, Bloomington, IN

³Department of Chemistry, University of Córdoba, Córdoba, Argentina

⁴Phoenix Police Department, Phoenix, AZ



Case information

- Home invasion, robbery and shooting of two victims in metro Phoenix
- Shoe impressions in dirt outside of victim's window
- Suspect identified
- When questioned, suspect was wearing boots with soil adhering to soles
- Suspect stated he was gardening in his yard

Samples collected by police detectives:

- Suspect's clothing
- Victim's house (multiple samples)
- Suspect's house (multiple samples)
- Other neighborhood yards (multiple samples)

Question:

*Was suspect's clothing sample consistent with any other
samples provided to analyst, without knowledge
of sample identity
How unique was the sample?*

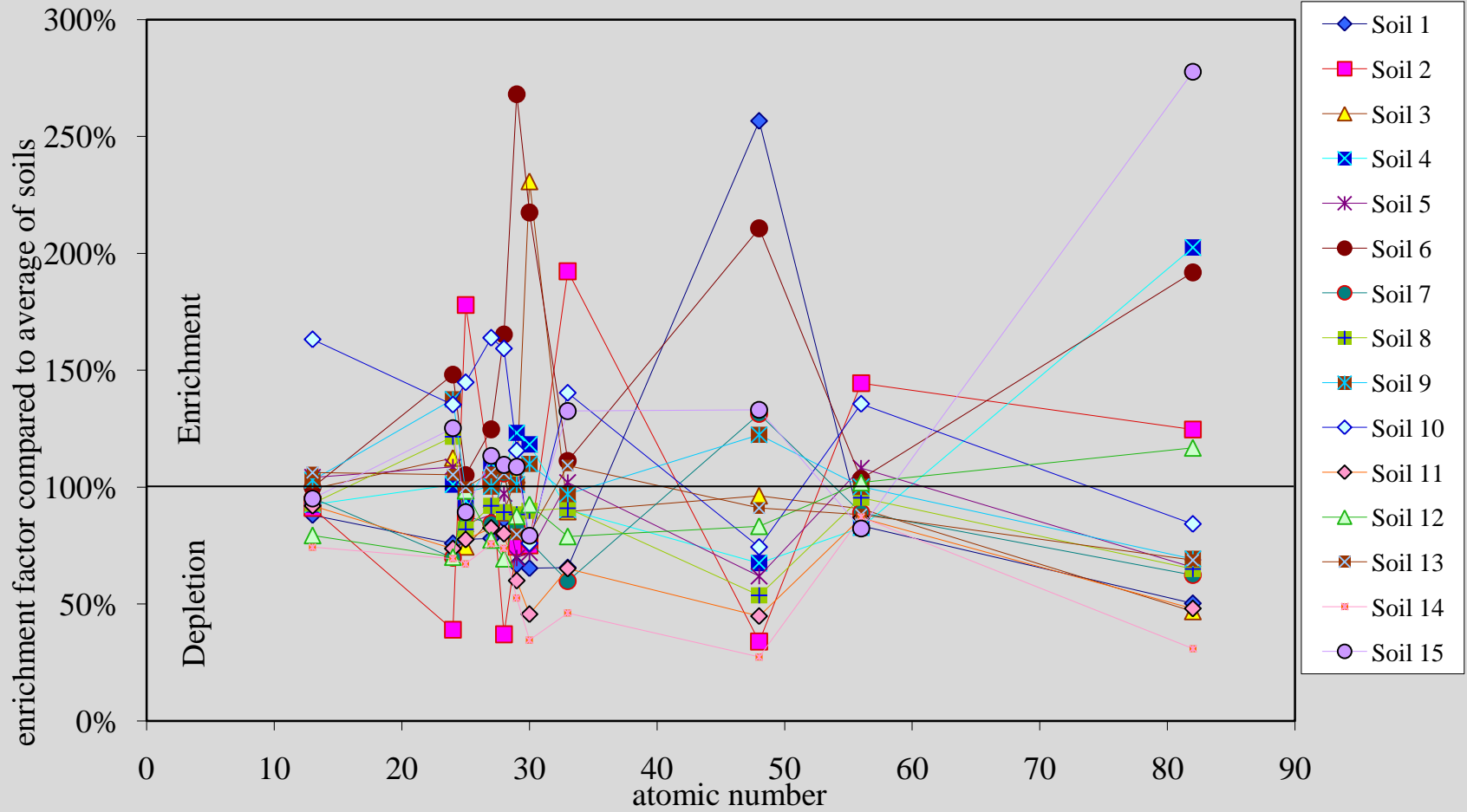
Analyses

- Visual analysis and photomicrographs
 - Munsell soil color
 - grain size, shape and sorting
 - mineral identification, exotic particles
- X-Ray Diffraction *on* $<150 \mu m$
 - Mineral content, including clays
 - Mineral ratios
- Elemental composition (ICP-MS) *39 elements*
- G-IRMS
 - C, N content, $\delta^{13}C$
- MC-ICPMS
 - Sr and Pb radiogenic isotopes

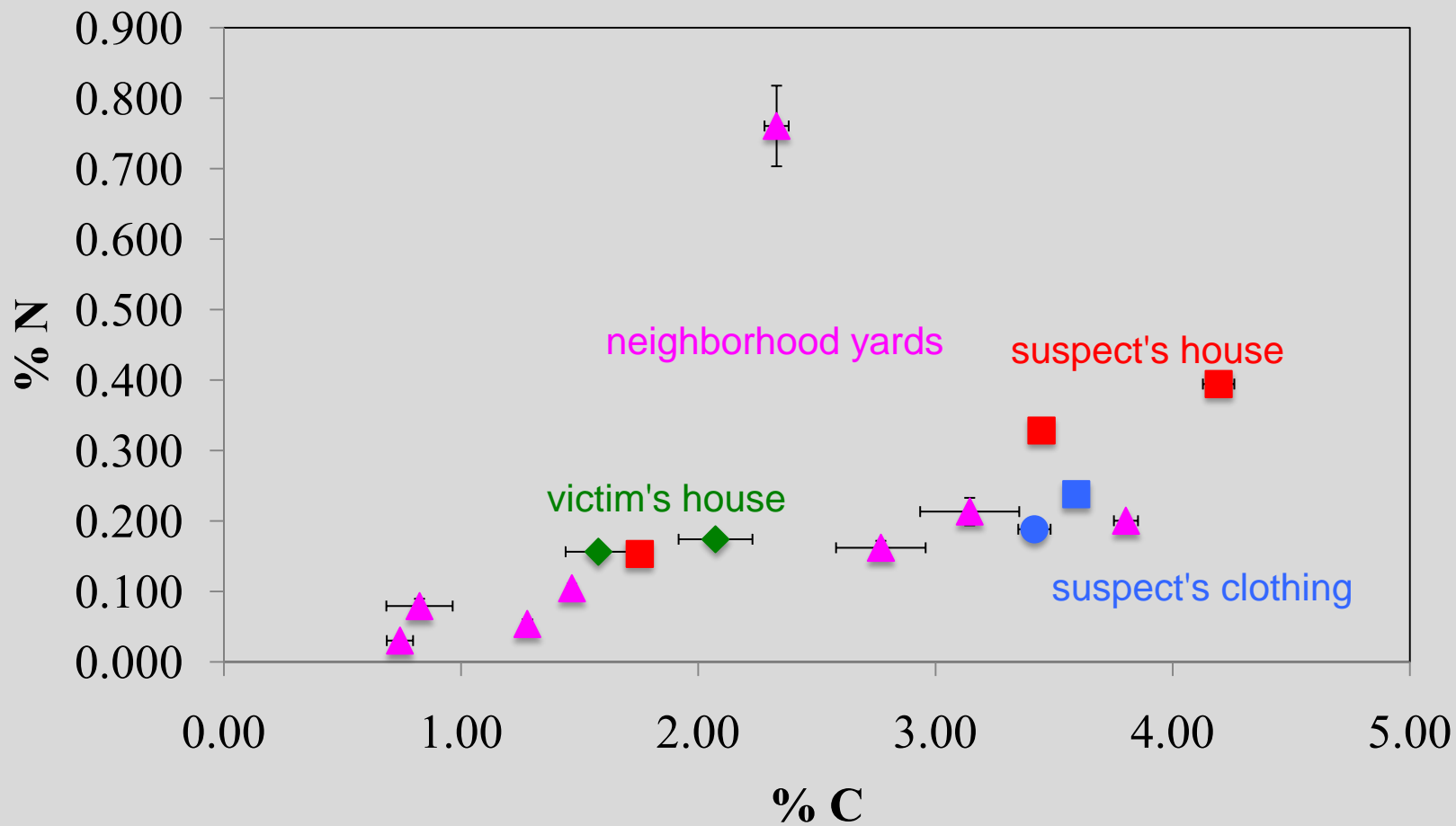
Sampling Considerations

- Chain of custody
- Sample bias due to collection time
 - Sample bias due to transfer
 - Sample heterogeneity
 - Particle size
 - Sample size
 - Preservation of sample

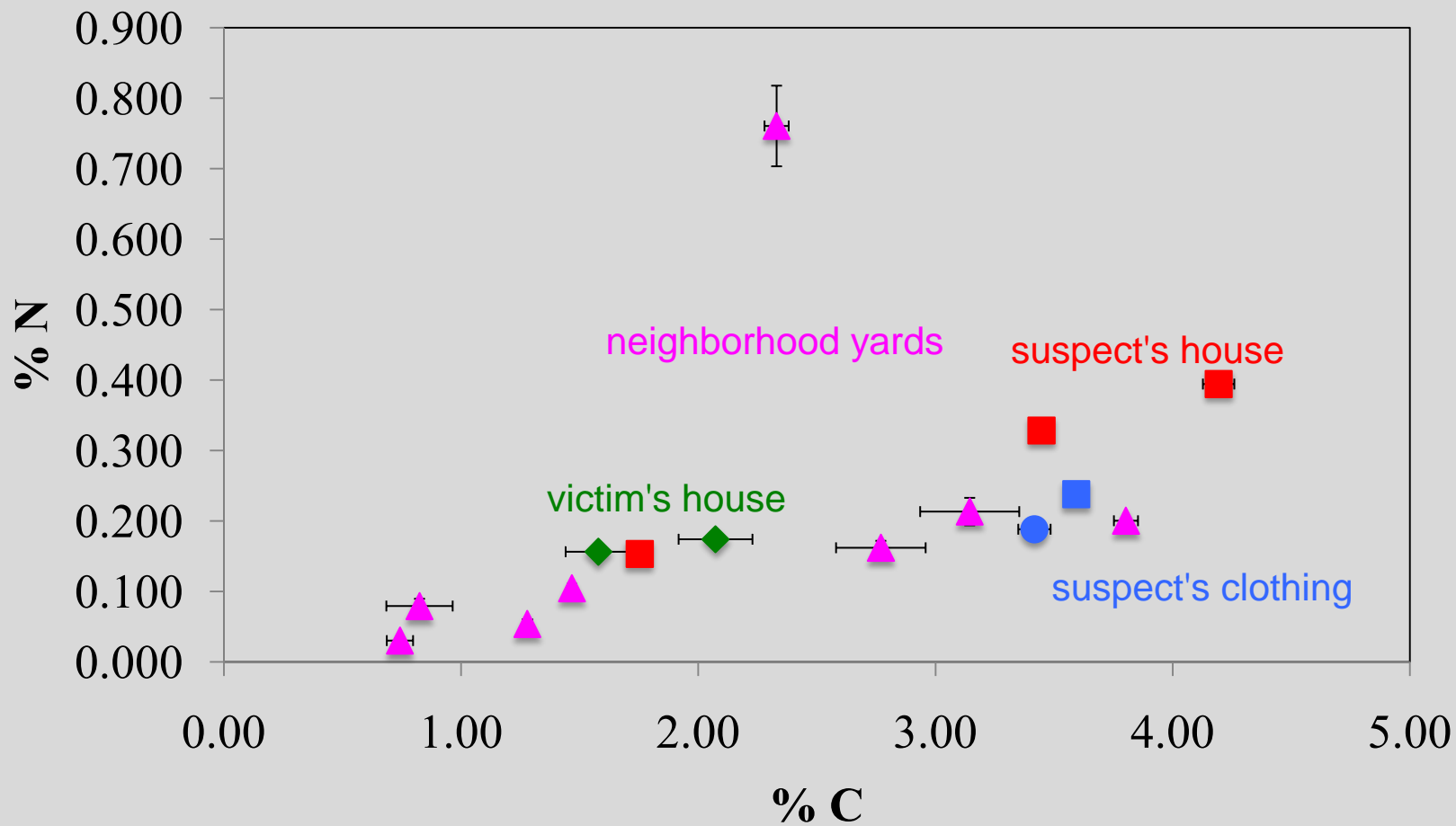
ICPMS



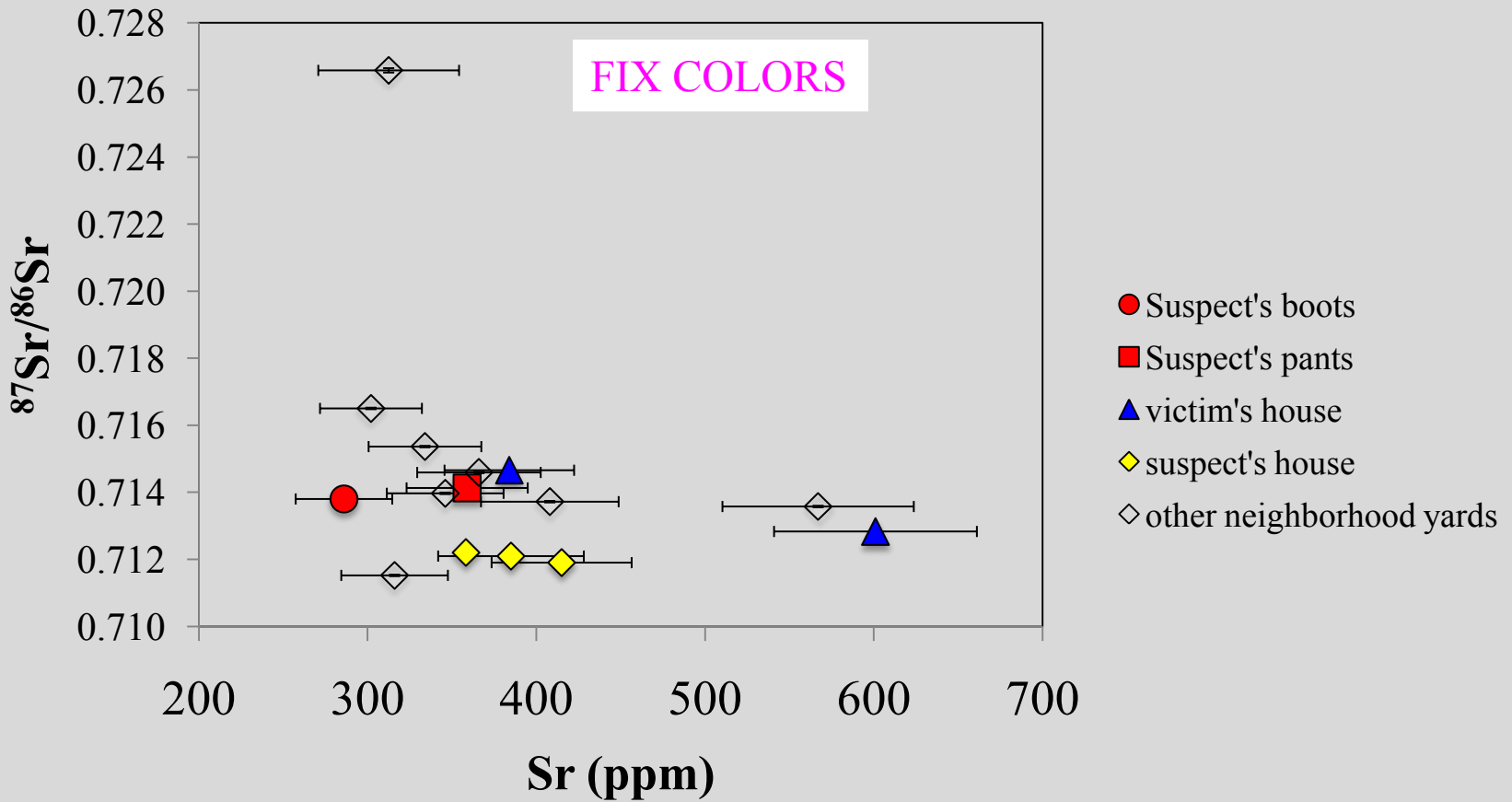
G-IRMS



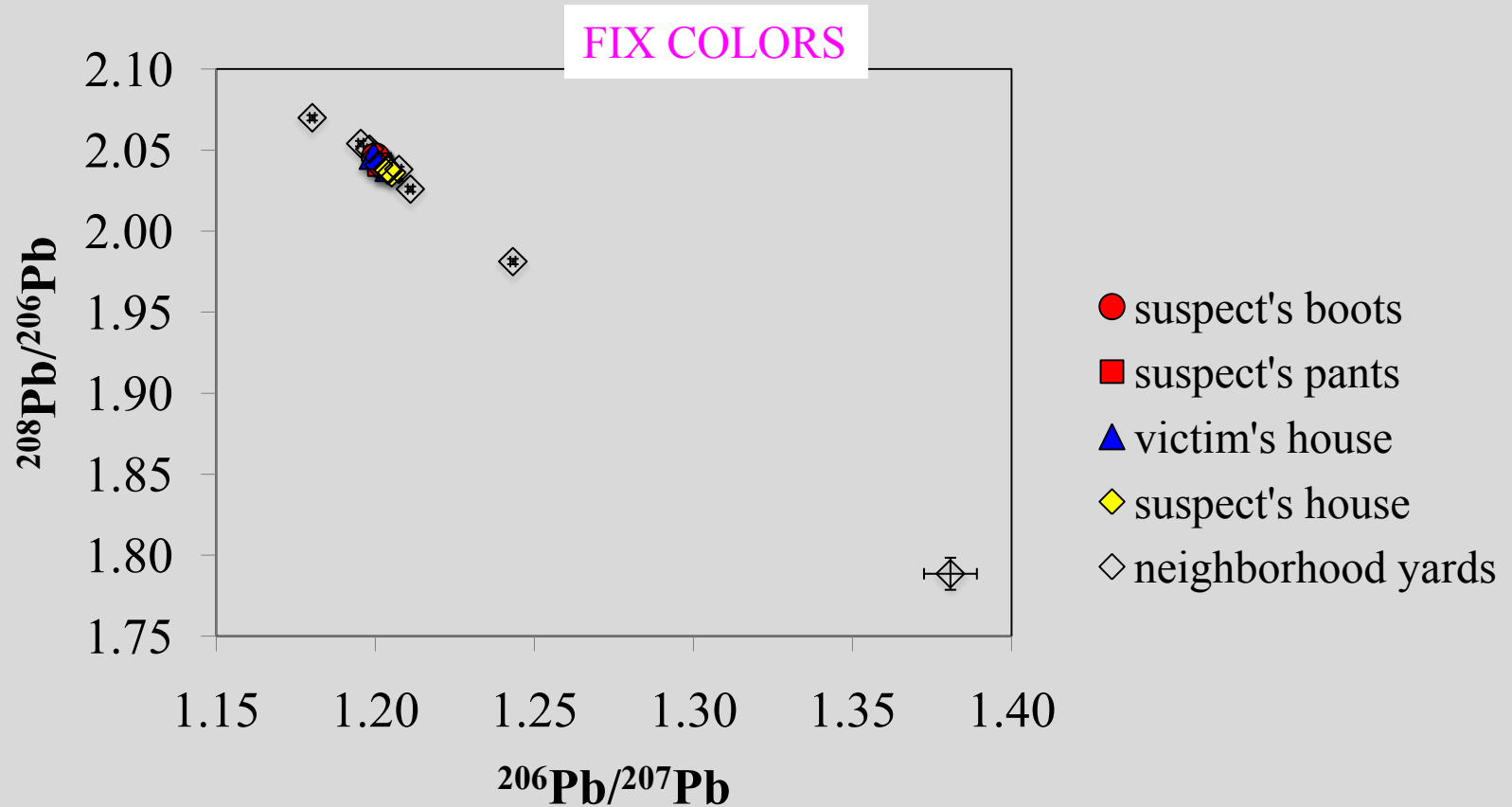
G-IRMS



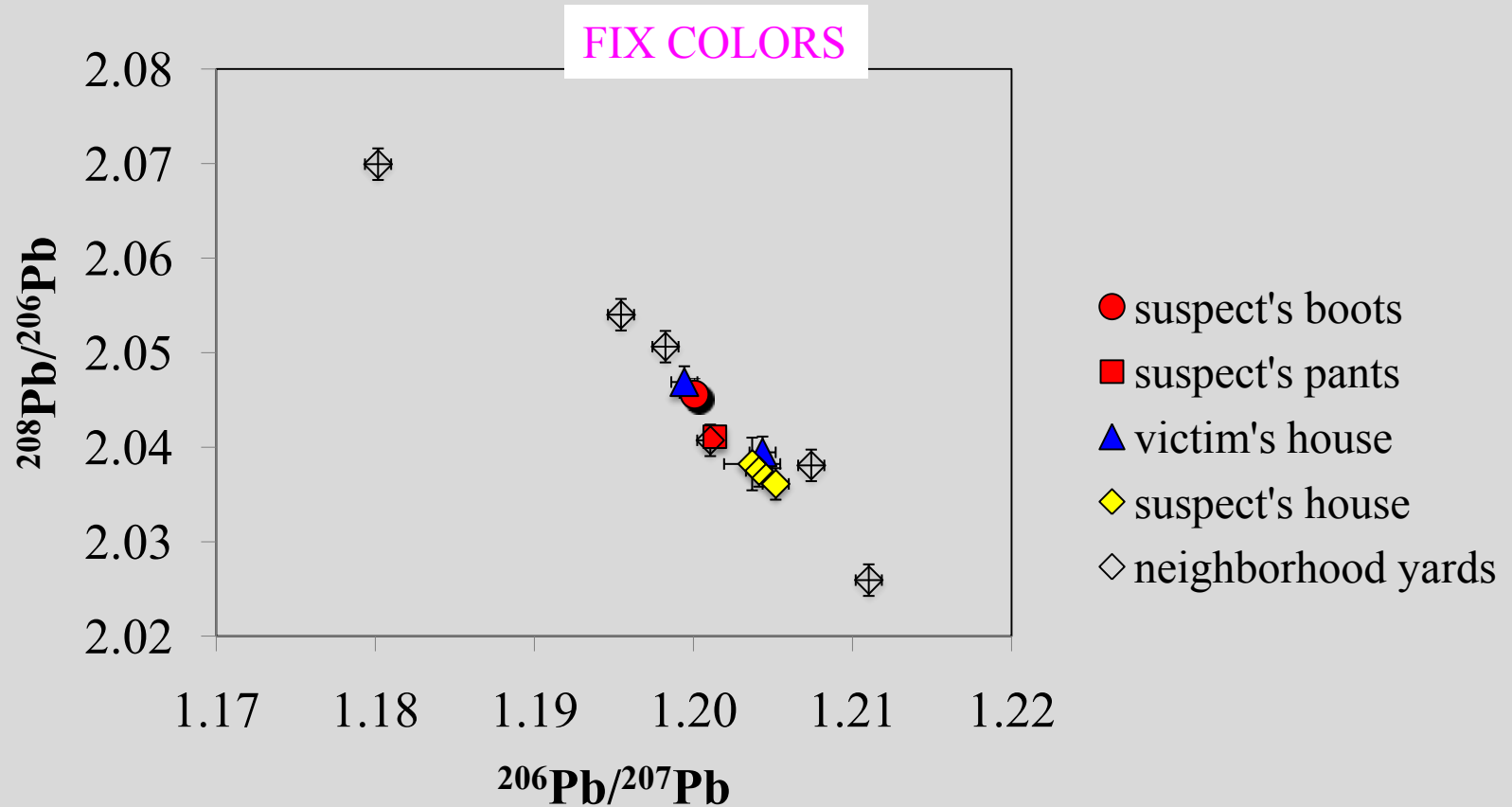
Radiogenic isotopes: $^{87}\text{Sr}/^{86}\text{Sr}$



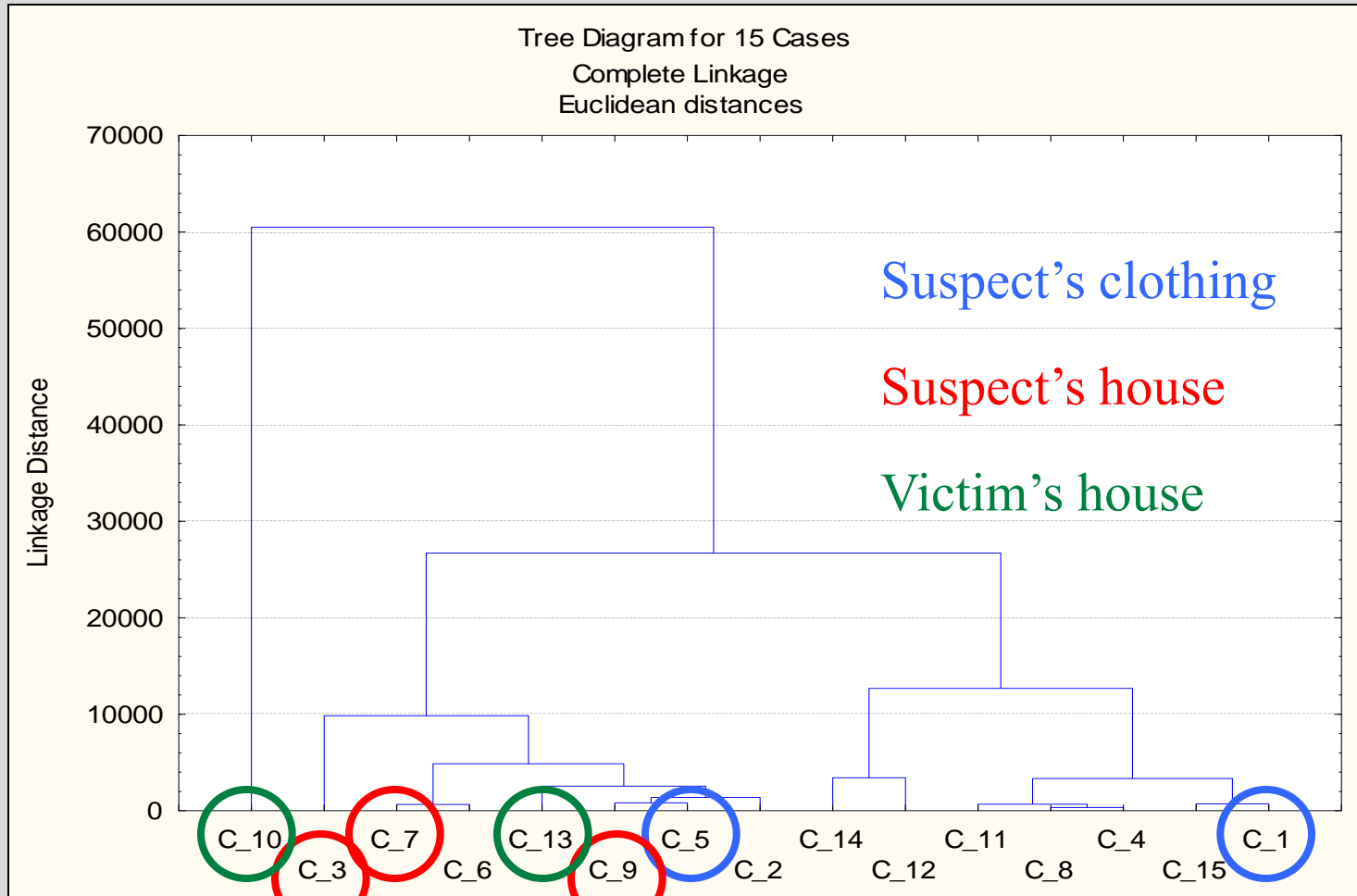
Radiogenic isotopes: $^{208}\text{Pb}/^{206}\text{Pb}$ and $^{206}\text{Pb}/^{207}\text{Pb}$



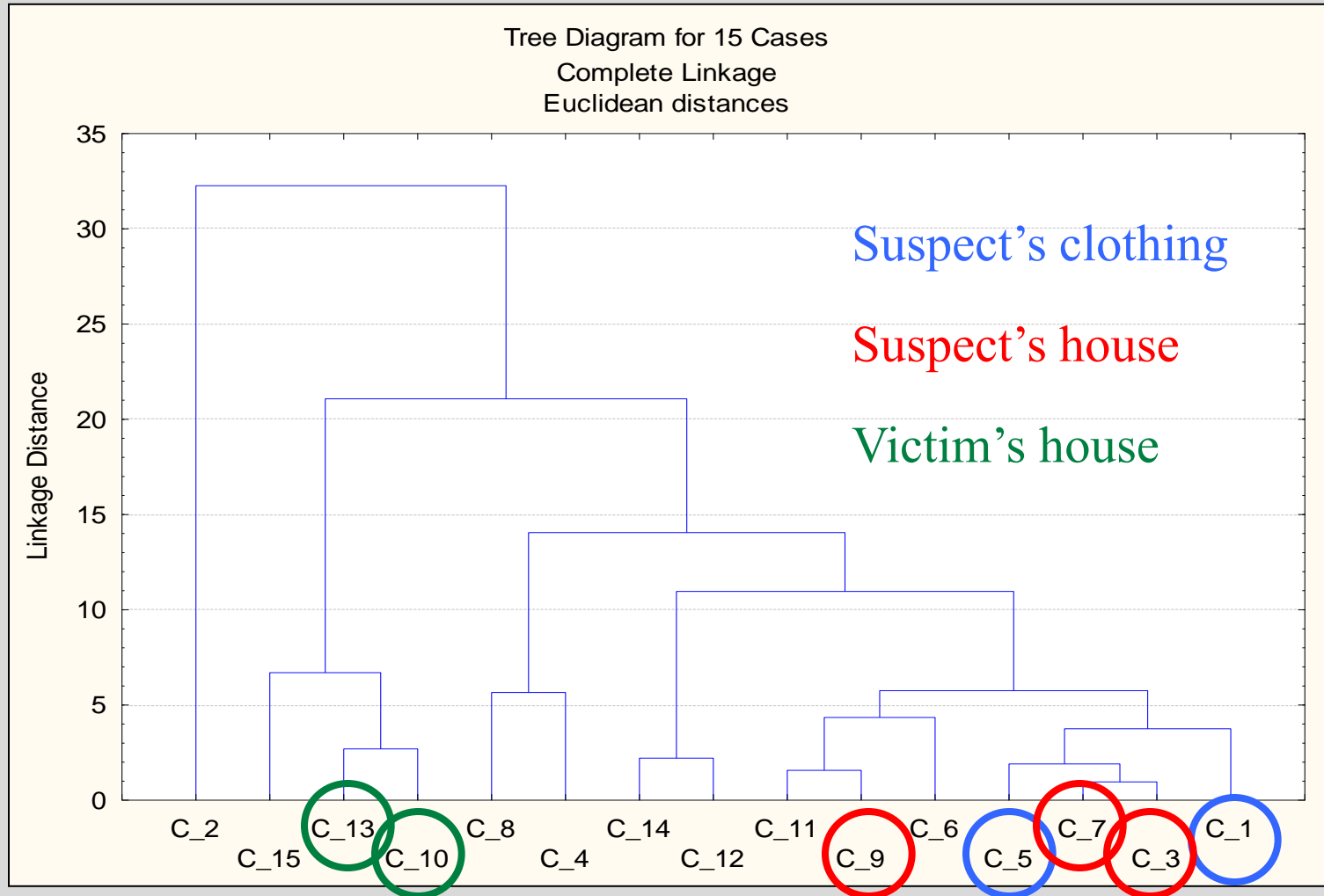
Radiogenic isotopes: $^{208}\text{Pb}/^{206}\text{Pb}$ and $^{206}\text{Pb}/^{207}\text{Pb}$



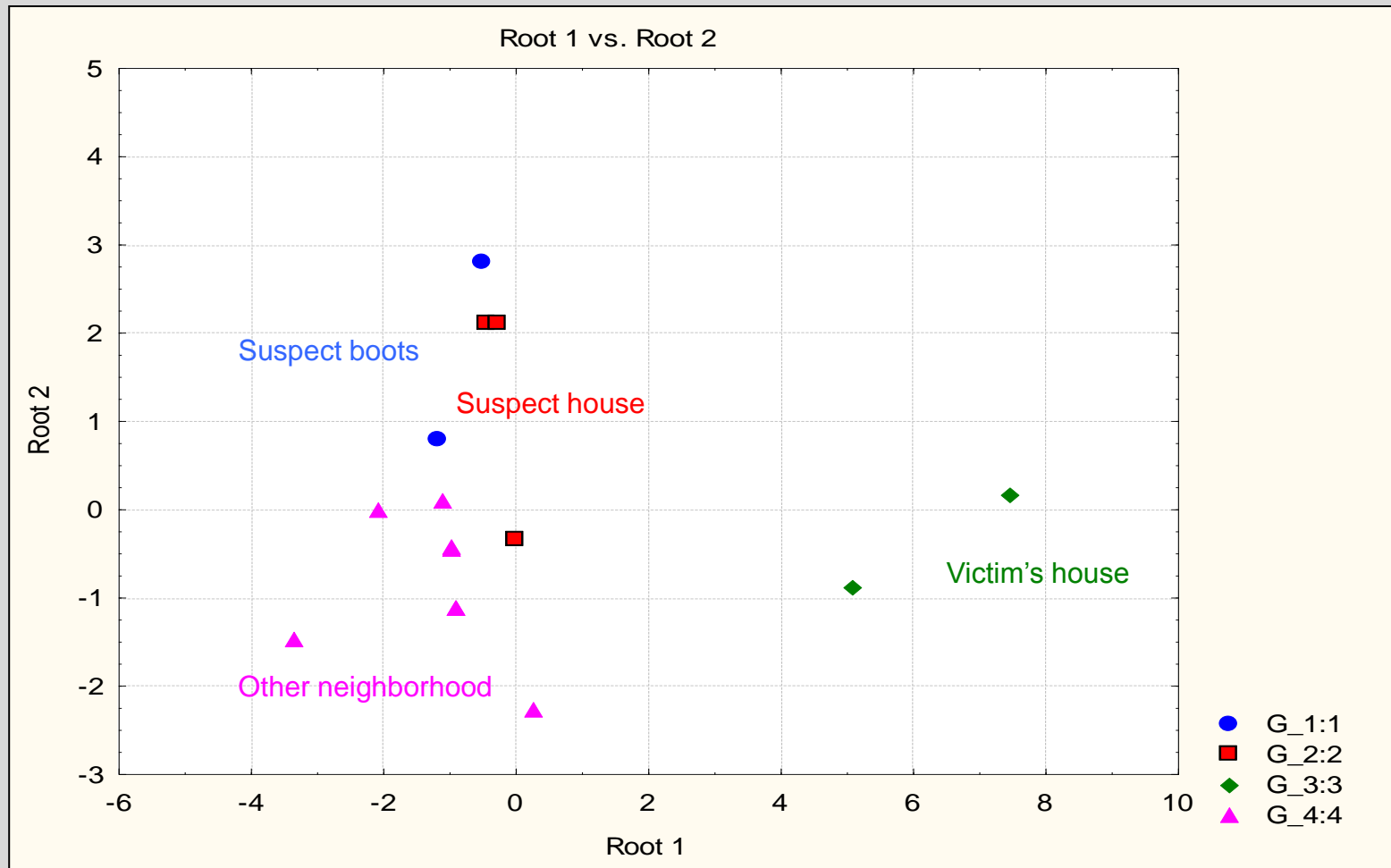
Cluster analysis, ICPMS data



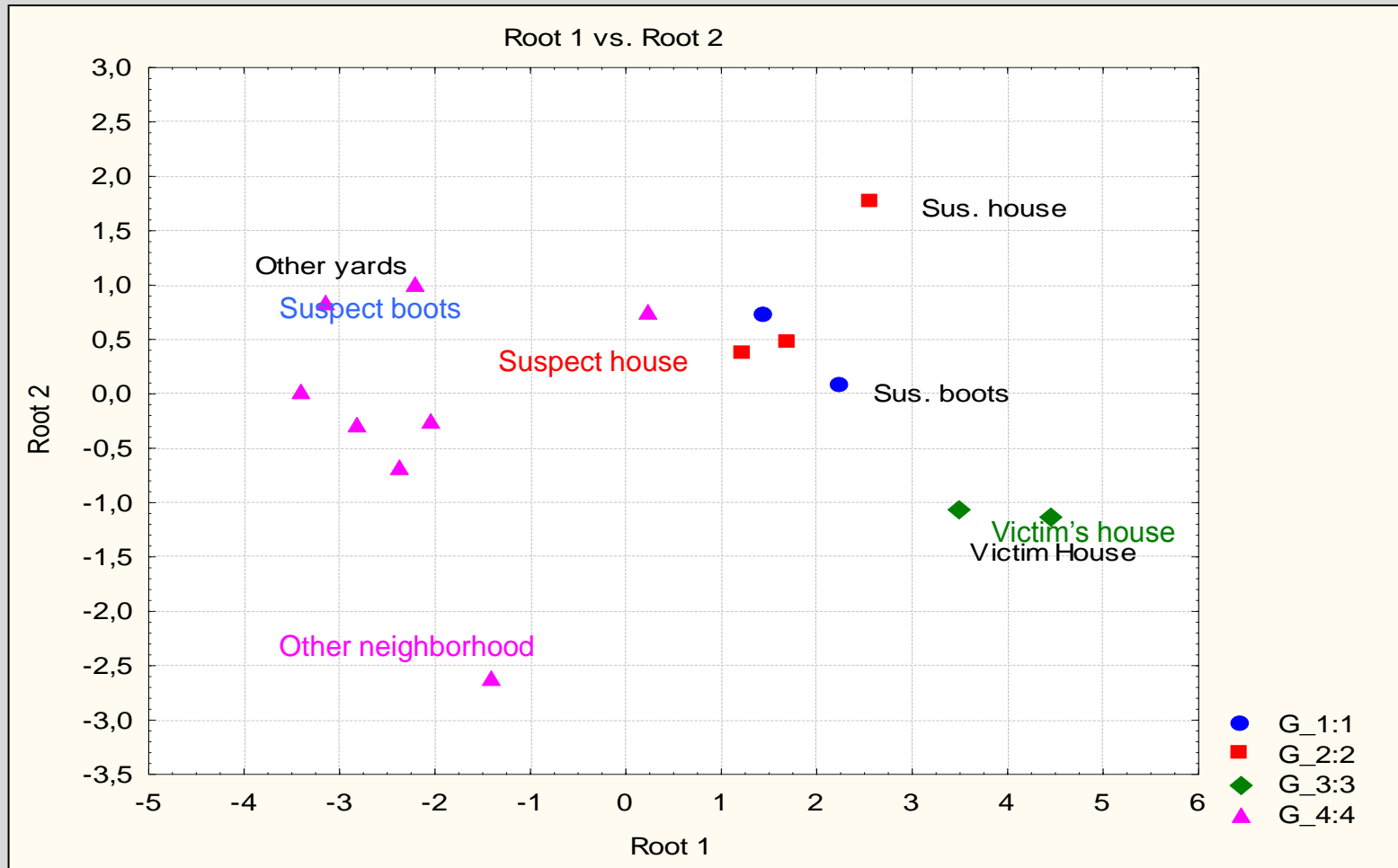
Cluster analysis, XRD, isotopes



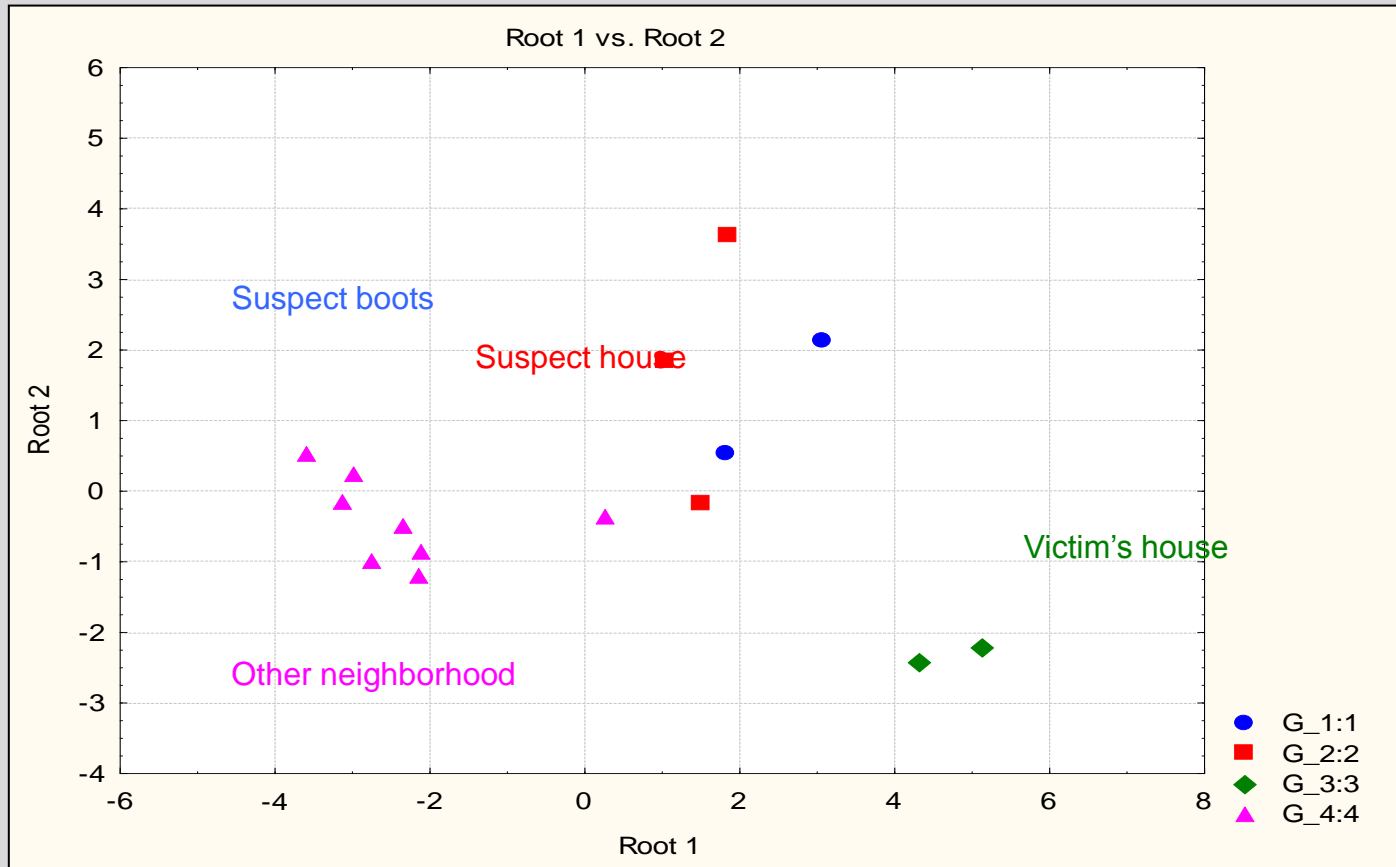
Munsell color, size & sorting



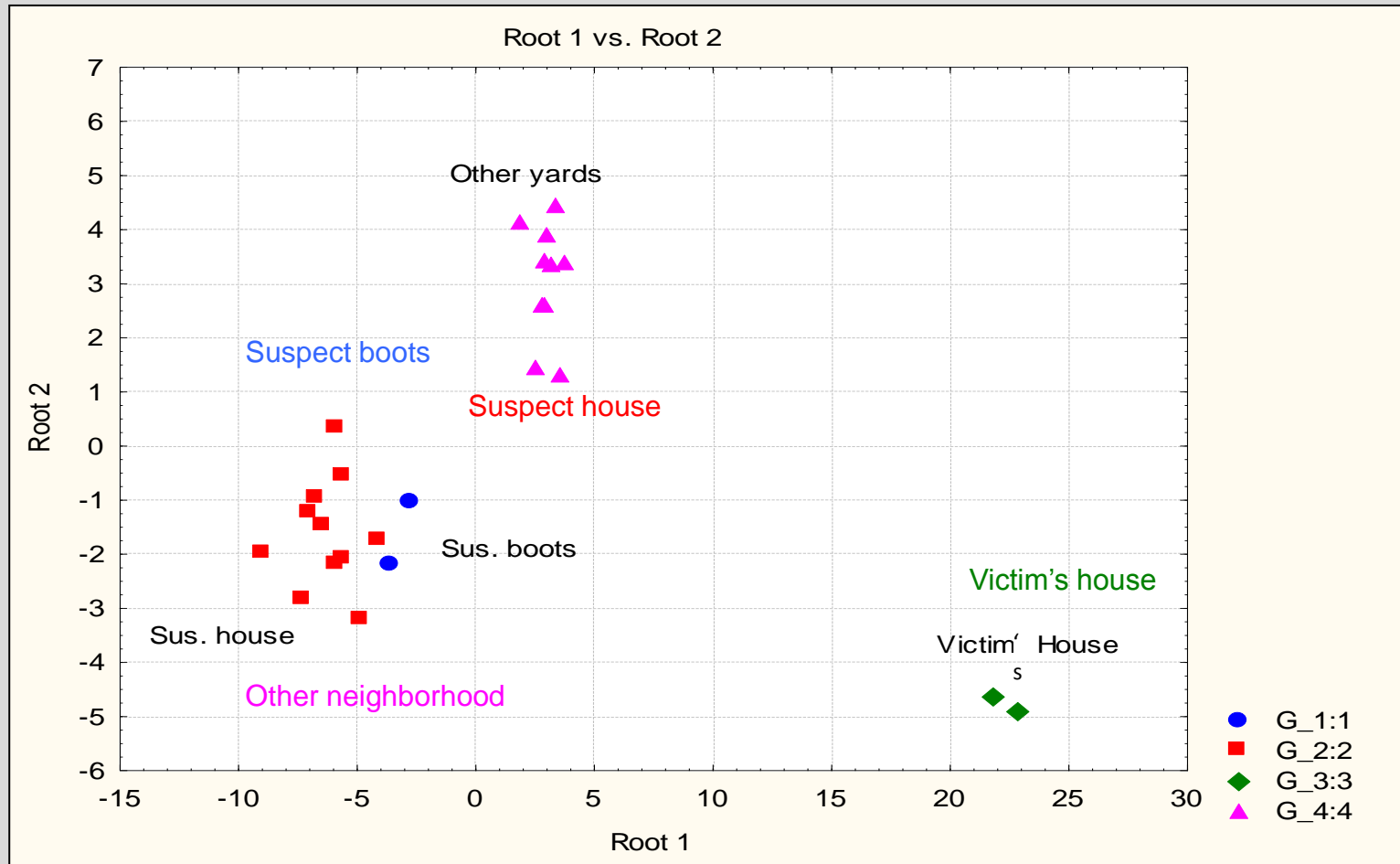
Linear discriminate analysis: X-Ray diffraction



Linear Discriminate analysis: Isotopes and X-Ray diffraction



Linear Discriminate analysis: ICPMS data



Conclusions

- Samples from suspect's boots and pants are not consistent with samples from the victim's house
- Samples from suspect's boots and pants are similar to samples from the suspect's house
- In LDA, color, size and sorting did as well as more expensive analytical techniques