



Geochemical Analysis of Iron-Enriched Soil in Meherrin, Virginia

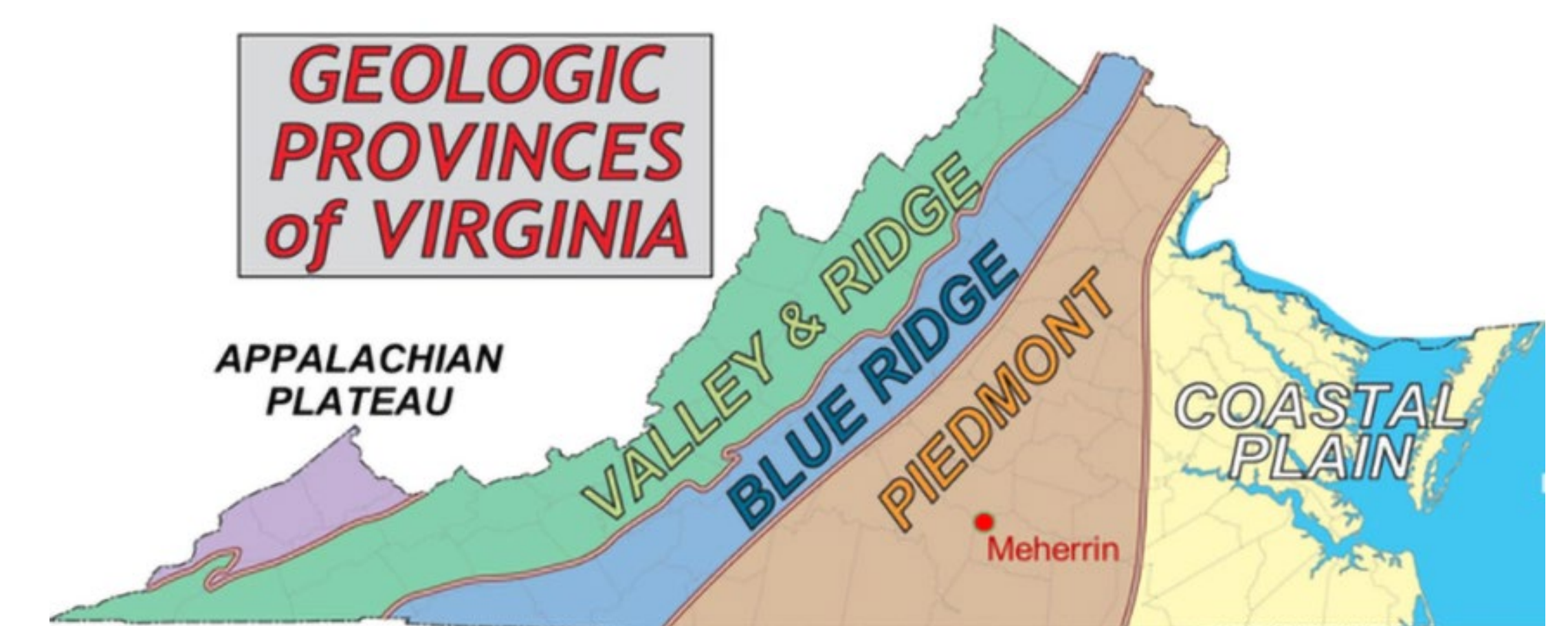
Meherrin is located in the Piedmont Region of Virginia. The Piedmont Region is at the foot of the Blue Ridge Mountain range, which is part of the Appalachian Mountain system. The Piedmont features rolling hills and deeply weathered bedrock.

Geology of the Piedmont Region

Most of the igneous and metamorphic rocks in the province range in age from Proterozoic to Paleozoic. They form the internal core of the Appalachian mountain belt.

Triassic sedimentary rocks, diabase dikes, and basalt flows are present in several grabens and half-grabens that formed during rifting associated with the opening of the Atlantic Ocean.

Rivers and streams carrying sand, silt, and mud flowed into these lowland rift basins burying swamps and marshes, later producing small coal measures.



Aim and Objective

- Consisting of ultisols of the Georgeville series, Meherrin's soil has a high amount of clay (27%) in comparison with the rest of the Georgeville series.
- A geochemical analysis was conducted to understand the difference between the soil characteristics in Meherrin and those of the nearby soils of the Piedmont Region.
- Several nearby sites have been assessed for comparison.

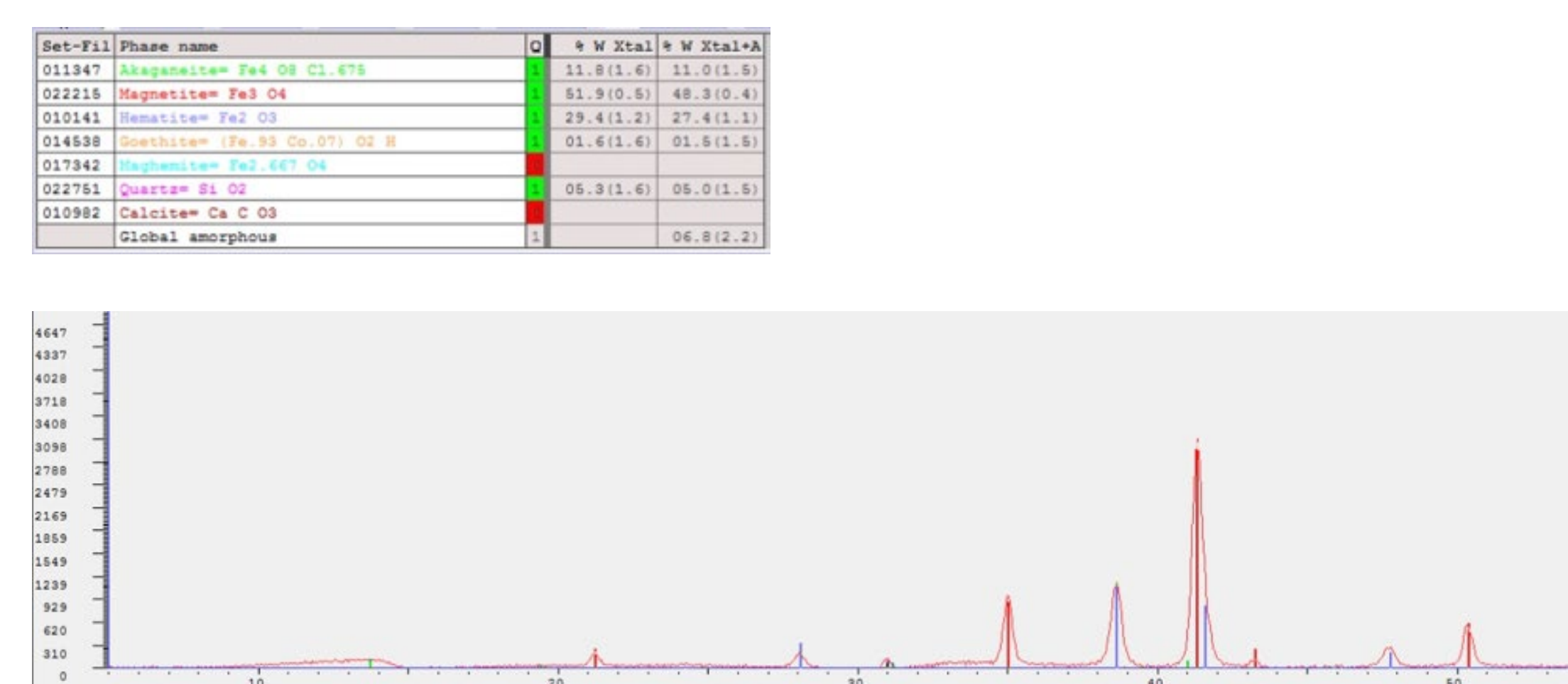


Analytical Approach

- Samples were size partitioned by wet sieving.
- The sample fractions, less than 63 microns and greater than 63 microns, were analyzed by an X-ray fluorescence (XRF) spectrophotometer to understand elemental composition, soil color, and properties.
- After thoroughly washing and drying the fractions greater than 63 microns, magnetic particles were manually separated using a strong hand magnet, and composition was studied with XRF.
- X-ray diffraction (XRD) analysis of separated magnetic particles.
- Micromorphological and elemental analysis by scanning electron microscope (SEM).

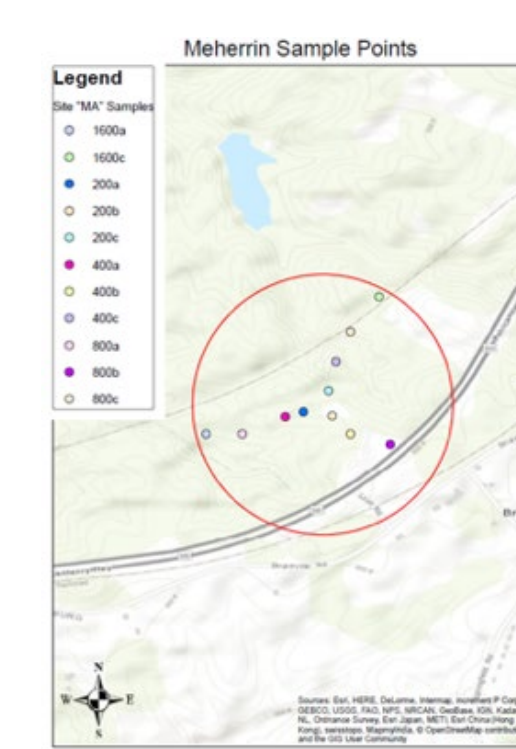


XRD Analysis of the Magnetic Particles: Cobalt Target

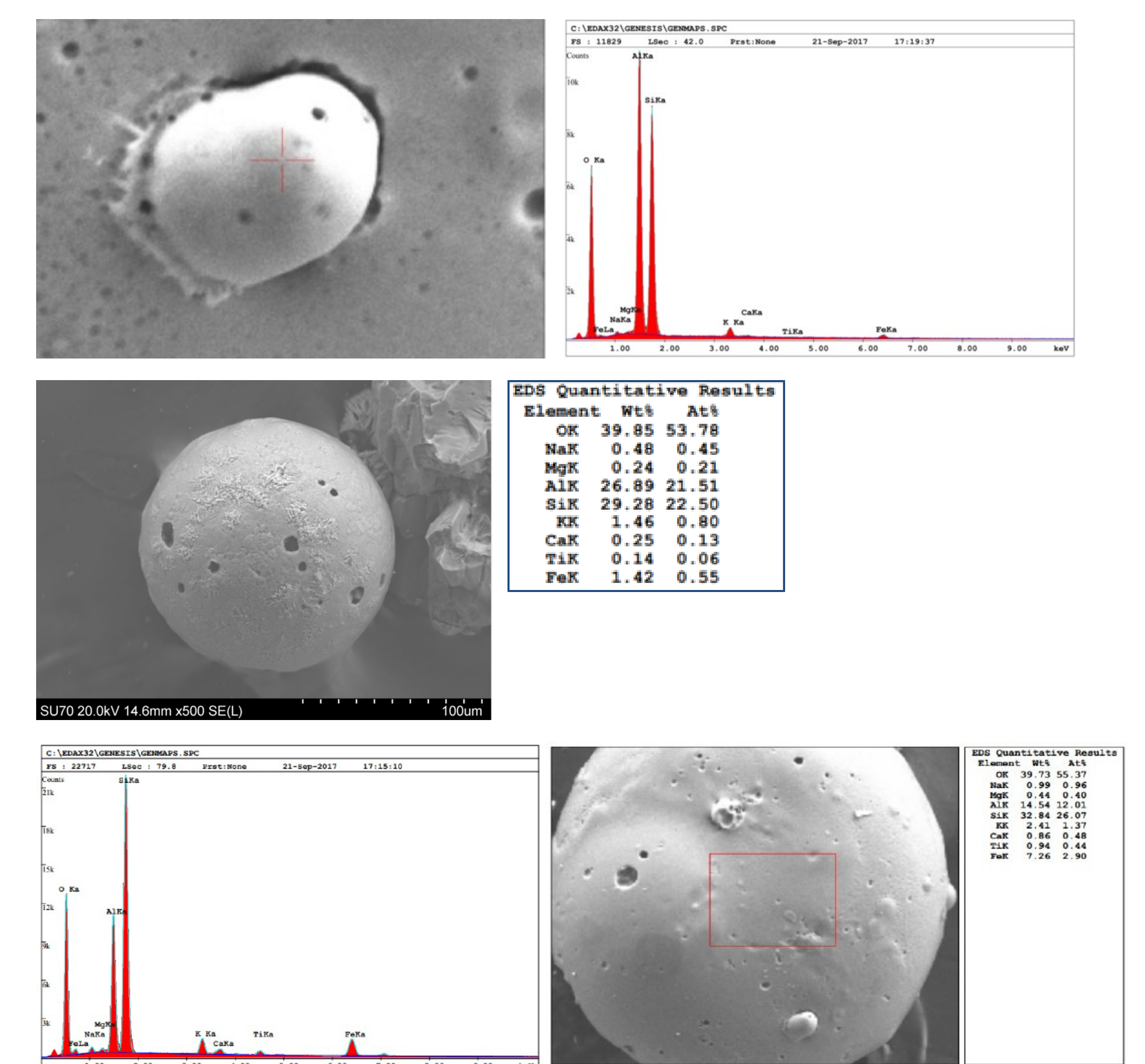


Distribution of Magnetic Particles

Sample ID	Bulk Dry Weight (gm)	Fractions > 63 um (gm)	Fractions > 63 um (wt%)	Magnetics > 63 um (gm)	Magnetics > 63 um (wt%)
200a	21.51	8.86	41.19014412	0.12	1.35440181
200b	8.75	5.73	65.48571429	0.09	1.57068063
200c	160.12	55%	22.27704222	0.44	1.23352958
400a	21.61	57%	63.11892642	0.22	1.61290323
400b	37.73	53%	45.85210708	0.21	1.21387283
400c	90.81	57%	16.94747275	0.23	1.49447693
800a	89.24	48%	26.7256355	0.32	1.34171908
800b	46.47	56%	50.91456854	0.66	2.78951817
800c	40.68	59%	57.76794494	0	0
1600a	35.83	60%	50.15350265	0.89	4.95269894
1600b	47.44	35%	27.02360877	0	0



SEM EDS Analysis



Observation

Microscopic analysis of separated magnetic particles reveals the presence of well-preserved euhedral crystals of magnetite, hematite, and potentially wüstite (cubic FeO). Furthermore, the SEM analysis revealed magnetic spherules and relic grains with apparent Widmanstätten patterns. Such patterns may indicate an extra-terrestrial or volcanic source of Fe-enriched mineral phases, accountable for the special characteristics of Meherrin soil.