



## Field and Dual Magnetic Susceptibility Proxies Implication for Heavy Metal Pollution Assessment in the Urban Soil of Al-Karak City, South Jordan.

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A total of 115 urban soil samples collected on grid bases from Al-Karak City, south Jordan, were investigated for their magnetic properties using Bartington portable magnetic susceptibility system with (MS2B and MS2D) probes. The magnetic proxies that were used in this study are the field & dual magnetic susceptibilities ( $\chi$ ). In addition the heavy metal contents in soil were determined using the Inductively Coupled Plasma (ICP-MS). The dual frequency magnetic susceptibility meter (MS2B) measurements showed that upper soils have higher values of ( $\chi_{lf}$ ) than lower soils. Moreover, the large grain size particles have more magnetic materials than smaller grain size particles. This might be attributed to the lack or low degree of pedogenesis due to prevailing arid climate. The field magnetic susceptibility measurements ( $\chi_{field}$ ) were positively correlated with low frequency dual magnetic susceptibility ( $\chi_{lf}$ ). Few selected samples that have anomalous magnetic susceptibility values were analyzed for their heavy metal content. The results showed a positively significant correlation between total heavy metal content and  $\chi$ , this was evident from the higher degree of fitness between the distribution maps of  $\chi$  and each heavy metal in the study area. These results indicate the applicability of these proxies as pollution indicator, and showed that higher  $\chi$  is associated with traffic areas more than industrial and residential areas. The Frequency Dependent Susceptibility ( $\chi_{fd\%}$ ) was found to be medium value and ranges between (2-10%), which indicate the presence of admixture of fine Super magnetic Particles (SP) or coarse non-SP grains or SP grains  $< 0.005$  micron. A mildly significant correlation existed between  $\chi_{fd\%}$  and  $\chi_{lf}$ , which implies that the soils contain anthropogenic multi-domain and stable single domain grains. Moreover, the hysteresis loop patterns, SEM investigations, thermo magnetic heating curves and XRD charts reveal the presence of magnetite as the main magnetic mineral phase. This confirms the anthropogenic source of pollution mainly from the vehicles emissions beside frame and brakes corroded materials. The positive correlation between heavy metal and magnetic parameters was additionally evidenced by using the index of pollution (IP) method, where the samples of high IP for ( $\chi_{lf}$ ) are almost the same samples that have high IP of THM content.