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A Comparative Study of Hand-Held Magnetic Susceptibility Instruments

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A study to compare six magnetic susceptibility (MS) instruments (the KT-10 sold by Terraplus Inc., RT-1 produced by Fugro, SM30 produced by ZH Instruments, MS2K & MS2C produced by Bartington Instruments and MPP-EMS2+ probe produced by GDD Instruments (denoted as GDD)) was conducted to characterize the equipment on the basis of their accuracies, resolution, range, reproducibility, ease of use and response to short term and medium term temporal drifts.

The results will help geoscientists decide which instrument has the characteristics most appropriate for their project. Two of the instruments we assessed (KT-10 and GDD) are also capable of measuring the conductivity. Knowing the how physical properties such as the magnetic susceptibility and conductivity can vary with lithology and alteration can be useful in geological mapping. Studies have shown MS measurements to correlate with resources (sulphide mineralogy and even oil and gas) as well as other natural occurrences [1], [2], [3].

The first step was to select the mode of data acquisition that is most appropriate for our project. Our comparison study was achieved by collecting MS data on 65 samples from BQ core from 3 holes, 2 NQ core samples, 2 rock samples and 2 calibration samples. These data sets were processed by plotting correlations diagrams, scatterplots and applying statistical methods. We also assessed the lower limits of accuracy for each instrument

The results showed that the GDD and MS2K are most affected by temporal drift whereas the KT-10 and MS2C gave more repeatable results in both paramagnetic and ferromagnetic samples. All instrument performed rather poorly in diamagnetic samples, the GDD and RT-1 do not give any negative readings. The MS2C, MS2K and GDD generally gave higher susceptibility readings than the rest of the meters. It was also noted that measurements on the flat face of half-core samples were always higher compared to measurements on their respective whole core samples because of a larger surface for coupling between the sensor and the half core. There is a correlation between instruments, frequencies and sensitivities, but no relationship between operating frequencies and the temporal drifts of these instruments.

The project concluded with suggested scenarios where each instruments and their given modes are more useful. In mineral exploration industry, the most useful meters are GDD and KT-10 S/C because they measure both magnetic susceptibility and conductivity measurements. In scientific expeditions and geological surveys, the KT-10, SM30 and MS2C provide more repeatable results and are able to measure negative susceptibilities as well. MS2C is less useful in the field and is recommended for laboratory use only. RT-1 is useful in paramagnetic and ferro-/ferrimagnetic rocks. Users of SM30 are strongly discouraged from using scanning mode if they require reproducible results.

References:

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