Geophysical Research Abstracts, Vol. 7, 04638, 2005
SRef-ID: 1607-7962/gra/EGU05-A-04638
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Low-field variation of magnetic susceptibility: accuracy and interpretational programme

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Low-field variation of magnetic susceptibility can yield a quick and routine indication of the main magnetic mineral in the rock under study. Paramagnetic minerals and/or pure magnetite that both show virtually no field variation of susceptibility can be easily distinguished from pyrrhotite and/or substituted magnetite showing considerable variation. The measurement made by the KLY-4S Kappabridge is fully automated, being executed in 21 distinct fields ranging from 2 A/m to 450 A/m. The measurement is rapid, 10 minutes per specimen, so that large collections of specimens can be investigated. Unfortunately, there are problems concerning the interpretation of the susceptibility measured in the lowermost fields, because the measurement accuracy decreases with decreasing field and it is not easy to decide whether a lowest field susceptibility variation is natural phenomenon or results from measuring errors. The sensitivity of the instrument is outstanding in the higher fields, for example being 3 x 10-8 [SI] in the field of 300 A/m. It decreases linearly with decreasing field, being only 3 x 10-6 in the field of 2 A/m. The accuracy of the measurement is about 0.1 % of the measured value in strong specimens, while it is controlled by sensitivity in weak specimens. The accuracy was investigated experimentally using artificial specimens (mixture of pure magnetite and plaster of Paris) with variable susceptibilities ranging from 1 x 10-5 to 5 x 10-2. The field variation of susceptibility of each specimen was measured 10 times and the standard deviation was calculated for each field. The standard deviation divided by the arithmetical mean for the strongest specimen is less than 0.1 % in all the fields. In the weakest specimen, it ranges from 0.32 % in the field of 450 A/m, which corresponds to the standard deviation of 3.2 x 10-8, to 35 % in the field of 2 A/m, which corresponds to the standard deviation of 3 x 10-6. This is in a good agreement with theoretical sensitivities. In specimens with susceptibilities higher than 100 x 10-6, the standard deviations divided by the arithmetical means are

lower than 3% in all fields and lower than 1 % in the fields stronger than 10 A/m. The program FieldVar was written to process the data on the field variation of susceptibility. One of its options is plotting the measured data with corresponding field-variable error bars. In this way, a tool is offered for interpreting such susceptibility changes that are sound and reasonable from the point of view of measuring accuracy.