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# Discussion on: "Magnetic Susceptibility Mapping at Broken Hill, Australia"

By B.P.J. Stevens, *Exploration Geophysics* **30** (1999), 105-112

R. J. Henderson
Geo Instruments Pty Ltd, 348 Rocky Point Rd,
Ramsgate, 2217
Phone: (02) 9529 2355
Email: sales@geoinstruments.com.au

Mr Stevens indicated that he had used a Geo Instruments' Magnetic Susceptibility Meter, Model GMS-2. He also indicated that there was a problem with instrument drift and difficulty with obtaining a constant zero. We have since discussed this with Mr Stevens and it may be appropriate to indicate to all users of the GMS-2 that the best practice with this instrument, like other instruments of its type, is that the zeroing must be done in a noise-free environment. It should also be zeroed at relatively frequent intervals. A figure of zero or one should be obtained in this case.

It would also seem to be not well known to many users that liquid crystal displays such as that used in the GMS-2 do not tolerate temperatures above 50° Celsius. If instruments are left in the hot sun, as they might do say at Broken Hill in the summer, temperatures can easily reach 60° or more in the instrument itself. This would prevent any liquid crystal display from functioning. Also such very high temperatures can cause slight distortions in the physical case itself and hence the separation between the measurement coils. As their spacing is extremely sensitive this can also cause drift. In such cases the instrument would be operating outside of its specification which is 50°C.

Users may also not be aware that because of the employment of an induction coil with a ferrite core, there is some memory retained in the core of high values. Thus to obtain readings of low magnetic susceptibility, the instrument should certainly be zeroed after having read high susceptibility values. We believe this may be the reason Mr Stevens could not obtain readings for values lower than $150 \times 10^{-5}$ SI units. Under normal circumstances the unit should behave according to specifications which would permit it to read values lower than $10 \times 10^{-5}$ SI units, with a resolution of $1 \times 10^{-5}$ SI units. This can be verified with standard samples.

Reply by B.P.J. Stevens

Geological Survey of New South Wales,
32 Sulphide St., Broken Hill, 2880
Phone: (08) 8080 0629
Email: stevensb@minerals.nsw.gov.au

I thank Roger Henderson for his discussion of my paper. It is very useful for the manufacturer of such an instrument to remind the users of the correct operating requirements. I hope the geophysicists reading this will pass on the information to the field geologists who are making increasing use of these valuable instruments.

As stated in the paper, I experienced drift problems with the magnetic susceptibility meter. The field work for my published paper was done at Broken Hill in summer, in temperatures in the high 30s or low 40s in the shade. Obviously the temperature in the sun was hotter. However, the instrument was held in my hand or placed in the leather pouch on my belt. It was not left lying on the rock surface. At no time was it too hot to hold, and at no time did the liquid crystal display disappear. The instrument was probably close to the top of its operating temperature range, but not above it.

The most likely cause of the drift problems was infrequent zeroing. In order to map whole outcrops with the instrument, a large number of readings were needed, and zeroing was done infrequently. The problem of inconsistent readings was noticed on one large outcrop, where I subsequently remeasured the whole grid. In this instance the overall pattern of readings did not change, but there were noticeable and significant differences in the areas of low magnetic susceptibility. While this was a concern, the order of magnitude of the drift was too small to affect the outcome of the project.

As advised by Roger Henderson, users of such instruments must be aware of the requirement to frequently zero the instrument. On the other hand, manufacturers might consider design changes to make susceptibility meters more efficient to use, especially for intensive applications such as outcrop mapping. An instrument, which requires less frequent zeroing, would be more efficient. Also, for the outcrop mapping application, it would be desirable to have a more powerful model, which could effectively measure a greater volume of rock.