# Evaluation of distortion in paleomagnetic measurements of discrete samples due to sensor response of superconducting rock magnetometer

*Hirokuni Oda[1], Chuang Xuan[2]

1. Institute of Geology and Geoinformation, Geological Survey of Japan, AIST, 2. University of Southampton

Sensor responses of superconducting rock magnetometers (SRMs) introduce smoothing and distortion in pass-through paleomagnetic measurements of continuous samples. Recent studies have demonstrated that with accurate estimate of SRM sensor responses high-resolution paleomagnetic signal can be restored through deconvolution of continuous measurement data. It is clear that different SRMs could have distinct sensor responses and the convolution effect of sensor responses will influence measurements of not only continuous samples but also discrete samples which are widely used in worldwide paleomagnetism labs. However, little work has been done to evaluate the distortion in paleomagnetic measurements of discrete samples due to SRM sensor response and how such effects could be overcome.

Following Xuan and Oda (2019),we conducted sensor response estimates of an SRM at the Geological Survey of Japan (GSJ), AIST using magnetic point source (MPS) measurements collected at 1 mm intervals while placing the MPS at each of the 4x4 grid points on the cross section (separated 6 mm apart). Magnetic moment of the MPS at the time when the measured was conducted (July-August 2016) was ~5.254 x $10^{-4}$ emu. We calculated the nine-element tensor components of the SRM sensor response (i.e. XX, XY, XZ, YX, YY, YZ, ZX, ZY and ZZ components) using the URESPONSE software (Xuan and Oda, 2019). Then, sensor response for u-channel were estimated by integrating over the cross section (19 mm x 18 mm). The effective lengths for the nine terms were calculated as 5.35, 0.28, 0.03, -0.20, 5.36, 0.07, 0.04, 0.10, 8.91 for XX, XY, XZ, YX, YY, YZ, ZX, ZY and ZZ components, respectively. XY and YX cross terms were relatively large compared with the other cross terms. Peak values for the three axes (i.e. XX, YY and ZZ) were 1.02, 0.97 and 1.02, respectively.

In order to evaluate the effect of sensor response on discrete samples, integration was conducted in the central area (20 x 20 x 20 mm) for the sensor response of GSJ. Peak values of the normalized sensor response for the three axes were 1.08, 1.03 and 1.07, respectively. Using these peak values together with those for the cross terms, a simple simulation was conducted. Model magnetizations were produced using a uniformly magnetized object which has volume of 20 x 20 x 20 mm and magnetic moment of 1 x $10^{-5}$ emu. Orientations of the model magnetizations were rotated systematically at 15° along major axes. Measurements with the SRM at GSJ were simulated by matrix multiplications using the model magnatizations and the nine-element tensor components. The results show a maximum angular discrepancy of 4.8 degrees from the true magnetization. In the presentation, errors associated with the sensor response will be evaluated.

Keywords: Superconducting rock magnetometer, sensor response, volume integration, cross terms

 