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A new spinner magnetometer using high sensitivity magneto-impedance sensor

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A sensitive spinner magnetometer was developed using a pair of high-resolution Magneto-Impedance sensors. The MI sensor generally utilizes the MI effect of amorphous wire whose impedance changes by the application of a small magnetic field. Various kinds of MI sensors are currently used in many electric devices, for example, a magnetic compass chip built-in smart phones and car navigations. The MI sensor employed in this study is a pico-Tesla MI sensor, an especially sensitive MI sensor originally manufactured for industrial use to detect contamination of small magnetic particles in industrial materials such as fabrics. To detect weak magnetic signals from natural samples and avoid DC drift, a gradiometer system was employed that consists of a pair of the MI sensors and the electronics with analog filter and pre-amplification circuit. This MI gradiometer system was equipped to a commercial spinner magnetometer (SMD-88, Natsuhara Giken, Osaka) with the spinning rate of 5 Hz. It is demonstrated that this new spinner magnetometer is capable of measuring weak magnetic samples of 10^{-6} mAm^2, with the highest resolution being 10^{-8} mAm^2, approximately two orders of magnitude better than the previous one using a ring-core flux-gate sensor. One of the advantages of the MI spinner magnetometer is that it can be easily modified to accommodate samples of any shape and size. Moreover the slow-rotating speed (5 Hz) allows to measure samples for archeomagnetic studies that are usually irregular and fragile. Because the irregularity of shape increases errors in measuring the dipole component of the total magnetization, it is necessary to increase the distance between the sample and sensor, resulting in poorer sensitivity. The high-sensitivity MI sensor enables to measure the NRM of such irregular-shaped samples from an appropriate distance to the sample, with no significant loss of sensitivity.