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Updated three-component spinner magnetometer with thermal demagnetizer ”tspin”

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A three-component spinner magnetometer equipped with a thermal demagnetizer, which is called ”tspin”, is finally used for routine remanence measurements involving thermal demagnetization and the Thellier paleointensity method. The original instrument design and the data reduction procedure based on the spherical harmonic analysis were already developed by Kono et al. (1991).

Three components of a remanent magnetization of a standard size (1-inch) specimen can be measured by a single fluxgate sensor without changing specimen orientation. A specimen mounted on a quartz tube holder is rotated by a single axis and translated along the axis. We can obtain the magnetization components on the plane perpendicular to the rotating axis like a conventional spinner magnetometer, and also the axial component determined by the translation. This time the quartz tube is redesigned to be connected to the rotating axis by a chuck, so we can precisely set the specimen by using a laser level and then calibrated the declination value of the in-plane components. The effective sensitivity is currently of 5e-8 Am2 but should be improved by one order if housed in a magnetic shield room.

An electric furnace is available in line to heat a specimen up to 700 deg.C by translating along the axis. Cooling position is located between the furnace and the sensor. After a measurement step, the specimen is inserted into the furnace that is already maintained at the next temperature step. This procedure makes sure that the specimen always follows the same heating treatment, which is especially important for zero- and in-field processes during Thellier experiments. We have done temperature calibrations by attaching K-type thermocouples into and onto a dummy basalt specimen.

Now stepwise thermal demagnetization and the Thellier experiments can be automatically performed using a home-made software coded on LabVIEW. We just need to specify temperature steps and a dwell time in the furnace before running the software. Zijderveld and Arai diagrams are drawn on a display in the course of measurements. Because we do not need to change the specimen orientations and a series of heating, cooling and measurement is performed without taking out the specimen from the mu-metal shield, we can see extremely beautiful straight lines on Zijderveld or Arai diagrams. By introducing ”tspin”, we expect laborious Thellier paleointensity experiments are carried out much more easily and precisely.

Keywords: paleointensity, Thellier method, magnetometer, thermal demagnetization