Geophys. J. R. astr. Soc. (1974), **38**, 431–433.

Research Note

Some Observations of Rotational Remanent Magnetization

A. Brock and W. Iles

(Received 1974 May 6)

Wilson & Lomax (1972) have recently described experiments which show that a remanence can be induced in rock specimens when they are rotated in a decreasing alternating field. They called this effect rotational remanent magnetization (RRM), and they suggested that other workers might try to duplicate it. We describe here some similar experiments which confirm the existence of the effect but which show that it can occur with either sign.

As Wilson and Lomax point out, RRM, if present, can produce apparently erratic behaviour during alternating field demagnetization with a tumbling mechanism. A number of specimens which appeared to show this effect were selected for more detailed investigation. The specimens represent two rock types. One (E25B) is a basalt from a recent lava flow of the volcano Emurangogalok in the Gregory rift valley, 100 km north-north-east of Lake Baringo, Kenya. The others (K3, K4) are lacustrine tuffaceous silts from the Acheulean archaeological site Kilembe near Rongai 30 km west-north-west of Nakuru, Kenya. In one case the remanence is TRM, and in the other probably DRM, but both have the ability to acquire RRM.

The specimens were demagnetized in the Nairobi equipment which consists of a two-axis tumbler with the outer axis rotating at 1·8 rotations per second, and the inner axis at 2·7 rotations per second. If RRM is present it would be expected to appear directed along the inner axis. For each maximum value of the demagnetizing field, the specimen is treated twice, with a selected axis parallel, and then anti-parallel to the inner axis of rotation. By vector subtraction any RRM should appear on the relevant specimen axis, the other two axes having near zero components if no other effects are present. Addition will then eliminate the RRM vector, and yield the demagnetized NRM free of RRM. In this way demagnetization curves for the NRM can be obtained at the same time as curves showing the growth of RRM. This follows standard demagnetization procedures, and will yield results of immediate interest to the practising worker. It should be emphasized however, that this RRM is developed on the inner axis of a tumbling mechanism, and is not directly comparable to the RRM of Wilson & Lomax which is developed along an axis perpendicular to the demagnetizing field. In this note we designate the former as RRM2 and the single axis type as RRM1. Experiments on RRM1 are described later.

The demagnetization of NRM and the concurrent growth of RRM2 are shown in Fig. 1 (a)–(c). The curves show a variety of shapes, and the relative importance of NRM and RRM2 at a given field varies widely from specimen to specimen. It is this which governs the actual impact of RRM2 in a given case; contrast K3 and E25B. The sense of the RRM2 vector in the sediment samples K3 and K4 was in the direction of $-\mathbf{w}$ in agreement with that observed by Wilson & Lomax for RRM1 in all their samples. In contrast the RRM2 vector in E25B was in the direction of $+\mathbf{w}$. This was sufficiently surprising for us to make careful repeat measurements and the effect

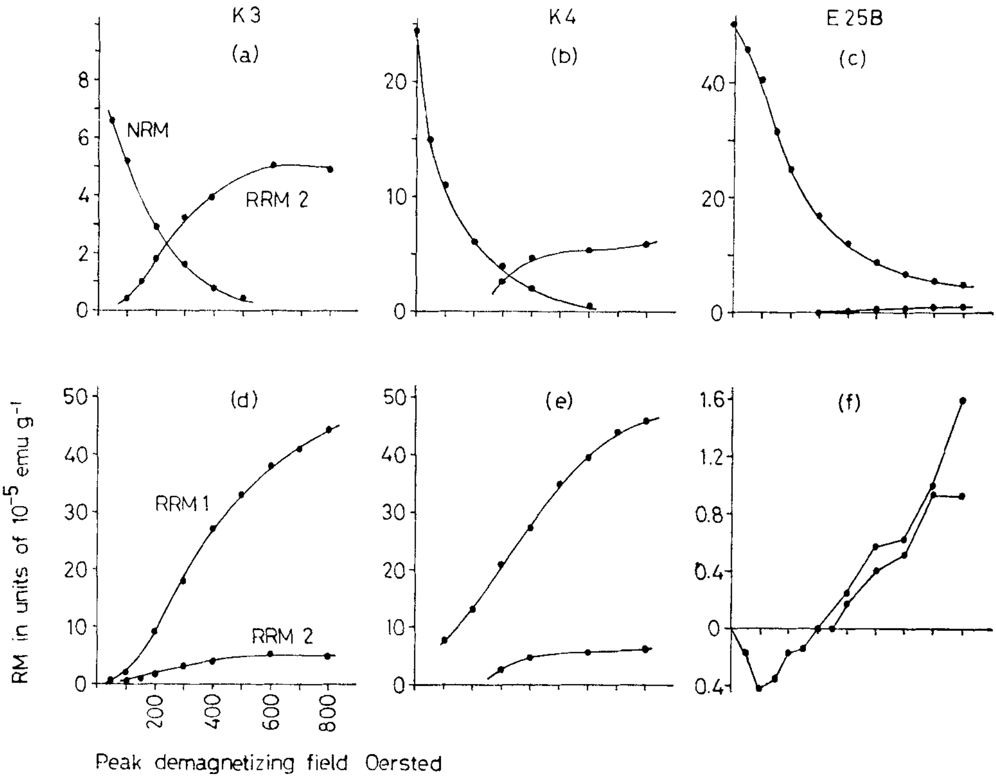

FIG. 1. The decay of NRM and the growth of RRM1 and RRM2 for several specimens as a function of peak demagnetizing field.

was confirmed. It is however consistent with the observations of Doell & Cox (1967) that the 'spurious' components induced along the inner axis of their tumbler can occur with either sign.

The demagnetization apparatus was then modified to produce a single axis spin perpendicular to the alternating field axis (at a rate of 1·8 rotations per second) and experiments on the growth of RRM1 were performed for comparison with RRM2. The results are shown in Fig. 1 (d)–(f). The volcanic sample E25B whose RRM2 was in the unusual +**w** direction, shows an RRM1 which develops initially along −**w**, before reversing to a +**w** direction at higher fields. The effect was repeatable. Another sample from the same flow showed similar changes of sign, but the exact shape of the growth curve was less repeatable. In both cases RRM2 was always along +**w**.

During these experiments a number of other tests were carried out. The sense of rotation was reversed for some runs, and the RRM vectors were found to change sign accordingly. The connections to the demagnetizing coil were also reversed, but with no effect upon the RRM. As in the experiments of Wilson & Lomax this points clearly to rotation as the determining factor rather than a disguised ARM or asymmetry of waveform.

It is also possible to summarize our experience of RRM2 as seen during routine demagnetization of a wide variety of other specimens. Often it is undetectable at the fields required to clean secondary components, but it does occur sufficiently often to make a check for its presence worthwhile. This can be done by demagnetizing twice at the same field, and we suggest that it be done routinely in all demagnetizing runs.

We understand that Doell & Cox regularly follow this practice (private communication). In Nairobi we often see small amounts of RRM2 in Plio-Pleistocene lacustrine sediments from east Lake Rudolf and Olduvai gorge and in all these cases the RRM2 vector is in the direction of $-\mathbf{w}$. We see the effect much less often in volcanic material, but it does appear occasionally, and one of our volcanic samples (E25B) showed RRM2 in the $+\mathbf{w}$ direction. To date however, the young lava flows of Emurangogalok are the only cases showing this unusual direction. All other cases seen in Nairobi have the opposite sense and are in agreement with the samples described by Wilson & Lomax.

Department of Physics,
University of Nairobi,
Nairobi, Kenya.

References

Doell, R. R. & Cox A., 1967. Analysis of alternating field demagnetization equipment, *Methods in Palaeomagnetism*, eds Collinson, Creer & Runcorn, Elsevier, Amsterdam.

Wilson, R. L. & Lomax, R., 1972. Magnetic remanence related to slow rotation of ferromagnetic material in alternating fields, *Geophys. J. R. astr. Soc.*, **30**, 295–303.