COMMUNICATION

THE CHOICE OF OPTIMUM TREATMENT FOR MAGNETIC CLEANING - AN EXAMPLE.

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RESUMEN

La desmagnetización por campos magnéticos alternos decrecientes es una técnica comúnmente empleada en paleomagnetismo (As y Zigderveld, 1958; Collinson *et al.*, 1967). Los criterios existentes (por ejemplo, As y Zijderveld, 1958, Irving *et al.*, 1961; McElhinny y Gough, 1963) se usan a juicio del paleomagnetista. En esta nota se presenta un ejemplo para seleccionar el tratamiento óptimo en el lavado magnético.

ABSTRACT

Alternating field demagnetization is commonly employed in paleomagnetism (As y Zijderveld, 1958; Collinson *et al.*, 1967). Use of existing criterion (e.g., As and Zijderveld, 1958; Irving *et al.*, 1961; McElhinny and Gough, 1963) is largely based on the judgement of the paleomagnetist. This note gives an example to illustrate the choise of optimum treatment for magnetic cleaning.

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INTRODUCTION

Alternating field demagnetization (magnetic cleaning) has been a convenient technique in paleomagnetic research. Details of this technique can be found in the early work of As and Zijderveld (1958) while instrumental aspects and analysis of data are very well covered in the book edited by Collinson *et al.* (1967) and also by Collinson (1975).

In judging the final stage of demagnetization, no uniform criterion, however, exists in literature. Some workers use the criterion that the stable component is obtained after vector rotation stops and changes occur only in intensity (As and Zijderveld, 1958; McElhinny and Gough, 1963). An alternative approach makes use of the change in dispersion of direction of several test specimens from the same site. The treatment necessary to produce minimum dispersion is then selected and applied to all specimens from the same site (Irving *et al.*, 1961).

This note illustrates the use of another criterion based on the idea originally suggested to us by Dr. D. A. Valencio, for magnetic cleaning.

A. C. DEMAGNETIZATION PROCESS

Demagnetization of samples of a given site can be carried out by running a pilot specimen of each group having similar characteristics of natural remanent magnetization (NRM) and subjecting the rest of the specimens to a similar treatment. Successively higher demagnetizing fields in known steps of say 25, 50 or 100 oersteds, are applied and the residual remanent magnetization (RM) is measured after each step. The resulting residual RM directions are plotted on a stereographic projection and the normalized intensities (J_i/J_o) as a function of the demagnetizing magnetic field strength on a Cartesian coordinate system. Analysis of changes in the direction and intensity of the residual RM permits one to deduce the stage at which the secondary remanent magnetizations (SRM) disappear or become negligible. This stage is generally characterized by a very small change in the direction of the residual RM and an asymptotic behavior of the normalized intensity curve. However, sometimes due to the presence of hard SRM, the above mentioned conditions are not satisfied or do so only partially.

In this method it is assumed that all the specimens of a given site have a homogeneous or nearly homogeneous magnetic behavior so that the conclusions drawn from the pilot specimen can be applied to all of them. Nevertheless, it is difficult to encounter such an ideal situation in nature and the necessary demagnetizing field varies from specimen to specimen.

The demagnetizing process can be assessed through statistical analysis for which certain statistical parameters, viz., K and α_{95}, are generally used (McElhinny, 1973). Table 1 gives the statistical analysis of the cleaning process of extrusive igneous rocks from NE Jalisco, Mexico (additional details given in Urrutia, 1976). The demagnetization steps used are 25, 50, 100, 150, 200 and 250 Oe. It can be seen that the best grouping is obtained after the 200 Oe step. The table includes three additional calculations using different stages of demagnetization for different specimens. The first two groupings are the better ones obtained by feeding all the possible combinations to the computer. The second of them is perhaps the best statistics obtained though not significantly different from the one of 200 Oe. The last grouping is the statistics obtained by using Briden index S (Briden, 1972). Table 2 illustrates the calculation of this index for one of the specimens for which a field between 50 and 100 Oe seem to be the best demagnetizing field when the index is nearer to one. The resulting statistics (last set of table 1) is however not better than the 200 Oe grouping. It should be mentioned that for a more complete study of magnetic remanence, more steps of demagnetization as well as higher demagnetizing fields should be used.

TABLE 1. Statistical analysis of the demagnetization process.

N	E	R	D	I	K	α_{95}	δ	Θ_{50}	Θ_{63}	Θ_{95}	H_d (O_e)
8	8	6.960	342.24	18.61	6.758	22.99	29.16	25.97	31.16	53.85	0
7	7	6.224	347.88	19.44	7.734	23.18	26.97	24.27	29.13	50.34	25
8	8	6.955	346.12	16.60	6.700	23.11	29.29	26.08	31.30	54.10	50
8	8	7.105	342.63	17.67	7.825	21.13	27.10	24.13	28.96	50.05	100
8	8	7.200	347.56	21.23	8.839	19.85	25.64	22.83	27.40	47.36	150
8	8	7.208	342.82	23.54	8.836	19.73	25.50	22.71	27.25	47.10	200
8	8	7.108	341.24	27.64	7.848	21.10	27.06	24.10	28.91	49.98	250
8	8	7.279	340.46	30.80	9.700	18.73	24.52	21.67	26.00	44.95	—*
8	8	7.337	344.40	20.39	10.560	17.87	14.82	20.77	24.93	43.08	—*
8	8	7.160	343.10	21.35	8.329	20.40	26.26	23.39	28.07	48.51	—**

* Best groupings of all the possible combinations of data.

** Grouping obtained using Briden index.

TABLE 2. Typical calculation of the Briden index for one specimen.

Demagnetizing field H_d O_e	Components of the magnetization vector			Briden index
	North X	West Y	Down Z	$S = 1 - \frac{\lvert Ji-Ji+1 \rvert}{\lvert Ji \rvert}$
0	0.264×10^{-2}	0.0385×10^{-2}	-0.680×10^{-2}	
25	0.291×10^{-3}	0.060×10^{-3}	-0.392×10^{-3}	0.576
50	0.288×10^{-3}	0.056×10^{-3}	-0.387×10^{-3}	0.983
100	0.274×10^{-3}	0.057×10^{-3}	-0.381×10^{-3}	0.984
150	0.242×10^{-3}	0.057×10^{-3}	-0.367×10^{-3}	0.964
200	0.230×10^{-3}	0.052×10^{-3}	-0.332×10^{-3}	0.905
250	0.212×10^{-3}	0.051×10^{-3}	-0.311×10^{-3}	0.937

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