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THE COMPLEX NRM OF THE PERMOCARBONIFEROUS BADEMLI REDBEDS

(Tauride Chains, Southern Turkey)

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SUMMARY

The analysis of the NRM of 27 Permocarboniferous samples from a nappe in the Tauride Chains revealed that in most samples three magnetic components were present. Two of the components are thought to be secondary due to remagnetization in Early Tertiary, and Recent times. The third and hardest component is assumed to be Permocarboniferous. It yielded an anomalous paleomagnetic direction, though the low inclination value indicates an equatorial position during the Permocarboniferous.

INTRODUCTION

To unravel the geotectonic history of the Mediterranean area a program (Rutten and Veldkamp, 1964) of paleomagnetic investigations, mainly on Permian rocks, is being carried out. Suitable Permian rocks, however, are of scattered occurrence only, and most results have been obtained from the Western Mediterranean region (van der Voo and Zijderveld, 1969). The only exception sofar is a result from the Amasra redbeds in the Pontide Chains in northwestern Turkey (Gregor and Zijderveld, 1969). This result concerns a series limited both in time and in space and it is obviously necessary to extend our knowledge with more data.

However, the geological situation is a serious restriction. Although the geological map of Turkey shows abundant Permian sediments, only very few of them appear to be suitable for paleomagnetic research, i.e. potential carriers of remanent magnetization. With the exception of the above mentioned Amasra redbeds (fig. 1), the redbeds of the Hazro anticline (fig. 1) and the redbeds of the present study,

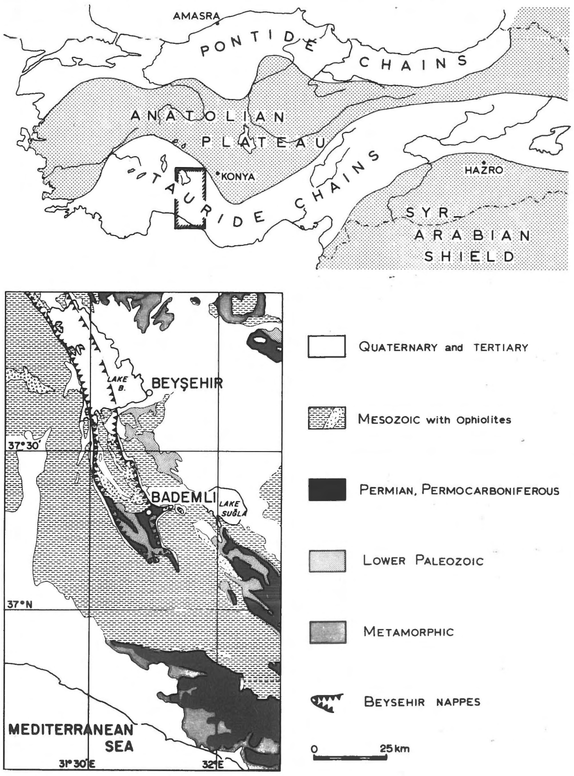

Fig. 1
Regional map of Turkey and map of the Beyşehir-Bademli area. On the regional map the main orogenetic provinces in Turkey are indicated after Ketin's map (1966a and 1966b). The geologic map of the Beyşehir-Bademli area is drawn after the maps by Gutnic et al. (1968) and Blumenthal (1963).

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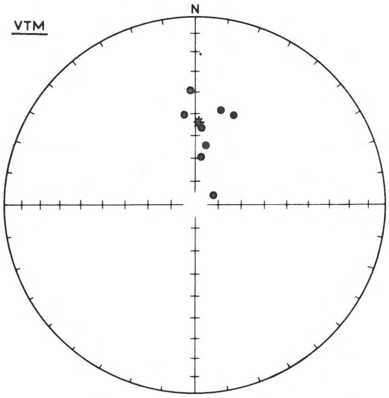

Fig. 2
Equal area projection of the directions of total NRM in the Permian samples from the Hazro anticline. The asterisk denotes the present-day local geomagnetic field direction.

most Turkish Permian rocks are marine limestones, which are not promising material.

Samples collected from the Permian of the Hazro anticline displayed only secondary magnetizations (fig. 2). Therefore, the only further Permian result to be expected was from the Bademli redbeds of the present study. Even here the geologic setting is not favorable for paleomagnetic research, since it was clear from the outset that there was no unfolding test possible and the outcrops were scarce. The Bademli redbeds, moreover, belong to the Beyşehir nappes ("nappe of Hadim") in the western Tauride Chains, which are supposed to have been transported during or after the Eocene period (Gutnic et al., 1968). This event probably had its influence on the magnetic composion of the (complex) NRM in the Permo-carboniferous samples.

The redbeds, enclosed between dark blue massive limestones, overlie Devonian sediments and are covered by the Triassic Çamlik limestones (Gutnic et al., 1968; Blumenthal, 1947). The six closely spaced sampling sites show a more or less uniform dip of 30° to the northwest.

THE NATURAL REMANENT MAGNETISM

The intensity of magnetization (total NRM) of the 27 samples investigated averages at 4×10^{-6} emu/cm^3; they have Q-values of about 0.4.

The NRM was analysed with the standard alternating field and thermal demagnetization techniques at Utrecht State University. In fig. 3 four of these progressive demagnetizations are figured. They clearly show the consecutive elimination of *three* magnetic components, each differing from the others both in direction and in hardness. We have indicated these three components as follows:

the s-components (softest components), eliminated either in ac magnetic fields up to 300 Oersteds, or in furnace temperatures to 200°C,

the a-components, medium in hardness and eliminated in ac magnetic fields between 300 and 2500 Oe, or in temperatures generally between 200° and 350°C,

the b-components, (hardest components) remaining in the samples after 2500 Oe, or eliminated in temperatures between 400° and 670°C (Curie temperature). The directions of the b-magnetizations could be determined accurately from the thermal demagnetizations. Since the end point of the resultant magnetization vector changed along a straight line towards the origin during demagnetization between 400° and 670°C (fig. 3), it is plausible that in this interval only one single magnetization is involved (Zijderveld, 1967).

The results of the ac magnetic field and the thermal demagnetizations are entirely consistent. In fig. 4 the directions of the s-, a- and b-components have been plotted in three equal area projections. These projections show the preferential grouping of the three types of magnetization.

PALEOMAGNETIC INTERPRETATION

Generally the hardness spectrum does not allow decisive conclusions concerning the origin of the magnetic constituents obtained by demagnetization analysis (Zijderveld, 1967). Especially when more than two components are found in paleomagnetic samples and when the geologic situation does not provide us with, for instance, an unfolding test, the interpretation of results might become a hazardous venture.

On the other hand, in the case of these Turkish Permocarboniferous redbeds, the interesting composition of the NRM invites an explanation we will tentatively try to undertake.

The s-components (fig. 4A) show directions roughly grouping around the present-day geomagnetic field direction in the laboratory where the samples have been stored in oriented position. These very soft magnetizations are obviously secondary.

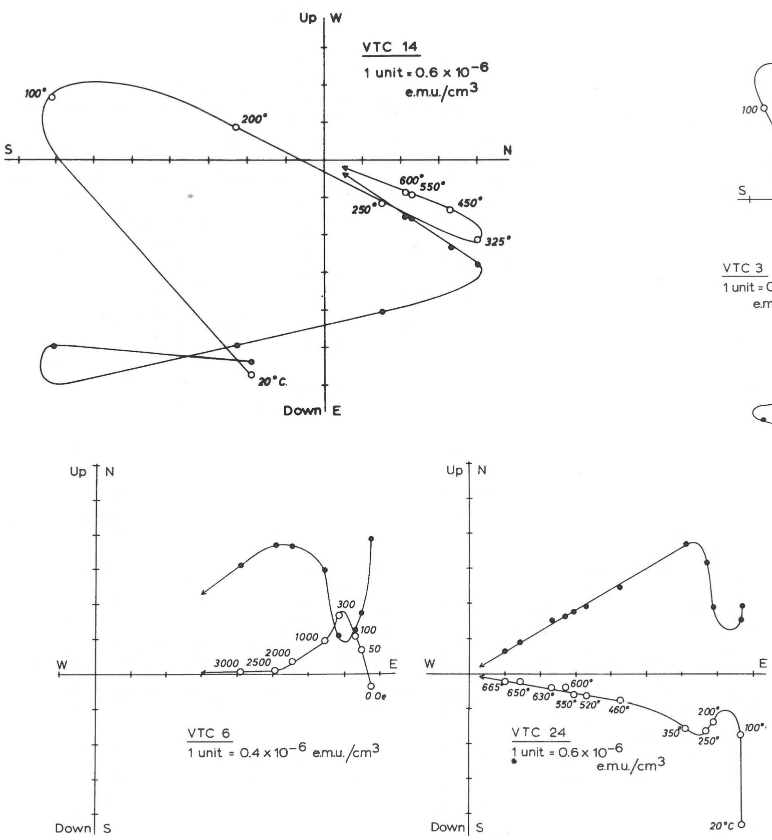

Fig. 3
Diagrams of progressive thermal and ac magnetic field demagnetizations on Permocarboniferous samples from the Bademli redbeds. Plotted points represent successive positions – in orthogonal projection – of the end point of the magnetic vector. Full symbols represent projections on a horizontal plane; open symbols represent projections on a vertical plane (Note that two projections are on the north-south vertical plane (VTC 3 and 14) and two diagrams have projections on the east-west vertical plane). Numbers denote ac magnetic field intensities in Oersteds, or furnace temperatures in °C.

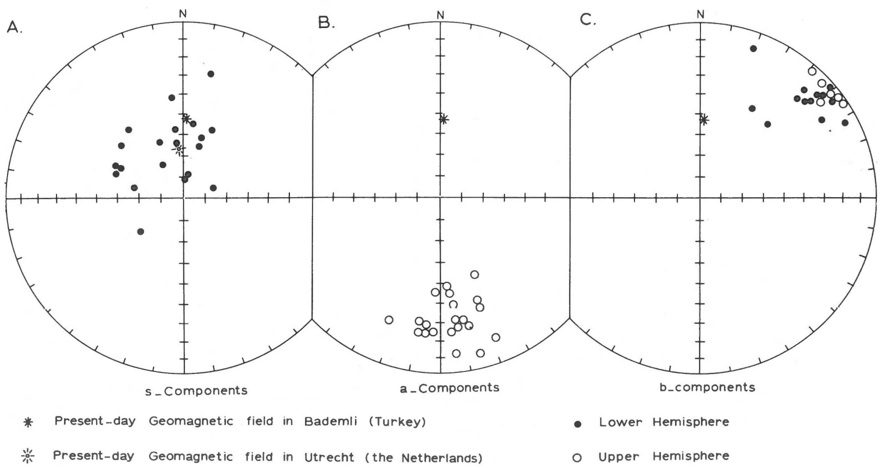

Fig. 4
Equal area projections of the directions of the three magnetic components in the Permocarboniferous redbeds from Bademli, before correction for the tectonic dip of the strata.

TABLE I

Summary of paleomagnetic measurements on Turkish rocks

	Age	D	I	K	α_{95}	N	Reference
Bademli redbeds							
s-components, before tectonic correction	Qu	340	+66	13	9.5	20 samples	present paper
a-components, before tectonic correction	K/Te	175	−30	28	6	21 samples	present paper
b-components, before tectonic correction	P-C	47.5	+10.5	22	7.4	19 samples	present paper
b-components, after tectonic correction	P-C	41	+13.5	22	7.3	19 samples	present paper
Amasra redbeds	P-C	292.5	−14.5	–	18	3 sites	Gregor and Zijderveld, 1964
Bayburt	J	146.5	+ 3.5	51	8	8 samples	Van der Voo, 1968
Gümüshane	K	153.5	−36.5	35	11	6 sites	Van der Voo, 1968
Niksar	K	140	−36	–	–	2 sites	Van der Voo, 1968
Gümüshane	Ku/Te	346	+40	90	7	6 sites	Van der Voo, 1968
Tunceli	Te	152.5	−48	33	16	4 sites	Van der Voo, 1968
Eastern Turkey	Qu	357.5	+54.5	–	6	26 sites	Sanver, 1968

The other two components (fig. 4B and C) revealed two completely different groups of directions, and it is evident that at least one of them is also secondary. Our reasons for thinking that the a-components are secondary are not based on the fact that they are "softer" (viz. more easily eliminated during demagnetization) but on the similarity between the directions of these a-components and those found in Late Mesozoic and Tertiary rocks in eastern Turkey (table I). We suggest that these magnetizations have been induced during a tectonic event, probably originating from, or at least related to, the formation of the nappe structure. Gutnic et al. (1968) suggested an Eocene/Oligocene age for this tectonic event.

There is no reason to suspect that the b-magnetizations are due to other than the original geomagnetic field during Permocarboniferous times. However, the mean direction of the b-magnetizations after tectonic correction is rather anomalous (pole position 43N, 150E) when compared with results published sofar for Turkey (table I). This is not surprising when we consider the geologic situation of the Tauride Chains, with a complicated orogenetic history and nappes possibly rotated (fig. 1).

Nevertheless, one firm conclusion can be drawn from the Turkish Permocarboniferous results: the areas investigated must have been situated in the equatorial belt, because of the low inclination values observed both in the Amasra samples (−14½) in northwestern Turkey, and in the Bademli redbeds (+13½) in southern Turkey.

The paleomagnetic data do not yet allow an elaboration in terms of mutual rotations, since the ages are not exactly known and since it is not known what polarity of the geomagnetic field is represented either by the Amasra magnetization or the Bademli magnetization.

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