

The Anticlockwise Rotation of Italy during Lower Oligocene, Palaeomagnetic Evidence from Age Dated Volcanics of the Monti Lessini, Italy

by

H. SOFFEL

Institut für Geophysik, München (Deutschland)

The first palaeomagnetic evidence for the anticlockwise rotation of Northern Italy through 50° during Middle Tertiary has been established by SOFFEL [1972] by studying the palaeomagnetism of 25 mostly acid volcanic units of the Colli Euganei. For part of these rocks radiometric age determinations have been available [BORSI *et al.* 1969] indicating that the rotation took place between 45 and 33 m.y..

Volcanism in the Monti Lessini and Monte Berici (in the area between Verona and Vicenza) is of the same age according to biostratigraphic and radiometric age determinations by PICCOLI [1973]. The palaeomagnetism of 37 volcanic units in the Monti Lessini and Monte Berici has been studied in order to test the Colli Euganei result. The collection includes also lava flows from east of the Lago di Garda and from south of Bassano di Grappa. The radiometrically determined ages vary between 47.2 and 33.5 m.y.. The rocks which have been sampled are basalts with primary Titanomagnetites as carrier of remanence. The Curie temperatures vary between 100° and 560° C. The high Curie temperatures are present in rocks showing signs of initial high temperature oxidation. Secondary oxidation features are rare and without importance for the palaeomagnetic result.

After alternating field demagnetization in fields between 50 and 500 Oe the initially large within site and between site scatter could be reduced drastically. The average precision k of the individual sites which was already as large as 184 for the Natural remanent magnetization could be raised to 300 for the stable remanence accompanied by an increase of the between site grouping. Tectonic corrections had to be applied for some of the sites. 24 of the 37 units have reversed polarity, 9 have normal polarity, 2 show intermediate directions and 2 have no stable remanence. The intensities of remanence are normal for basalts.

Similar to the results of the Colli Euganei volcanites the declinations of stable remanence (after reversal of all normal polarities) vary between 239.9° and 130.5° while the inclinations vary between -4.2° and -57.7°. All sites with Middle to Lower Oligocene age have declinations between 240° and 170°, those with Upper Eocene age have declinations between 180° and 130°. Rocks with ages of about 40 m.y. (limit between Upper Eocene and Lower Oligocene) have declinations of about 180°. The mean direction of stable remanence (CARM) of the Lower to Middle Oligocene rocks is : $N = 15$, $D = 204.1^\circ$, $I = -34.8^\circ$, $k = 17.6$, $\alpha_{95} = 8.6^\circ$. The corresponding values for the Upper Eocene rocks are : $N = 18$, $D = 156.5^\circ$, $I = 38.1^\circ$, $k = 13.6$, $\alpha_{95} = 9.0^\circ$. The difference in declination is 47.6°. It is in agreement with the Colli Euganei result within the limits of error. The difference in the inclination is not significant.

The data from the Colli Euganei and from the Monti Lessini can be combined in order to improve the result. For the Lower to Middle Oligocene rocks of both areas the following data can be computed for the mean CARM direction : $N = 31$, $D = 197.1^\circ$, $I = -42.1^\circ$, $k = 13.3$, $\alpha_{95} = 6.9^\circ$. The corresponding data for the Upper Eocene rocks are : $N = 25$, $D = 150.3^\circ$, $I = -37.3^\circ$, $k = 12.1$, $\alpha_{95} = 8.0^\circ$. The declination difference is here 46.8° and within the limits of error of the same amount as previously determined for Permian and Triassic rocks.

In combination with the radiometric and biostratigraphic age determinations one can deduce from the palaeomagnetic data that the rotation of Northern Italy took place between Upper Eocene (45 m.y.) and Lower Oligocene (35 m.y.) and was completed in Middle Oligocene. A comparison of the pole positions derived from the above mentioned CARM data with corresponding data from Central Europe indicates that the rotation of Northern Italy has been accompanied with of motion towards north which might still have continued in times later than Middle Oligocene.

*
* *

Discussion

Finetti : It seems to me dangerous to assume an indication of rotation of the entire Italian Peninsula from the paleomagnetic data of the Lessini area because that zone belongs to the Adriatic-Po Valley plate, while Italy is mostly interested by the allochthonous Apennine Chain which is a geotectonic unit quite different from the Lessini area. It is also surprising that MM. LOWRIE and ALVAREZ find the same rotation into overthrust blocks of Scaglia rossa.

Answer : On the basis of new paleomagnetic results from Central Italy one has to develop a more complicated model for the rotation of Italy as a whole (if it ever rotated as a single unit). It seems to be the case that the Colli Euganei and Monte Lessini results indicate the time of rotation of Northern Italy and the Southern Alps, while the horizontal movements in Central and eventually also Southern Italy are older and in connection with an earlier event.

Closs : The results of the author are very remarkable because they show that either during the movement of the highest alpine nappes a rotation took place or before the movement of the nappes. In the Tauern-window it seems that the remanent magnetism prefers directions of stable Europe. This is a case in which the paleomagnetism can hopefully make a very important contribution to the orogenetic events.

*
* *