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eEarth Discussions

Interactive comment on "Palaeomagnetic investigations of sediments cores from Axios zone (N. Greece): implications of low inclinations in the Aegean" *by* E. Aidona et al.

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a) Manuscript summary

The authors present a classical palaeomagnetic study from Greece focusing on tectonic aspects in northern Greece during Eocene and Oligocence covering about 26 million years. The study relies on 13 sediment cores (sandstone, limestone, clay) taken from the Axios zone (northern Greece). A large number of samples from various depths were demagnetised by alternating magnetic fields and thermal demagnetisation to find the characteristic component of the natural remanent magnetisation (NRM). The palaeomagnetic investigations are accompanied by rock magnetic experiments

and mineralogical analyses determining the remanence carrying magnetic mineral assemblages. As exact sample orientation remains difficult for drill cores, re-orientation techniques were attempted to obtain original core position. The palaeomagnetic results agree in general with already published palaeomagnetic data confirming both, low inclinations for the concerned time period and the cenozoic rotational clockwise rotation.

b) General impression

The authors present new palaeomagnetic data from Northern Greece for a period that is generally lacking in data. Hence, this work contributes fulfilling gaps in the palaeomagnetic database. The conclusions drawn by the data shed some light on past geotectonic processes of this active region helping to understand tectonic mechanisms causing earthquakes. I consider this manuscript therefore as an interesting work which deserves publication.

The manuscript suffers from illogical text flow and non-concrete statements (particularly the discussion), and the author's cogitations are sometimes heavily comprehensible. Apart from this, I have no general criticisms. Due to the amount of minor criticisms (see below), I suggest careful reworking the manuscript taking my comments into account.

c) General comments

Introduction

- The aims of the study are mentioned in the last paragraph of the introduction, which should be re-organised: First, the aims of the paper should be stated and then the investigation plan should be presented and not vice versa.
- Results of existing data are indeed discussed in the introduction, but more weight should be given addressing the two aims of the authors study, i.e. a) validity of the rotational pattern (state the exact geographical area), b) low inclination problem.

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- It should be stated precisely on what time periods the study focuses on.
- Explain better: *a few specific strata of interest* on page 39, line 15.

Geological setting and sampling

- This paragraph should be better organised in order to avoid confusion. Cognising the exact geological time interval of the investigation remains difficult for the reader. Either eons or periods should be used and not both.
- The geology of the 4^{th} group, which consists only of 1 marine core (NIR-1) is neither mentioned in the text nor in figure 2.
- It remains unclear from which depths, respectively from which stratigraphic horizon, the individual samples originate. Are these depths arbitrarily chosen or do they correspond to marker horizons indicating an age? Indicate in Figure 2 the depths of the samples.
- Figure 2: a) The lithostratigraphy is presented in a too simple manner, but should be more detailed. At which depths occur sands, sandstones, clays, red beds marls and limestones? This would particularly be helpful when interpreting Figure 11. b) the presentation of the three groups is not correct, because one gets the impression that the different cores are aligned along a profile, but this is not the case according to Figure 1, e.g. the cores from Kassandra are rather aligned along a circular arc.
- It is not clear which samples belong to basement, Eocene, Oligocene, Miocene or Pliocene. This again, is very important for the interpretation.

Results

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- Figure 3: The number of Zijderveld diagrammes (only two) is insufficient. Later in the manuscript viscous remanent magnetisation (VRM) is used for sample orientation, but I cannot see really a viscous ChRM overprint in those two examples. Show a Zijderveld diagramme examples with significant viscous overprints.

- Page 42 line 9: a) Okay, if pyrite is present it oxidises to maghaemite or haematite (4 FeS_2 + 11 $O_2 \rightarrow$ 2 Fe_2O_3 + 8 SO_2), but I wonder why the newly formed minerals become magnetised during demagnetisation, which is done in zero magnetic field. What about the rest field of the oven?

- Page 42, line 25 sqq. One cannot infer from IRM acquisition curves only the presence of magnetite in a sample, and therefore this statement should not be the first. Restructure this paragraph: a) state the IRM observation (e.g. samples mostly saturated at 300 mT), b) mention your thermomagnetic curves (Curie points) and c) make the conclusion (magnetic mineralogy).

- There appears to be a contradiction between SEM observation and the magnetominerlogical results. On page 43 line 3 it is stated that secondary magnetite is formed during laboratory heating. Magnetite forms rather if pyrrhotite (e.g. $Fe_{1-x}S$, 0<x<0.2) or greigite (Fe_3S_4) is heated while heating of pyrite forms maghaemite or haematite, which have both higher Curie-temperatures than 580 °C. Could there be evidence for pyrrhotite presence instead of pyrite? Often mineral different mineral phases occur also together: e.g. pyrite and greigite.

Reorientation

- The authors use the VRM for sample reorientation, but the given Zijderveld plots in Figure 3 do not show really a strong viscous overprint. It should be stated which temperature of alternating field range was used to isolate the VRM.

Discussion

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- The discussion is sometimes confusing, because it is unclear which data is concerned. In the beginning it should be clearly stated which dataset or drill cores are excluded due to impossible reorientation. Moreover, a better distinction between own data and literature data should be made when referring to both.

- The authors pose two aims in the end of the introduction a) validity of the rotational pattern and b) low inclinations. Point a) is only marginally discussed and should be more extended. A clockwise rotation is mentioned in the abstract but not at all in the discussion.

- Page 44 last two lines: It is not clear how the age of the specimens was determined but this is very important, because the interpretation relies on the ages and it is unclear how they were derived. When making correlations between the drill cores it should be ensured that depth intervals of the same age or geological period are compared, but this is not evident from figure 2. Figure 2 should therefore include the age information, i.e. which depth interval corresponds to which geological period (for each drill core).

Conclusion

- Page 48 line 4 to 6. During dolomitisation Ca^{2+} ions in the calcite $CaCO_3$ crystal structure are replaced by Mg^{2+} ions, and the mineral dolomite $CaMg(CO_3)_2$ is formed. Both minerals are diamagnetic (= negative susceptibilities). Dolomitisation does not affect the kind of magnetism and moreover it does not involve ferrimagnetic minerals. Apart from that, this conclusion falls a bit from the sky, because it was not discussed before.

- After imbedding the rotational pattern in the discussion, a conclusion concerning this item should be mentioned in this section.

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d) Detailed comments
Please refer to the annotated manuscript.

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