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Solid Earth Discussions

Interactive comment on "Paleointensities on 8 ka obsidian from Mayor Island, New Zealand" *by* A. Ferk et al.

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General Comments/Summary

This manuscript presents geomagnetic paleointensity results from an ∼8 ka obsidian in New Zealand. As there are currently few paleointensity results from the southern hemisphere, this work represents an important contribution towards a better-constrained geomagnetic field model. The experimental methods were very thorough, as the authors attempted to correct for both anisotropy and cooling rate effects, both of which are rarely done. However, sample alteration precluded applying these corrections in most cases. Identification of the remanence-carrying magnetic mineralogy was also hampered due to the high paramagnetic to ferromagnetic ratio. The manuscript should be published with minor clarifications and corrections.

Specific Comments

1) The authors were frustrated in their attempts to determine anisotropy and cooling rate corrections for most specimens due to sample alteration. Yet in the introduction they state that by choosing these particular samples they would be able to correct for these biasing effects. A slightly longer discussion on the uncertainty arising from the inability to apply these corrections seems in order. Previous work by two of the authors (Leonhardt et al., 2006, EPSL, 243, 282-292) suggests that cooling rate corrections are 13-20% in obsidian, though Bowles et al. (2005, Geochem. Geophys. Geosys., 6, Q07002) find no systematic bias in submarine glass. Although it may be preferable to determine sample-specific cooling-rate dependencies of magnetization, could not an estimate be determined simply by assuming published values for SD material or by using the relationship determined for the one successful sample? The samples seem fairly uniform in terms of their magnetic properties, and one might expect cooling rate dependencies to also be similar. As Muxworthy points out in his comment, magnetostatic interactions would affect the cooling-rate dependence, but I would be surprised if there were considerable magnetostatic interactions in the glass. Have there been any TEM studies of similar obsidians that imaged the magnetic minerals?

2) A considerable amount of text is devoted to the cooling rate experiments and results (Section 3: Relaxation geospeedometry), which are already published in Gottsmann and Dingwell (2002). Especially considering that only one of the cooling rate results is even used in the present study, I would recommend paring Section 3 down considerably. The results could be summarized in a single paragraph. Likewise, 5 out of 11 figures are merely reproduced from Gottsmann and Dingwell (2002). While Figure 2 is useful in orienting the reader, I think the remaining 4 figures (Figures 3-6) could be eliminated and the reader referred to the original source.

3) Although the authors state that the paleointensity data are of "good quality" (and results in Fig. 10 appear quite good), it would be nice to have more information on the quality selection criteria used. What are the "default criteria" used in data interpreta-

tion? It should also be relatively easy to include in Table 2 the actual quality statistics referred to in the text (e.g., list f, g, DRAT, etc.). Also, the authors should define or give a reference for the criteria “d(TR)” (pg. 689, line 26). I am uncertain as to what this is.

4) How are the uncertainties at the specimen level determined in Table 2 (for uncorrected paleointensities)? Are these used at all? They appear to be disregarded when calculating site averages and standard deviations.

5) Page 688, Lines 8-11. The interpretation of the difference between the FC and ZFC (or LTSIRM) warming curves as arising from an antiferromagnet is non-unique. It looks very similar to the difference you see in nano-magnetite or -titanomagnetite, where at low temperatures magnetocrystalline anisotropy increases dramatically.

6) The writing is unclear or awkward in many places, often due to improper English language usage or grammar. I have tried to highlight the most problematic sections below.

Technical Corrections

Page 680

Line 24 It may be more appropriate to cite one or some of the original work or discussion on cooling rate differences (e.g., Coe, 1967; Halgedahl et al., 1980; Dodson and McClelland-Brown, 1980; Fox and Aitken, 1980. . .)

Page 681

Line 5 “crystals” Be more explicit, e.g., “single silicate crystals with magnetite inclusions”

Line 7 What is the source for the data in Fig. 1?

Line 8 “The data set behind of for example the global field model. . .” Change to: “For example, the data set behind the global field model. . .”

Page 682

Lines 11-13 Unclear. Perhaps: “The deposit has been interpreted as a fountain-fed flow that deformed after emplacement. . .” ??

Line 29 Replace “i.e.” with “e.g.”

Page 683

Line 9 Change “in” to “an”. Close bracket needed after Al2O3.

Page 685

Line 15 “For some samples also the dependences of hysteresis and backfield on temperature were measured. . .” Change to “For some samples, the temperature-dependences of hysteresis and backfield were also measured. . .”

Line 18 “different low temperature experiments” Describe those experiments here.

Line 23 “according data was” Change to “data were”. Remove the word “according”

Page 686

Line 4 Change “shows” to “show”

Line 7-8 Sentence beginning “Plotting of Mrs/Ms. . .” is awkward. Perhaps something like: “These two samples plot in (near?) the SD region of a standard Day plot (Mrs/Ms vs. Bcr/Bc), assuming a magnetite mineralogy.”

Line 9 (and 25) Describing a hysteresis loop as “thin” seems strange. Perhaps say that it is “dominated by paramagnetic behavior”.

Page 687

Line 6 Insert comma after “loops”

Line 12 Change “of” to “off”

Line 13, 15, 18, 19 Change “implied” or “applied” to “imparted”. In general, fields are “applied”, while remanences are “imparted”.

Line 18 Add “in zero field” after “cooling”

Lines 10-19 Move up to beginning of section where you are describing methods.

Page 688

Line 18 Change “inch” to “1-in”. Also on Page 689, Line 12, change “8 inch cores” to “eight 1-in cores”. That way it is clear that the cores are not 8 inches long.

Line 24 Add reference for pTRM checks (Coe, 1967, J. Geomag. Geoelec., 19, 157-179).

Line 689

Line 6 Remove the word “were”

Line 17 Add comma after “In total”

Line 22 Remove “higher”

Line 23 Sentence beginning “However, for the temperature intervals. . .” is awkward. Perhaps something like” “However, for the temperature intervals used for paleointensity determination, the DRAT parameter (Selkin and Tauxe, 2000), which measures deviations in pTRM checks, is typically <=5.1, suggesting the data are reliable.

Page 690

Line 9 Change “magnetic” to “magnetically”

Line 18 Change colon to period.

Lines 18-22 Sentence beginning “After determining. . .” is long and awkward. Perhaps something like: “After determining the ATRM tensor, a paleointensity scaling factor, fATRM, is calculated based on the directions of the ancient field and the laboratory

field. “

Page 691

Line 7 Remove the words “also for them”

Lines 8-10 Perhaps instead: “Vector subtraction of the TRM remaining at 390°C from each step in the anisotropy experiment should yield a reasonable measure of the ATRM tensor.”

Line 21 Change “with-in” to “within”

Line 27 Remove “already”

Page 693

Lines 1, 2 “rock magnetic” is two words

Line 4 What are the “thermal repeat steps”?

Line 22-23 “. . .alteration connected to Tb<Tg. . .” Change to “. . .alteration at Tb<Tg. . .” Also, the claim that this alteration can be ruled out may be a bit of an overstatement , given that 16 of 24 samples altered during the ATRM experiments at T < Tg.

Page 695

Line 2 Insert comma after “It is”

Line 6 “Rock magnetic” is two words

Line 9 “Mathematica” should be capitalized.

Figure 1 Where are these data from? Reference?

Figure 2 The inset map is very hard to see. Is it possible to make it a little bit larger?

Figure 3 Scale?

Figure 6 “Encirceled is data. . .” Change to “Encircled (spelled correctly) data are from

a single 5-m long flow ridge sampled in detail."

Interactive comment on Solid Earth Discuss., 3, 679, 2011.