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Archaeointensity data from Japan: current status and future perspectives

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Japan is a country with very rich cultural heritage and with many archaeological sites that can offer precious information about the geomagnetic field secular variation in the past.

However, even though archaeomagnetic research in Japan started more than 60 years ago, with numerous studies focused on archaeodirection determinations of *in situ* archaeological structures, the available up to now archaeointensity data are still scarce.

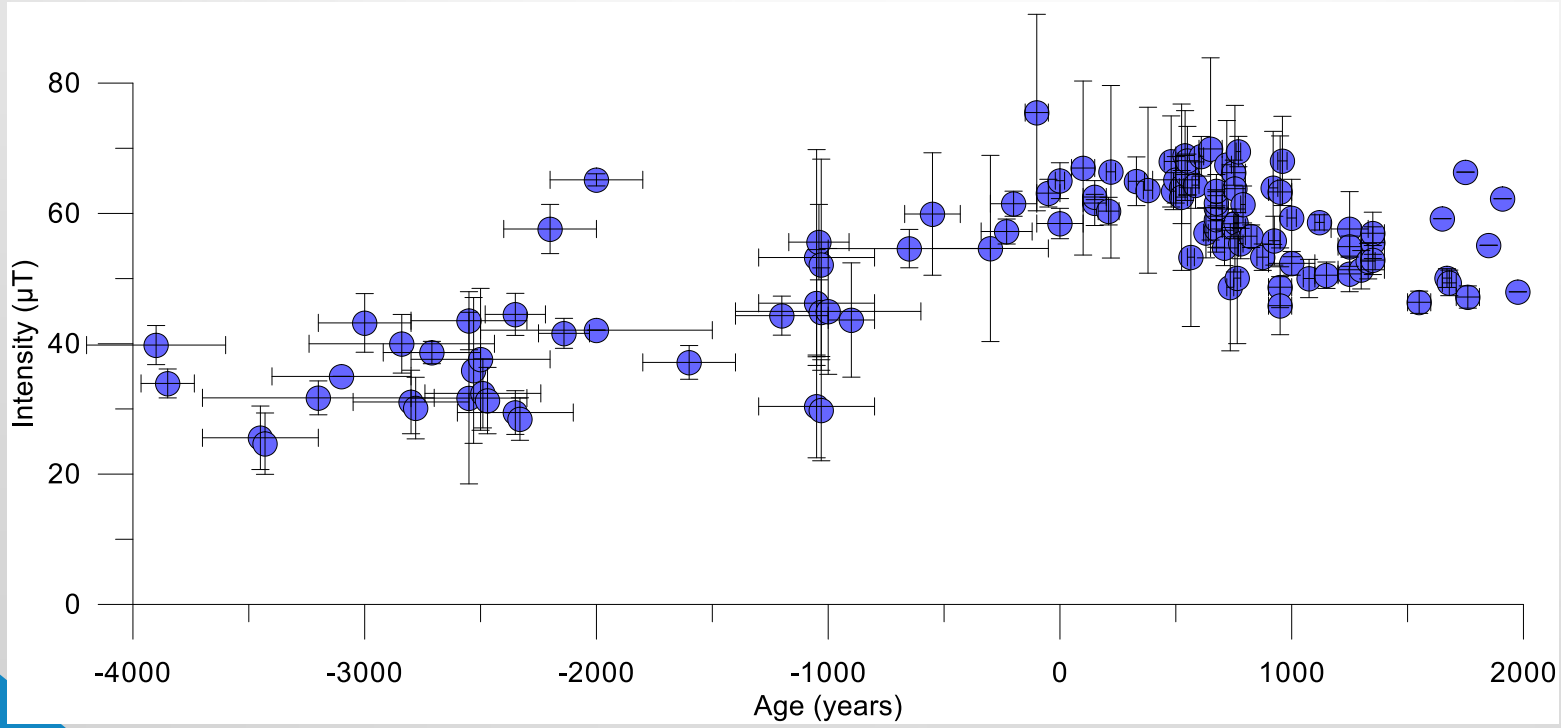
Archaeointensity data from Japan

Japan Archeomagnetism Database 日本考古地磁気データベース

T. Hatakeyama, Okayama Univ. Sci. (http://mag.center.ous.ac.jp/en)

GEOMAGIA50 - Home

Brown et al., 2015 (https://geomagia.gfz-potsdam.de/index.php)



Data from archaeological artefacts

All data are reduced at the latitute of Tokyo

Archaeointensity data from Japan

Most of the absolute intensity records from Japanese archaeological artefacts come from studies carried in 60's, 70's and 80's, mainly obtained with the original Thellier-Thellier method or its modifications.

- In none of these old data, cooling rate and anisotropy corrections were applied.
- During the last 20 years, only two more archaeointensity studies have been published, applying the Tsunakawa-Shaw palaeointensity method on baked clays from Japanese kilns.
- This current status of archaeointensity studies in Japan makes evident the need of new high-quality intensity reference data for Japan.

Archaeomagnetic sampling

In order to obtain new high quality archaeointensity data from Japan, we have collected a total of 56 fragments from well-dated baked clay archaeological artifacts from six archaeological sites located at the Okayama prefecture.

Archaeomagnetic sampling

The baked clay pieces collected have various dimensions, ranging from 3 cm to 10 cm, and come from ancient coffins, haniwa artifacts and pottery.

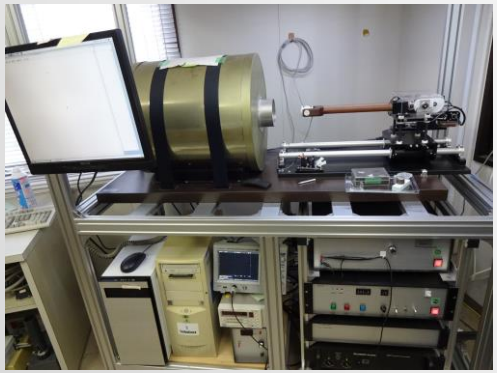
Archaeological Site	Code	No of fragments	Type	Archaeological Age
Nima Ohtsuka	NIMA	8	Haniwa	550-600 AD
Sada Hifashizuka	SADA-1	9	Coffin	630 AD
Sada Nishizuka-No2	SADA-2	7	Coffin	630-650 AD
Sada Nishizuka-No4	SADA-4	7	Coffin	650-675 AD
Tatetsuki	TATET	8	Pottery	100-200 AD
Tatezaka	TATEZ	7	Pottery	100-200 AD
Tenguyama	TEN	10	Haniwa	450-500 AD

Their ages range from 100 AD to 675 AD based on archaeological evidence

Rock magnetic analysis

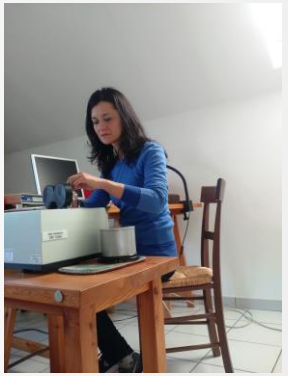
Magnetic analyses were performed at :

- Palaeomagnetic laboratory of Okayama University of Science, Japan
- ALP-CIMaN Palaeomagnetic Laboratory (Peveragno, Italy)



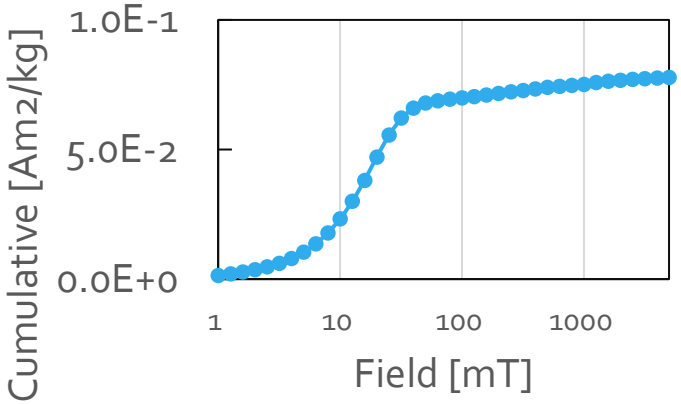
Okayama University of Science, Japan

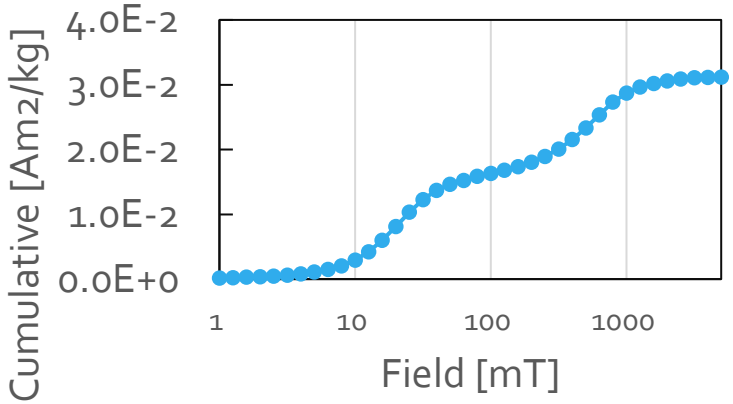
ALP-CIMaN Palaeomagnetic laboratory, Italy

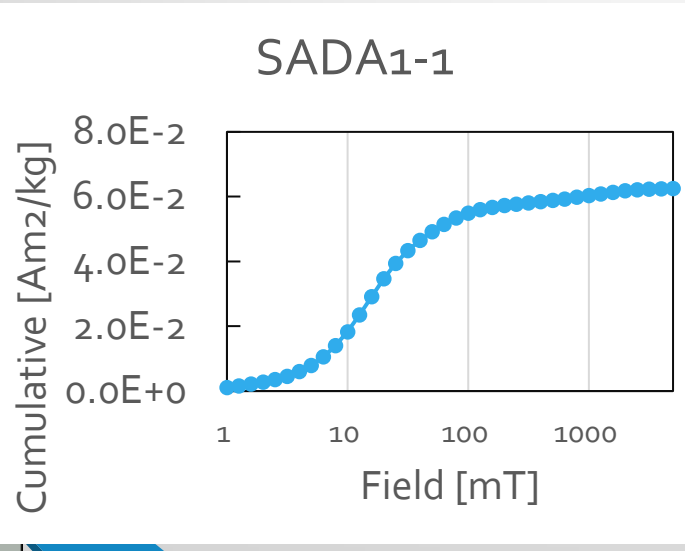


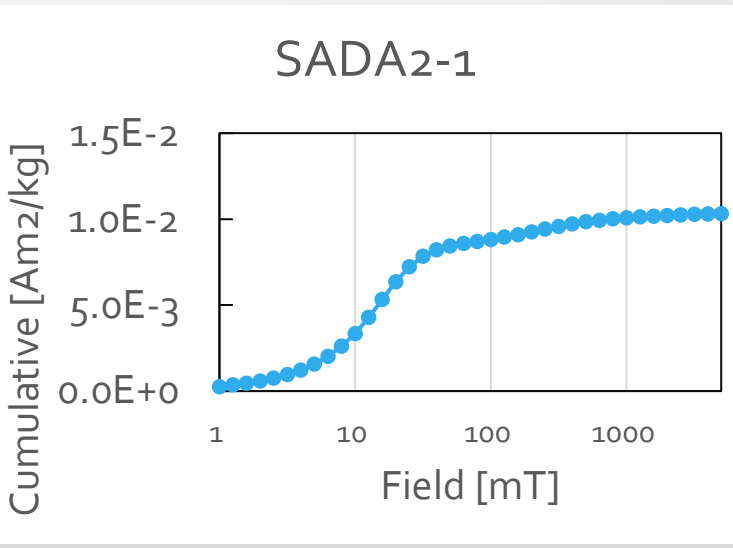
Rock magnetic analysis

Isothermal Remanent Magnetization (IRM) acquisition curves



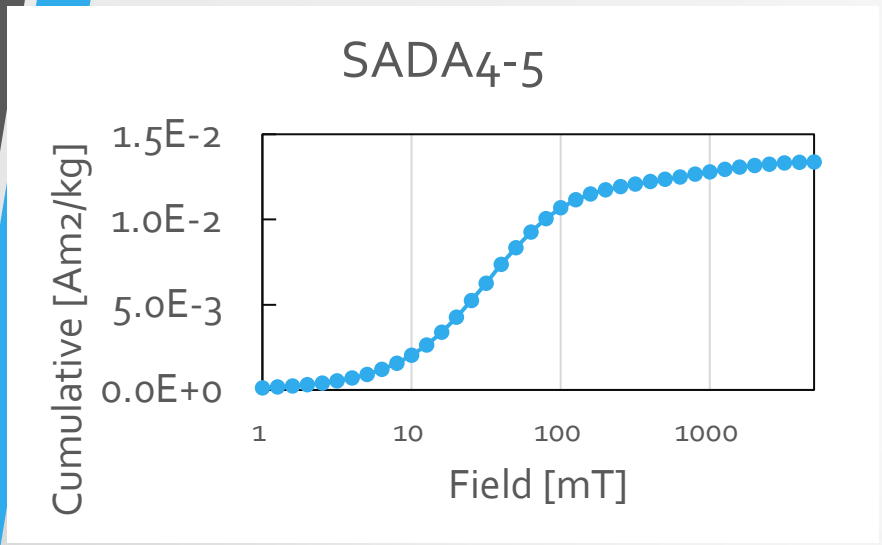


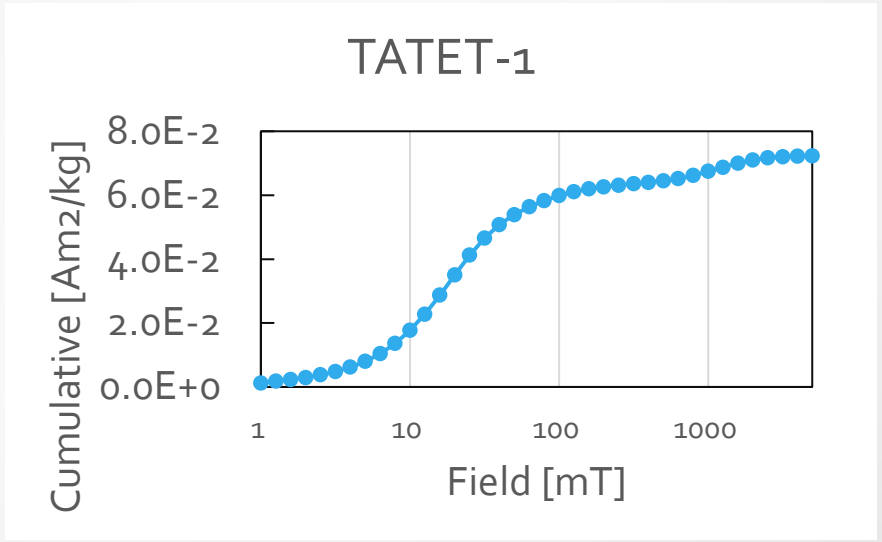


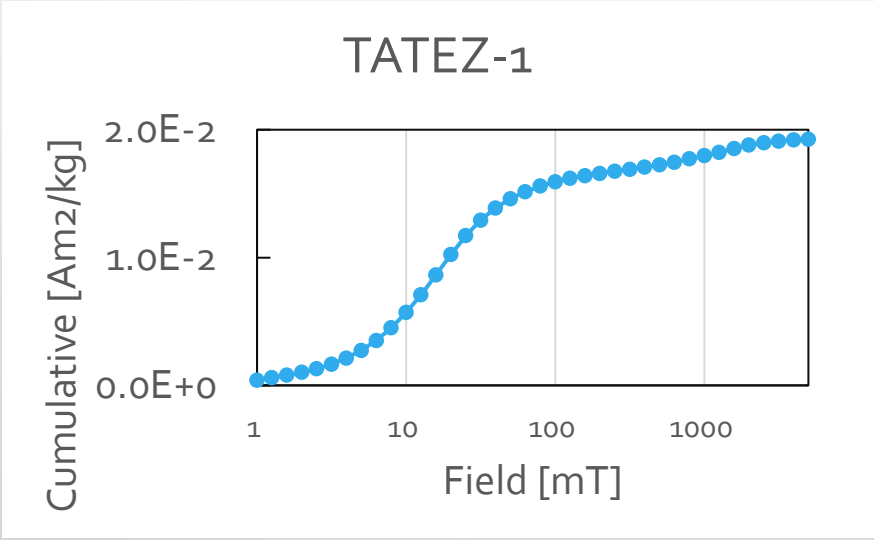


Rock magnetic analysis

Isothermal Remanent Magnetization (IRM) acquisition curves

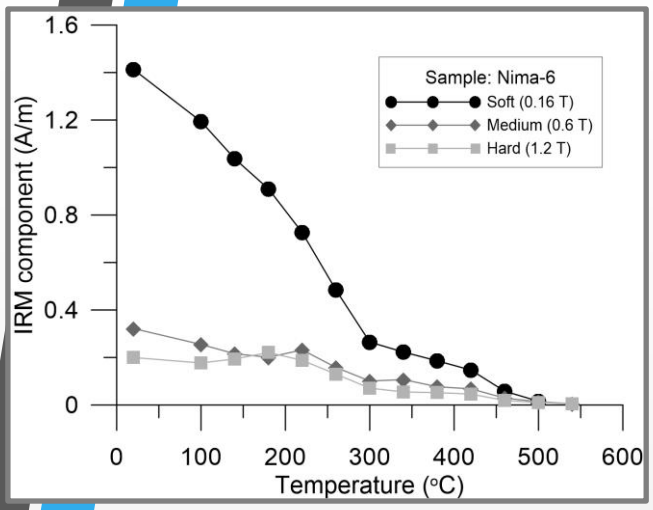


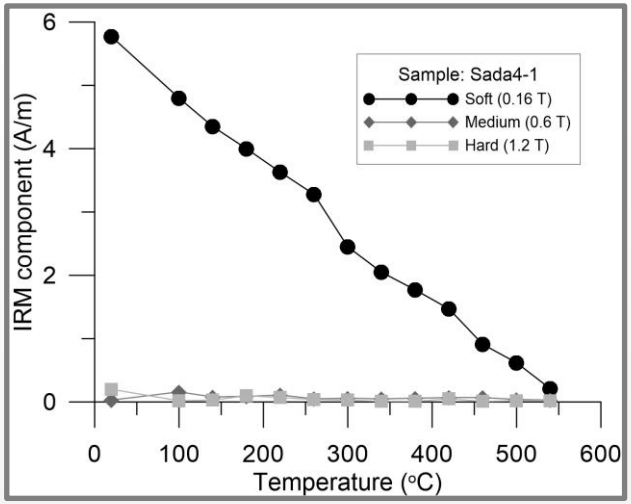


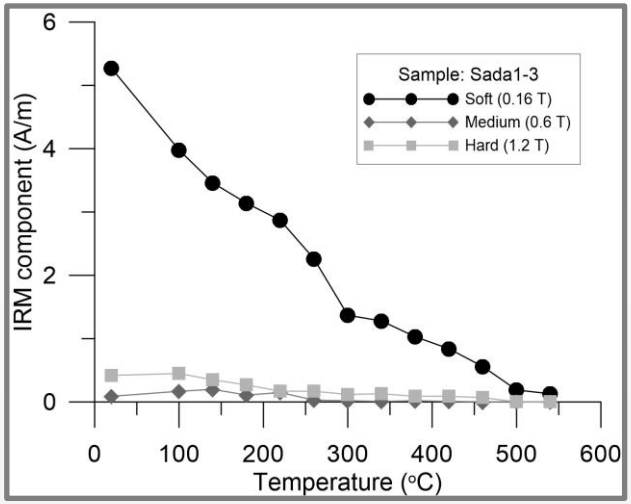


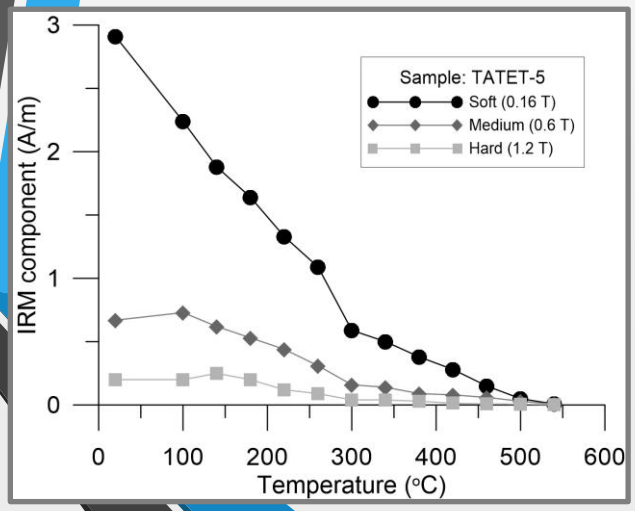
Rock magnetic analysis

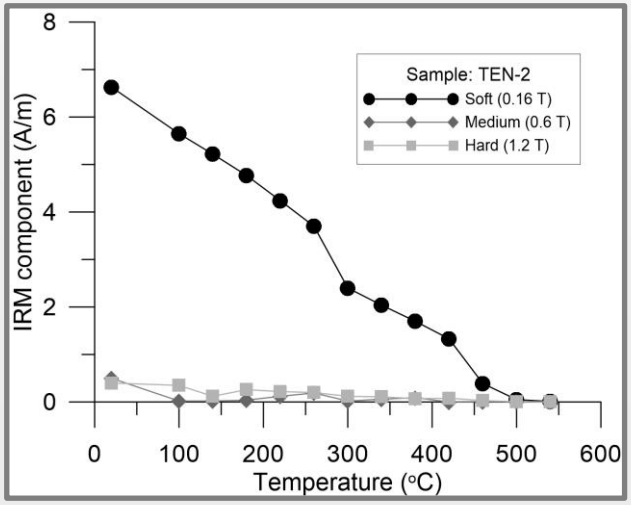
Lowrie experiments

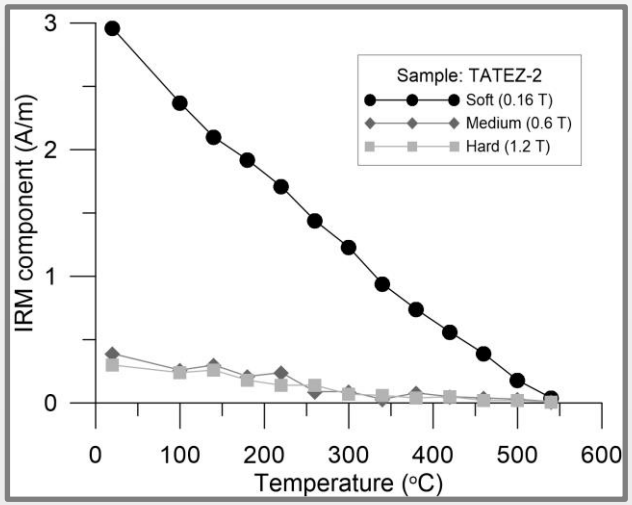






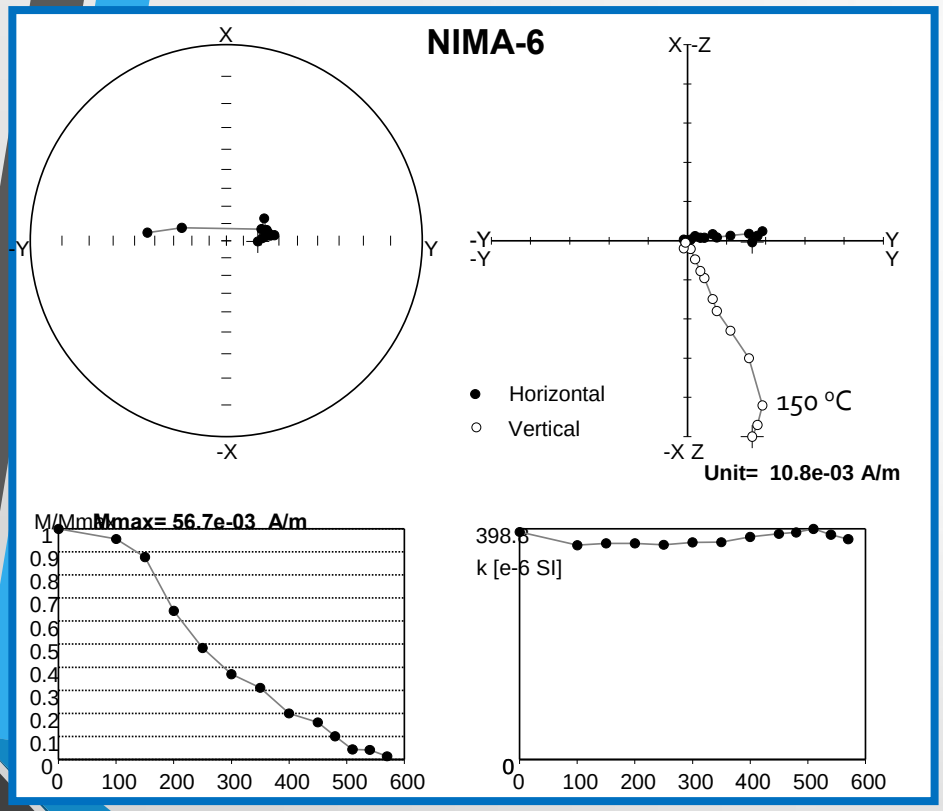


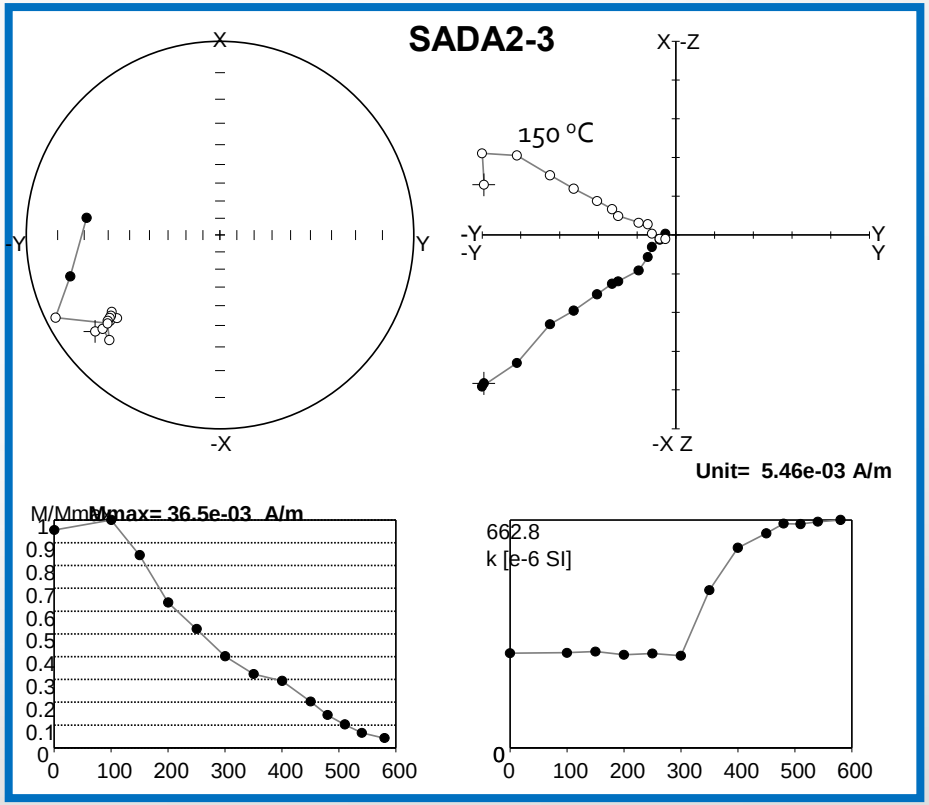




Archaeomagnetic analysis

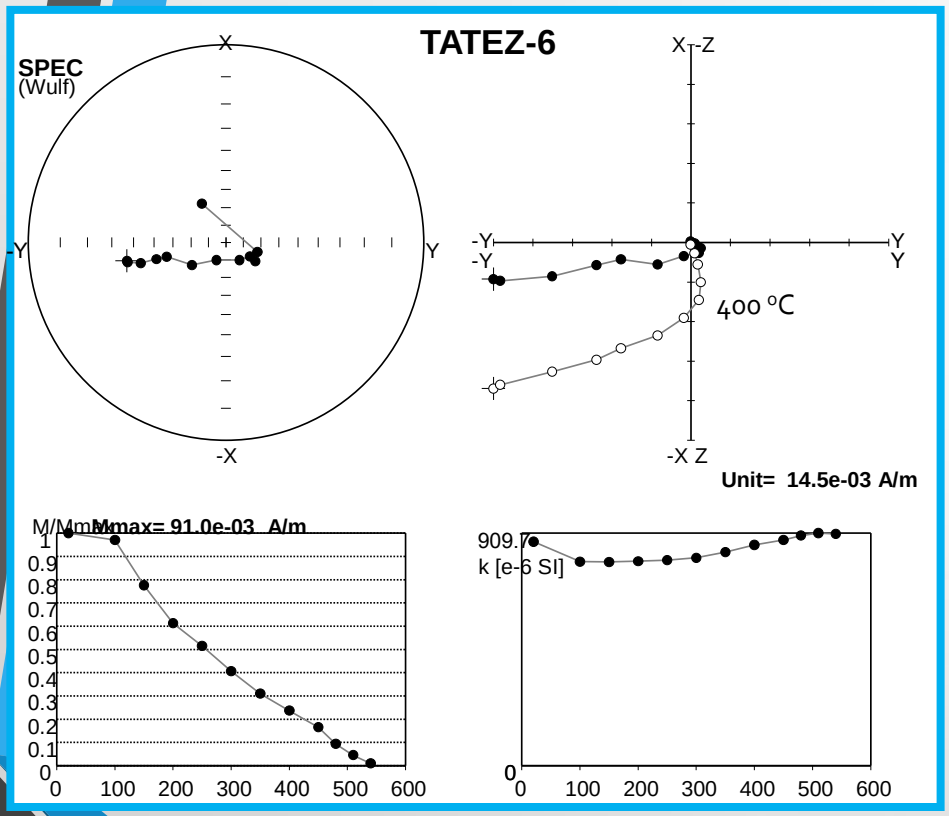
Thermal Demagnetization

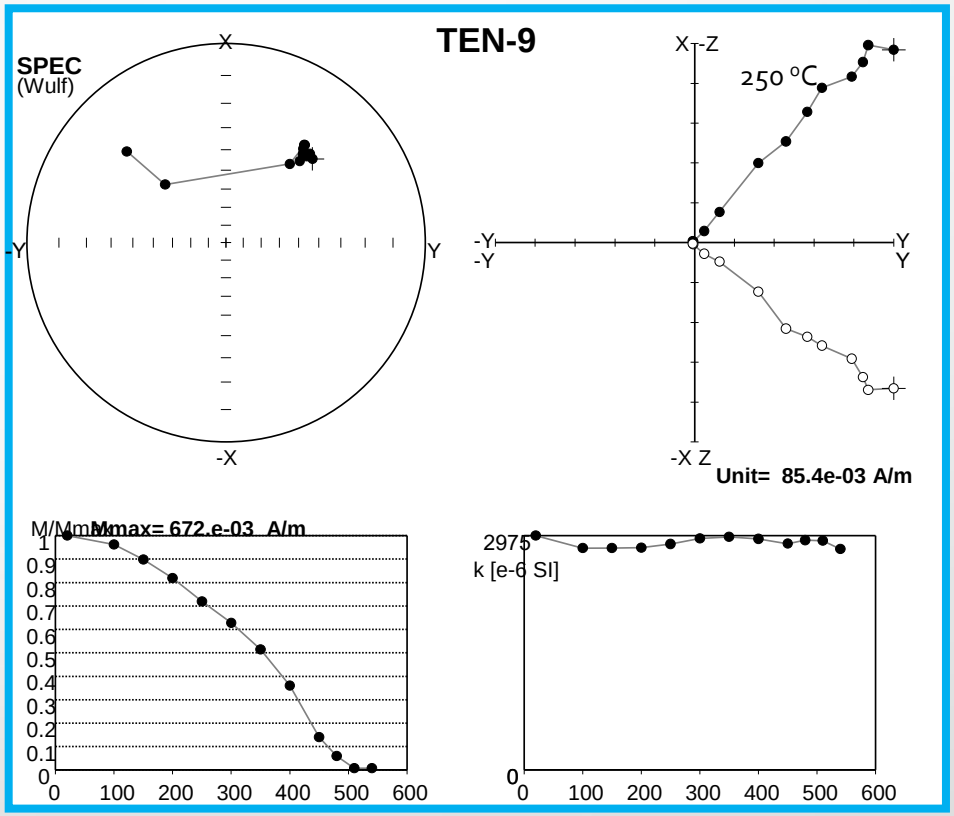




Archaeomagnetic analysis

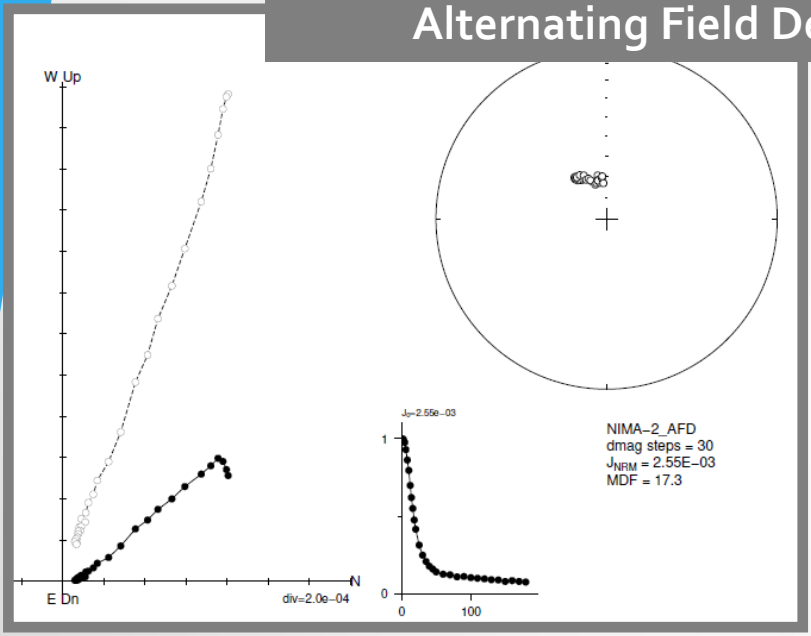
Thermal Demagnetization

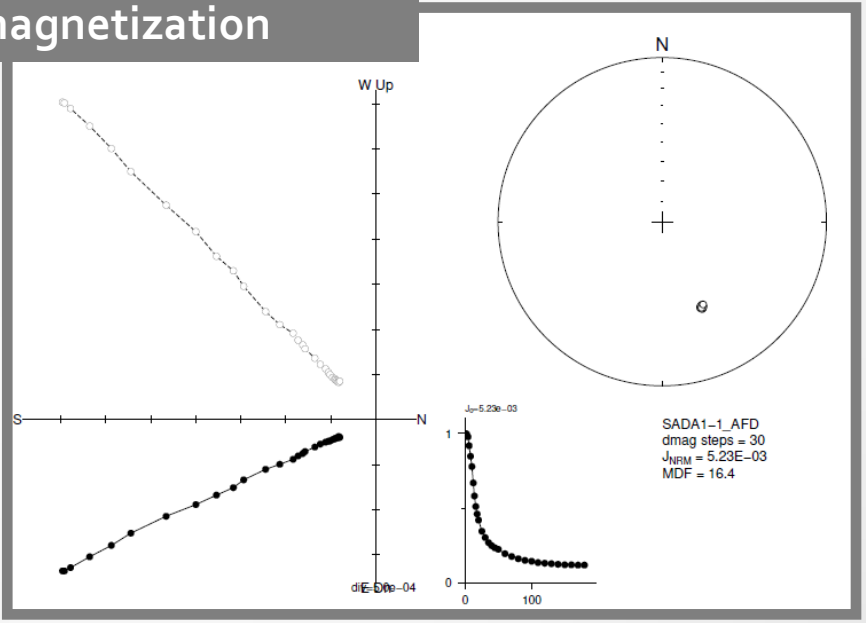


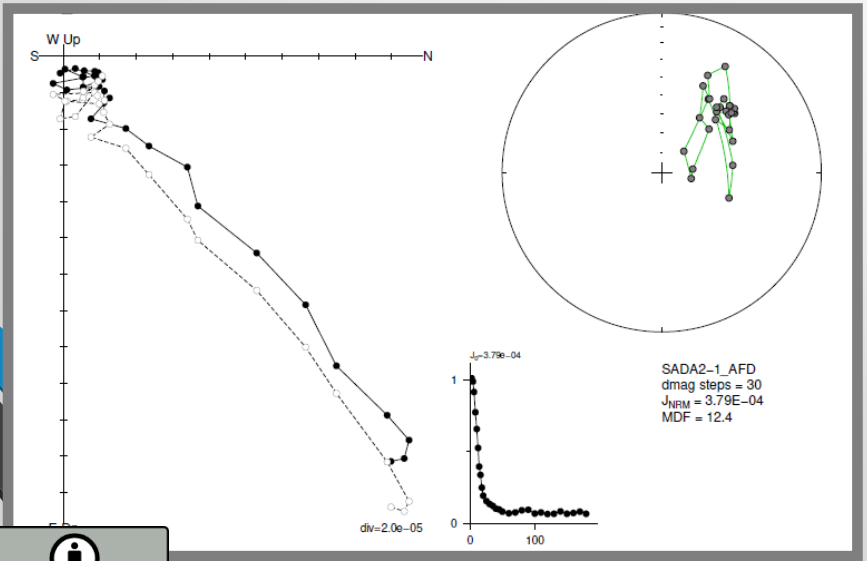


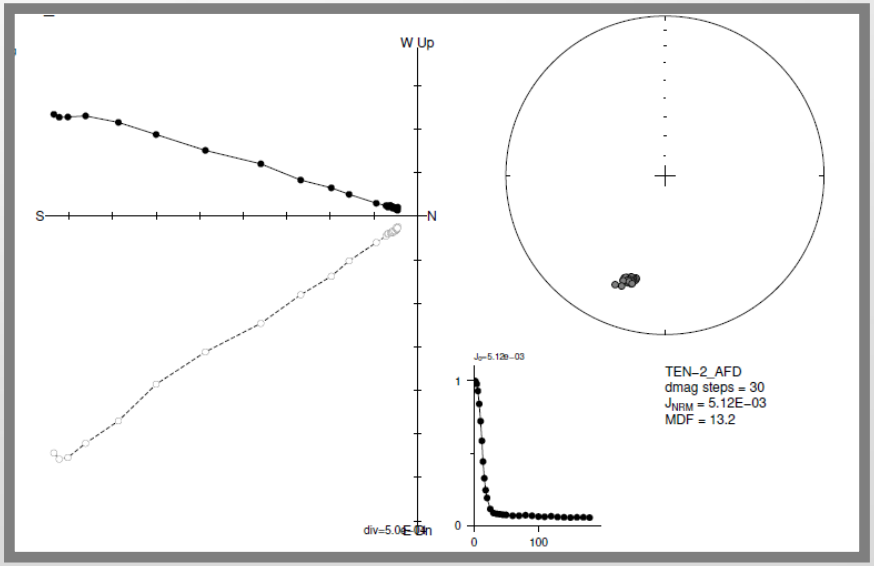
Archaeomagnetic analysis

Alternating Field Demagnetization









CONCLUSIONS

- IRM curves obtained up to 5T show the presence of a low coercivity mineral or a mix of low and high coercivity magnetic carriers (e.g. Nima-1).
- Lowrie experiments indicate the dominance of a soft magnetic component, while hard and medium components are minor, demagnetized around 300 °C.
- Thermal demagnetization results indicate in all samples the presence of a magnetic mineral with Curie temperature ranging from 480 to 560 °C, most probably magnetite and/or Ti-magnetite.
- A secondary high coercivity and low Curie temperature mineral is also present in some samples, most probably identified as ε-Fe_2O_3.

CONCLUSIONS

Both thermal and AF demagnetization diagrams reveal a stable, single component of magnetization for most of the samples.

All samples from the Sada Nishizuka Kofun No2 (SADA2) show significant magnetic susceptibility increase at temperatures above 300-360°C and non-linear Zijderveld diagrams.

A couple of pottery samples from the sites of Tatetsuki and Tatezaka show secondary magnetic components (e.g. TATEZ-6), probably related to the pottery use.

CONCLUSIONS and FUTURE WORK

Haniwa artefacts revealed to be promising geomagnetic field recorders.

With only exception samples from Sada Nishizuka Kofun, all other sites show a thermally stable behavior and can be used for archaeointensity determinations.

Future work will be focused on the archaeointensity experiments aiming to obtain new high-quality archaeointensity records for the Late Yayoi and Kofun periods.

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Thank you!

Tadahiro

Evdokia

Naoko