A class room tool for demonstrating the striped magnetic anomaly across the mid-oceanic ridges

G04-P01

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Preface

The striped magnetic anomalies over the mid-ocean ridges play an important role at the emergence of the plate tectonics from the classical continental drift theory. So-called " The Tape-Recorder Model" developed by Vine and Mathews(1963) is essential to study this process in a high-school class room. However only text-based resources are used to study for this theme. The students do not learn the theory and development process with firm reality or motivation. In this regard, we developed an analog model showing this striped magnetic anomalies in our class room..

A demonstration class

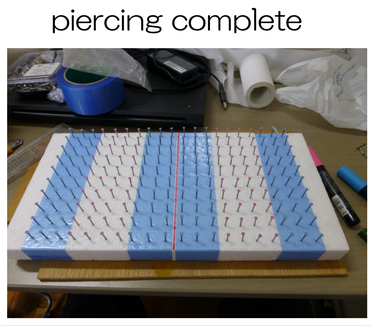
This apparatus is used for demonstrating the magnetic survey on the sea above the mid-oceanic ridges. The right photo shows a demonstrating class of earth-science at our high-school. A student carries a magnetometer probe above the apparatus, the signals were shown on the monitor upper left.

Making apparatus

<Materials>
A thick foamed styrol plate(30x200x400mm)
Iron nails(d:1.7mm 25mm length);
Blue tape, Alnico bar magnet, Ruler, Acrylic plate
<Preparation>
Iron Nails; already magnetized using an alnico bar and polarity colored.
<Making>
1. The plate is a mimic of ocean floor and covered partly with colored tapes symmetrically showing stripes.
2. The normal magnetized nails and reversed nails are stuck on the grids of the plate symmetrically across the center respectively.

piercing nails

piercing complete



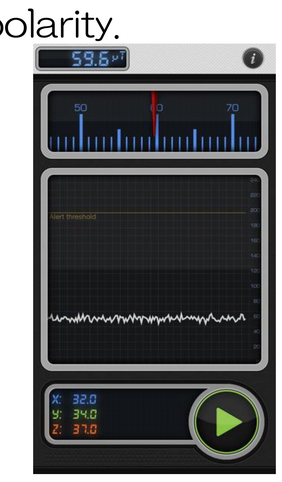
horizontal nails model

survey at the school yard

Magnetometer (Gauss meter)

・MILLI-GAUSS METER GU-3001D（約
producted by Sato Shoji, 600USD）＋
・MJ-LOG2(Multi-logger software,
100USD total 700USD
・Range: ±3000mG（±300μT）

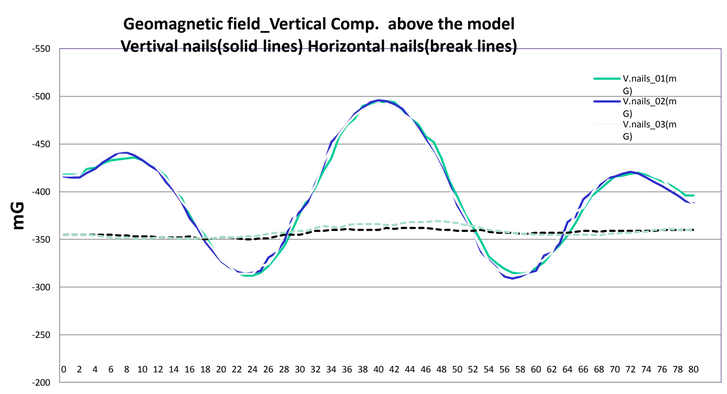
The Probe detect negative polarity.



・iPhone free application
Teslameter 11th
by Sky Paw Co. Ltd
⇒3-comp. geomagnetism
+ Total strength
Data can be sent via e-mail.

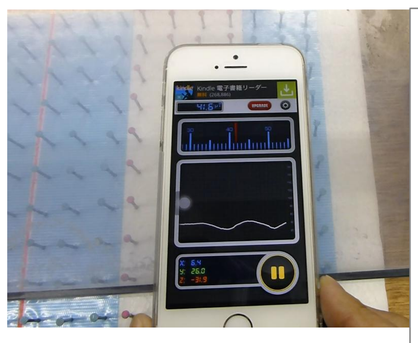
Geomagnetic strength（Vertical comp.）

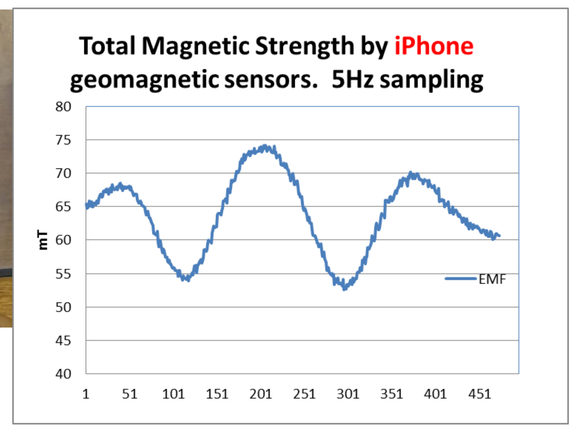
The measurement ion a acrylic transparent plate above the foamed styrol plate (h=8cm); symbolizing sea surface and sea floor.
Measurements at the school garden; avoiding electro-magnetic noises.
Data: The profile shows a symmetrical qualitative anomaly as same as the mid-oceanic ridges.



MILLI-GAUSS METER
1Hz sampling.
Vertical nails: 3-times
H-nails: twice
Horizontal nails; no significant changes.
Noise level: ±8mG(MAX)
Due to JR lines close to our ..school

Using iPhone sensors





Using iPhone Tesla-Meter 11th
5Hz sampling.
Similar results are shown. The data are Total strength instead of the vertical comp. only.
The data can be displayed on a PC via a wifi.

Discussions

1. The magnetic strength of Alnico bar magnet using magnetized nails is around 120mT. The mean strength of nails is around 2.4mT. The 8cm measuring height of apparatus is suitable for qualitative demonstration of geomagnetic anomaly survey.
2. A magnetic probe (Gauss-mater) transverses over the model slowly; the vertical magnetic strength are measured at real time showing a periodic change due to striped magnetized nails. So, the students can be experienced the survey on the ship and can comprehend easily the meanings of this survey and the relation with the mechanism of The Tape-Recorder Model.
3. The cost of Gauss-meter is high expensive and also this is an awkward tool ; a smart-phone as installing geomagnetic sensors is the best alternative solution.
4. The iPhone geomagnetic sensor + free application are sufficient and quite useful for this type of measurement. However the data are 20% high compared with the MILL GAUSS METER' s . The calibration of the iPhone sensors needs a further study.

Remarks: Vine&Mathews（1963）treats a magnetic anomaly at the Indian Ocean; low magnetic latitude. Therefore their results show a negative correlation between the total magnetic strength and the geomagnetic polarity of the oceanic floor basalt. The text books and other resources do not discuss these issues further, so sometimes the teachers have misinterpreted as the opposite manner which the one of author once had taught at the geoscience classroom.

Closing remarks

A classroom tool for demonstrating the striped geomagnetic anomaly above the mid-oceanic ridges is presented. The story of developing plate tectonics theory is quite interesting for high school students, however the opportunity of introducing original papers of this episode is still rare. Therefore we try to develop these tools to explain the plate tectonics revolution. The misinterpretation about the description of text book of geomagnetism and gravity sometimes exhibits, so we will study these issues in the future. Any comments or suggestions would be welcome.

References and Acknowledgements

<References>
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Vine, F. J. (1966):"Spreading of the Ocean Floor: New Evidence (PDF)" (PDF). Science 154 (3755): 1405-1415.
.Webpage of prof. Kazuo Saito (Yamagata University): http://ksgeo.kj.yamagata-u.ac.jp/~kazsan/class/geomath/geomath-enshu03.html
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