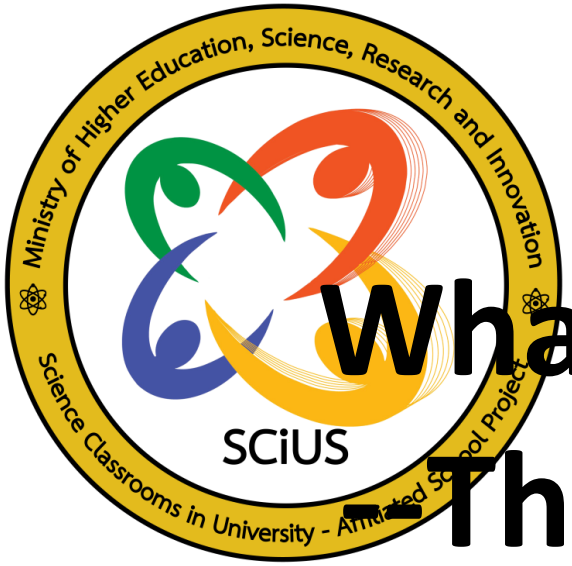



# What is Science and what to learn? Through our Geosceince Projects

Yoshio Okamoto

SCiUS lecture at Phayao University DS 10th Sep. 2023

yossi.okamoto@gmail.com

http://www.yossi-okamoto.net/index_e.html

# Overview of today's talk

- Self-Introduction
- What is Science?
- My iPhone15!!
- Watching Two Videos
- Science projects by my students (Examples)
- →Primitive and Super-Analog Tools are the alternative way of ICT or digital gadgets.

# Who a

- **Earth Science** high-school te
- Associate professor and part
  **Osaka-Kyoiku University** 2
- Earth Science visiting teache
  **PCSHS Mukdahan** in 2019, **P**
- School seismograph system (
  PCSHS Loei, PCSHS NST)
- 3D seismicity maps, tsunami
- Polarized microscope unit &
- Linux Programming (awk, C,
  etc.)
- 3D printing (2019- )


Teaching Tools | Publish Resources | Field Trip(World) | Field Trip(Japan) | Essay etc.

RAYS-COUNTER.com

Teaching Tools. Feel Free to Use with Copy Left! (GNU).

日本語はこちら

**What's New (20th August 2022)**

20th Aug. 2022 **for the GeoSciEdIX** Page Open New!
04th Aug. 2022 My Lecture_menu Page Open New!
03rd July 2022 KVIS_Seismograms Page Open New!
06th June 2022 Geology Videos New!
29th May 2022 JpGU_2022ePoster New!
11th Feb. 2022 Rock-Thin Section and Polarized Unit (EER2021)
30th Jan. 2022 **A barometer** for micro pressure changes
27th Jan. 2022 **for the 5th KVIS-ISF**
3rd Jan. 2022 Wegener's Puzzle
26th Dec. 2021 2022Calendar
14th Sep. 2021 Rock Thin-section Page
21th Aug. 2021 Making printed circuit board
17th June 2021 2021 Rock Thin-Section Page
2nd May 2021 Rocks of the trip to South Africa Barberton 2010
23th Apr. 2021 The 4th KVIS-ISF teacher show
23th Feb. 2021 Rock thin-section library
12th Feb. 2021 3D printer products
04th Feb. 2021 Seagull Factory teaching materials
23th Jan. 2021 Some teaching materials are updated below
22th Jan. 2021 Uploading the resources for the 4th KVIS-ISF

**Presentation Resources**

- for the GeoSciEdIX
- for the 5th KVIS-ISF
- for the Earth Educators' Rendezvous 2021
- for the 4th KVIS-ISF
- for IGC36 delegates
- for KVIS students
- for HS students
- for PCSHS Mukdahan students_2019 and WS

**Seagull Factory**

Tools for Classroom

# Overview of today's talk (14h - 16h)

- Introduction: What is science?
- What is geology? Field and classroom

# My policy! for science education

- I will show you two videos of the volcanic eruptions.

- What is the **fundamental difference** between the two videos?


1991 Unzen Pyroclastic Flow

# A Day in Pompei  AD79

# Comparison of two videos

- Real (Fact) VS. CG (Artificial)
- Low-resolution High-


- Fact

Science is based on!!

- Artificial

- **Fact (Nature)**

Science is based on!!

- Artificial (AI, Fake)

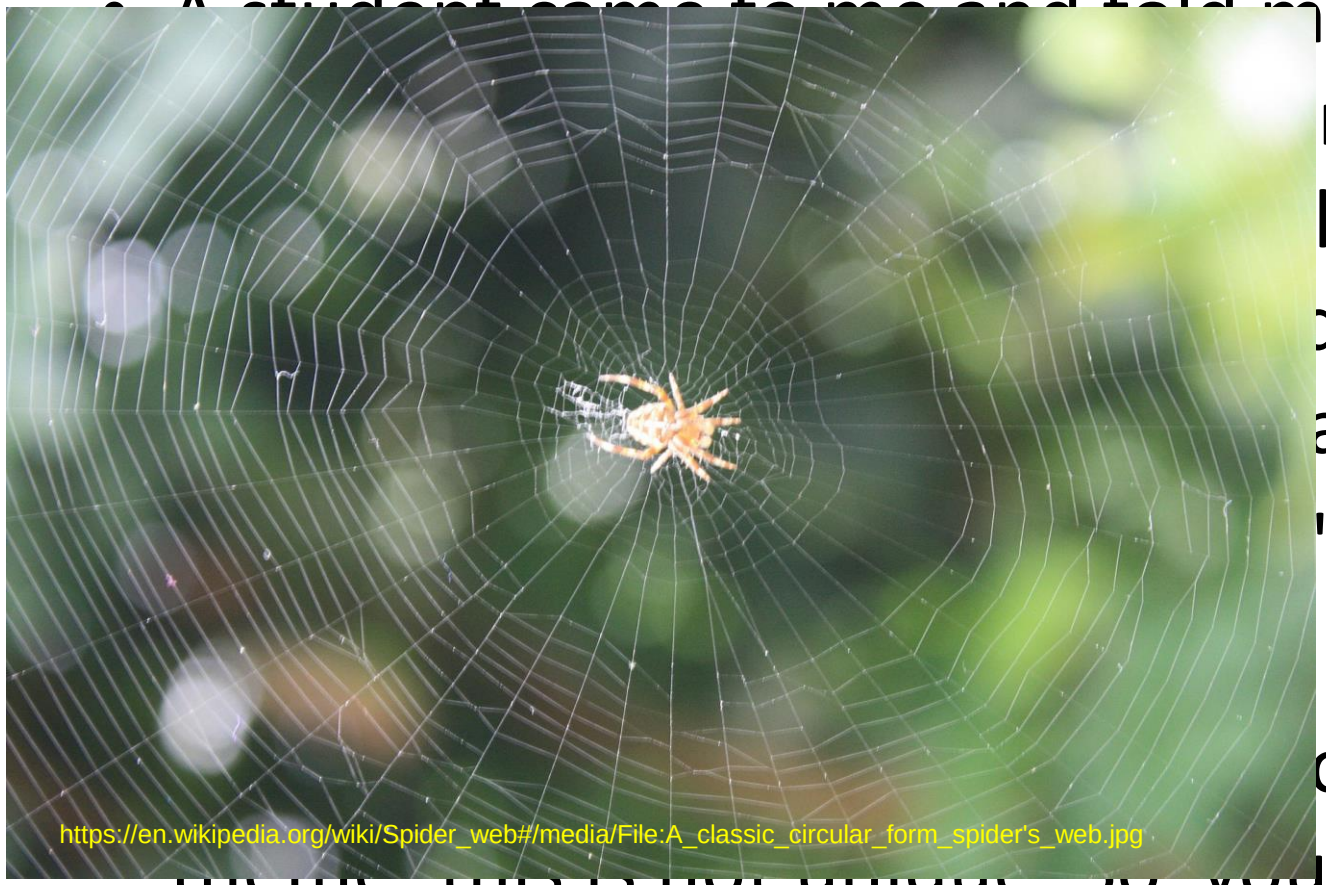
# What I most emphasize in science education

- The original data  -> How to get them
- The mechanism of sensors or recording systems that you use.
- Because, in science festivals, the students treat many data in their presentation; However, **only a few students comprehend how their data are collected and where come from.**
- This is because most **ICT devices are “Black-Box”,** so students can not understand the mechanism inside.

# Appendix: If the time permits: How to decide the theme!

# What the themes for the students are the best?

# How to decide on the theme?



https://en.wikipedia.org/wiki/Spider_web#/media/File:A_classic_circular_form_spider's_web.jpg

From wikipedia

# How to decide on the theme?

- She made a lot of candies using l
- She repeatedly test the characte string made of sugar;
- width, strength, density, viscosit
- Under the different conditions;
- temperature, time from the mak
- She made her poster presentatic
- Finally, she got pass the Exam!

# How to decide the theme?

- Dr. Isao Iizawa, he is an earth science teacher in Kyoto.
- He made very useful suggestion about this;
- Three misunderstanding of the high-school students about the theme decision;
- 1) Chose their favorite field; insects, flowers, space, etc.
- 2) They think they can do great or amazing research
- 3) They think they easily to establish a professional level research

# Add to Dr. Iizawa's suggestion (My opinion)

- They think the high level study uses high-expensive tools.
- Or high-expensive tools or high-tech tools make them easily or automatically complete their project.
- Also, they are not familiar making statistics for analyzing from actual measured scattering data.
- So, they strongly want to use high-tech tools, which are "Black-Box" inside, but display measured values quickly.
- So, my opinion is; To learn about research methods about science; Measuring nature by using primitive techniques is more important than using high-tech tools.

# ”Kitchen Geoscience” by our students

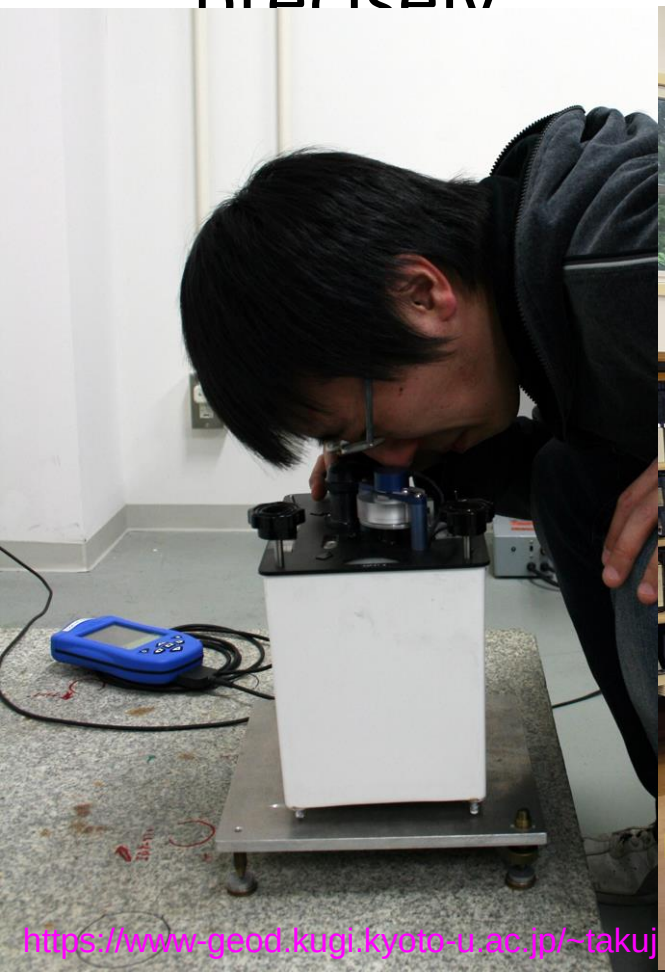
- “Model experiments” related with Geosciences
- Our unique study at GeoSciEd2006 and JpGU2007
- “Kitchen Geoscience” trend around 2000 to 2010
- It is popular again for Geo Park Outreaches  in Japan
- 1) Primitive method:
- 2) Daily materials:
- 3) Quantitative analysis: → **measuring and graph plot**
- 4) This is not a science magic or science show!

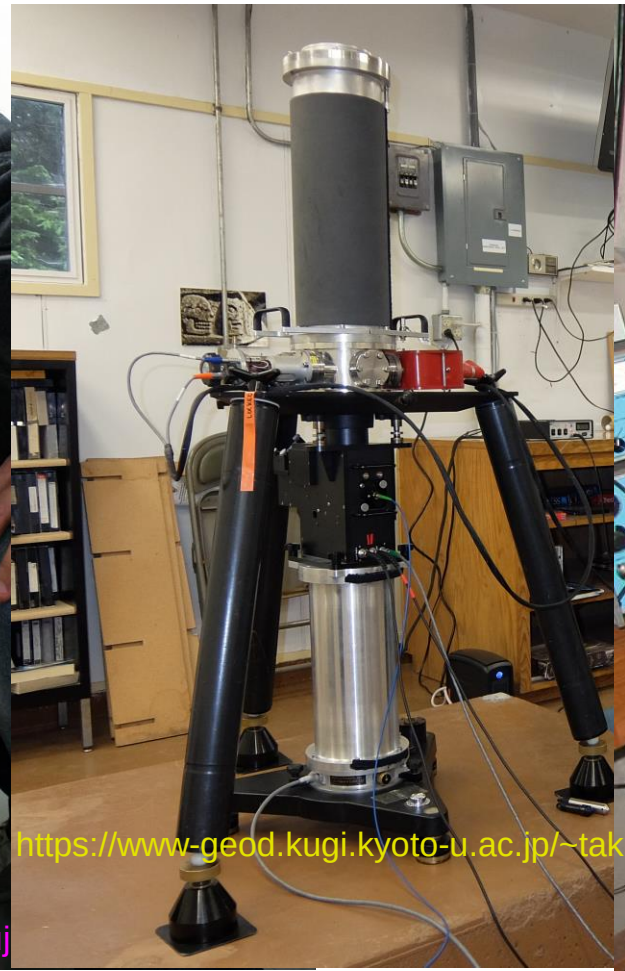
http://seagull.stars.ne.jp/Old_Conferences/2007_rengo_5.pdf
http://seagull.stars.ne.jp/2006_Germany/model-based777.pdf

# Our students' Projects!

# Gravity measurement using a simple pendulum in the school excursion

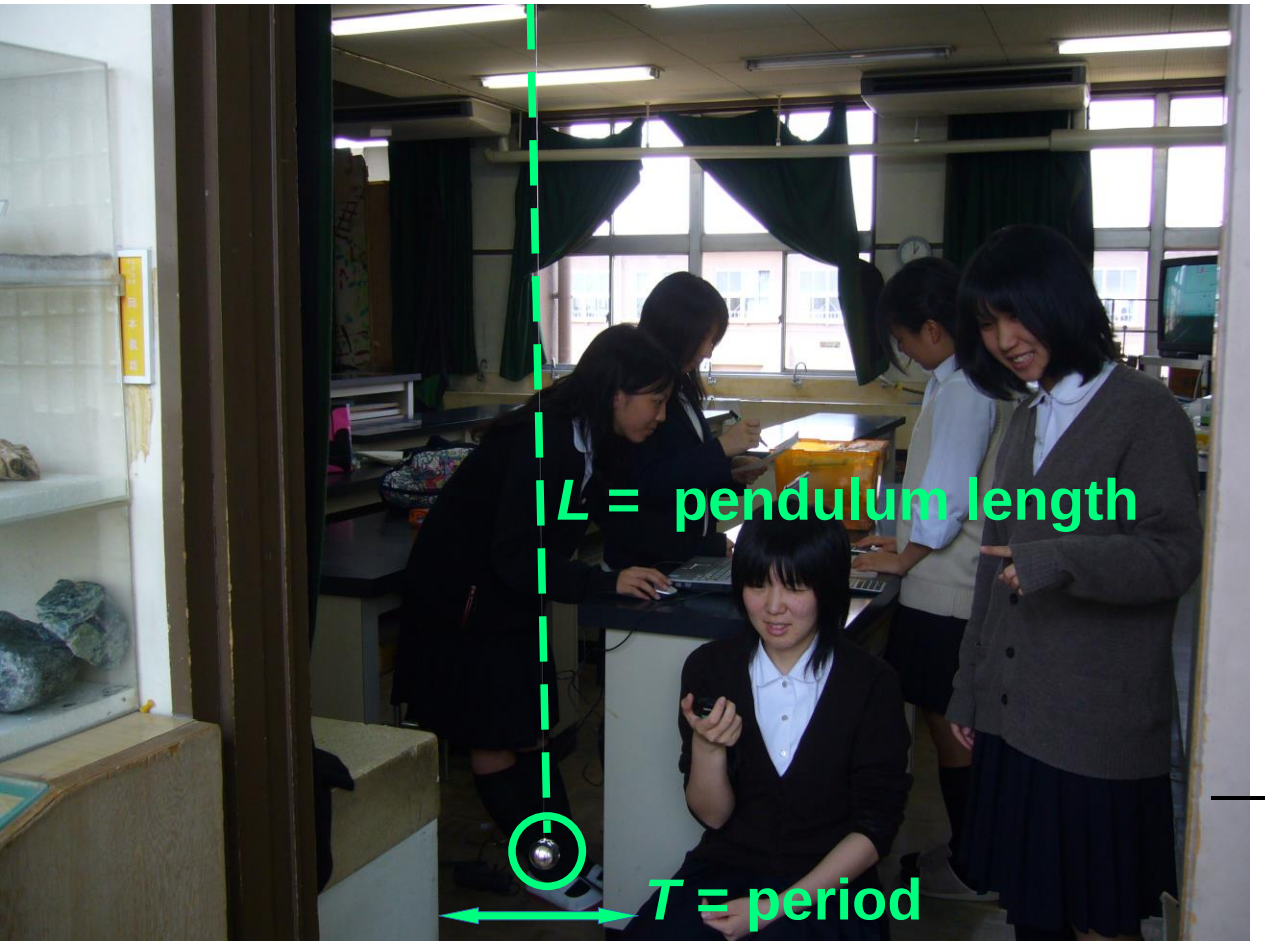
- Gravity measurement is simple but very difficult to measure precisely




# Preparation


- A sphere mass (20mm)
- A fissing string (0.5mm)
- Two coins
- Calicurator
- Electric-Guitar string
- Stopwatch
- Recording paper
- Measure
- C-Cramp



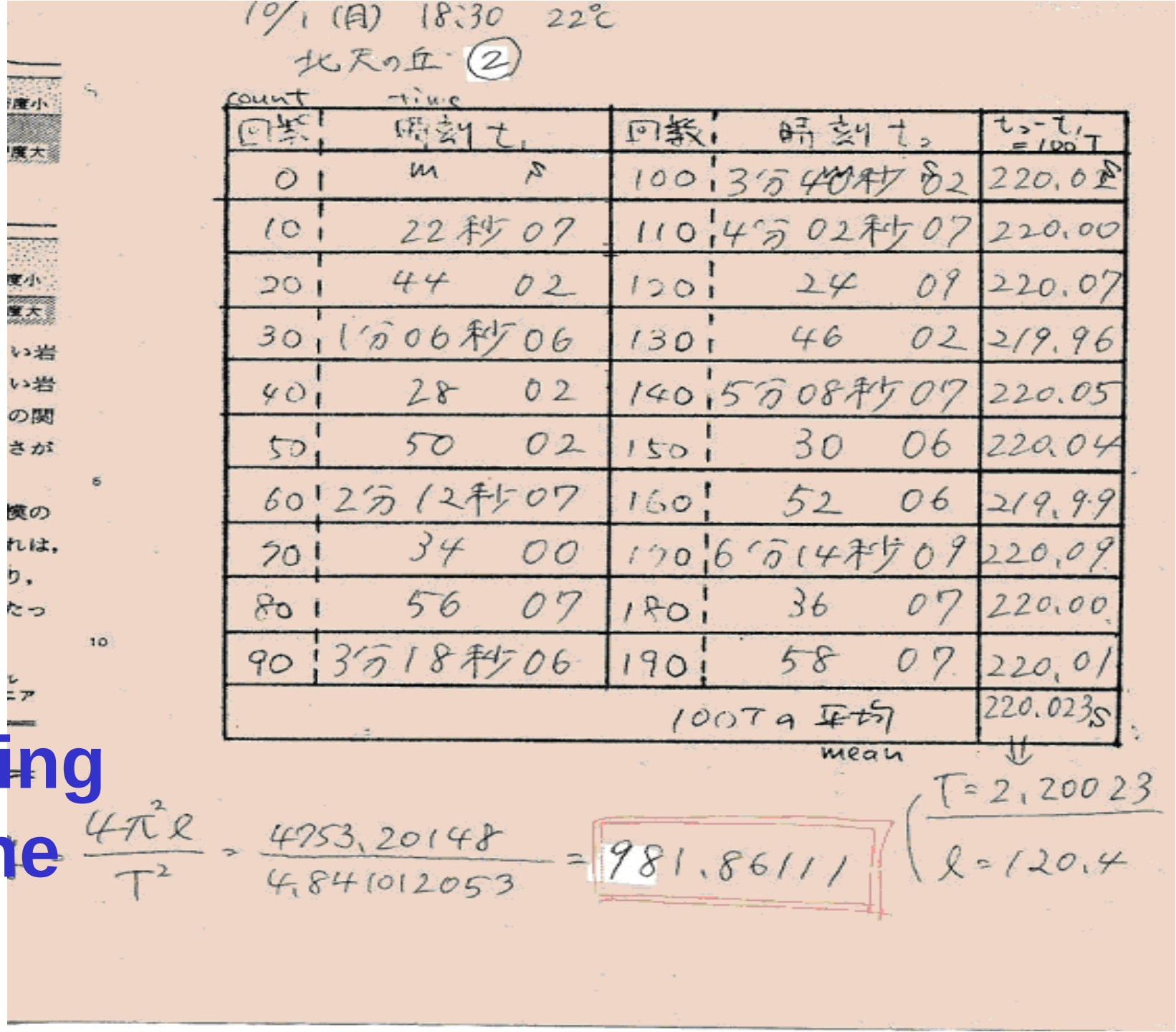

$$T = 2\pi\sqrt{\frac{L}{g}}$$

***T*** = period
***π*** = pi
***L*** = pendulum length
***g*** = acceleration due to gravity

# Measuring at

# Our geoscience room

# Calculating moving averages from the measuring data



10/1 (月) 18:30 22℃

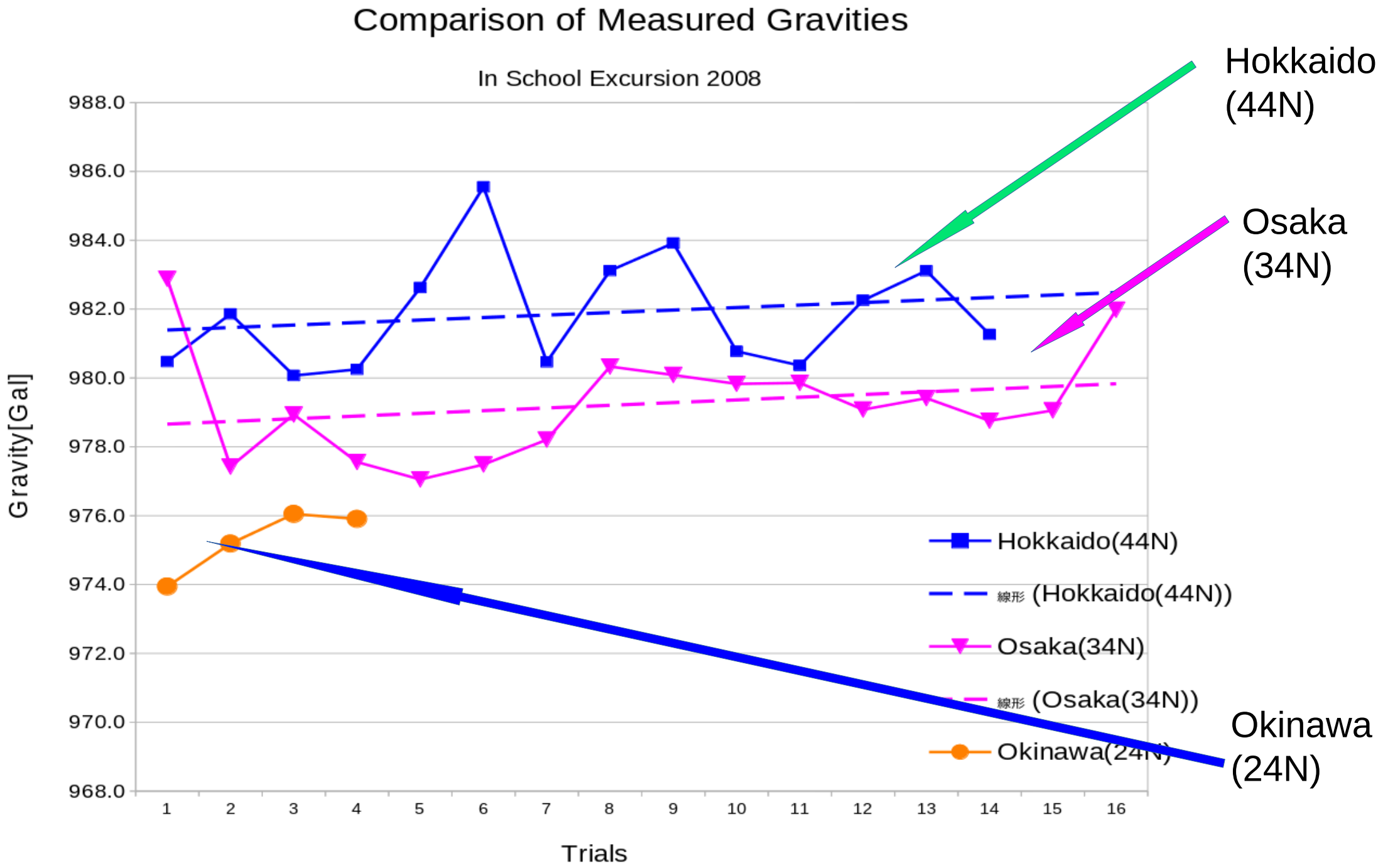
北天の丘 ②

| count 回数 | time 時刻 $t_1$ | 回数 | 時刻 $t_2$ | $t_2-t_1$ = 100T |
|---|---|---|---|---|
| 0 | m s | 100 | 3分40秒02 | 220.02 |
| 10 | 22秒07 | 110 | 4分02秒07 | 220.00 |
| 20 | 44 02 | 120 | 24 09 | 220.07 |
| 30 | 1分06秒06 | 130 | 46 02 | 219.96 |
| 40 | 28 02 | 140 | 5分08秒07 | 220.05 |
| 50 | 50 02 | 150 | 30 06 | 220.04 |
| 60 | 2分12秒07 | 160 | 52 06 | 219.99 |
| 70 | 34 00 | 170 | 6分14秒09 | 220.09 |
| 80 | 56 07 | 180 | 36 07 | 220.00 |
| 90 | 3分18秒06 | 190 | 58 07 | 220.01 |
| | | | 100Tの平均 mean | 220.023s |

$T = 2.20023$

$\ell = 120.4$

$$\frac{4\pi^2\ell}{T^2} = \frac{4753.20148}{4.841012053} = 981.86111$$

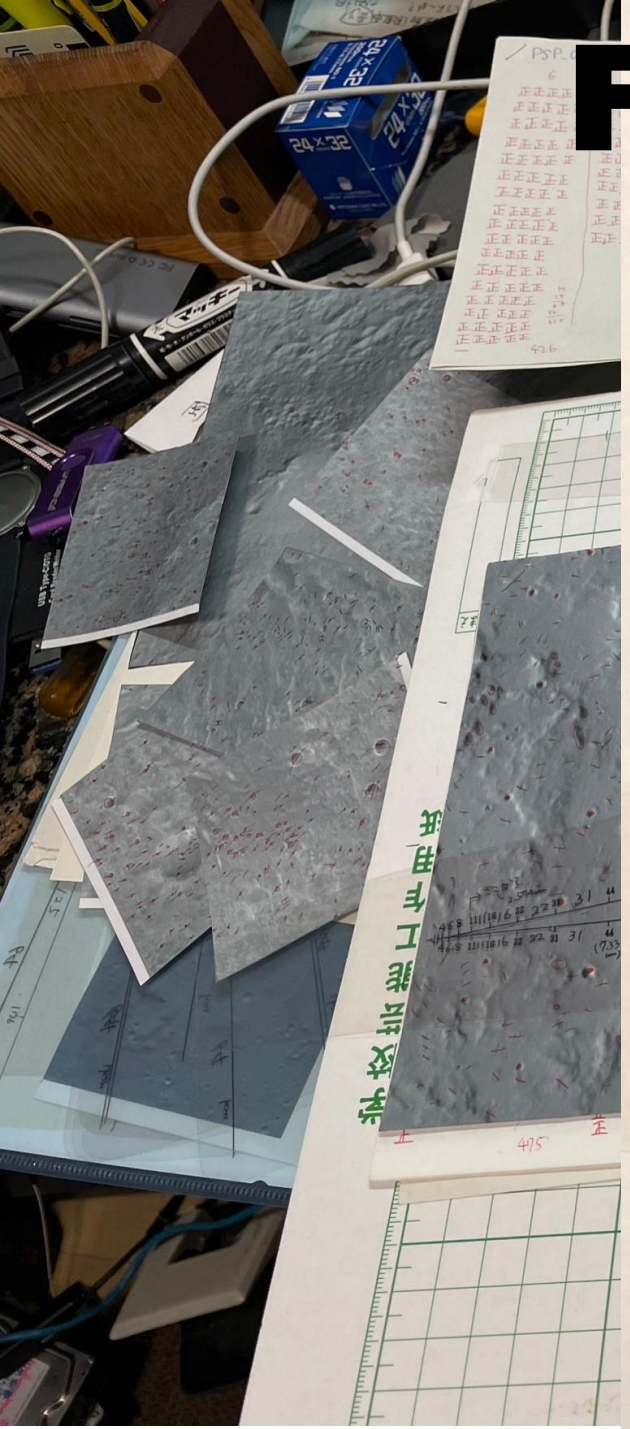

Comparison of Measured Gravities
In School Excursion 2008
Gravity[Gal]
988.0
986.0
984.0
982.0
980.0
978.0
976.0
974.0
972.0
970.0
968.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Trials
Hokkaido(44N)
線形 (Hokkaido(44N))
Osaka(34N)
線形 (Osaka(34N))
Okinawa(24N)
Hokkaido
(44N)
Osaka
(34N)
Okinawa
(24N)

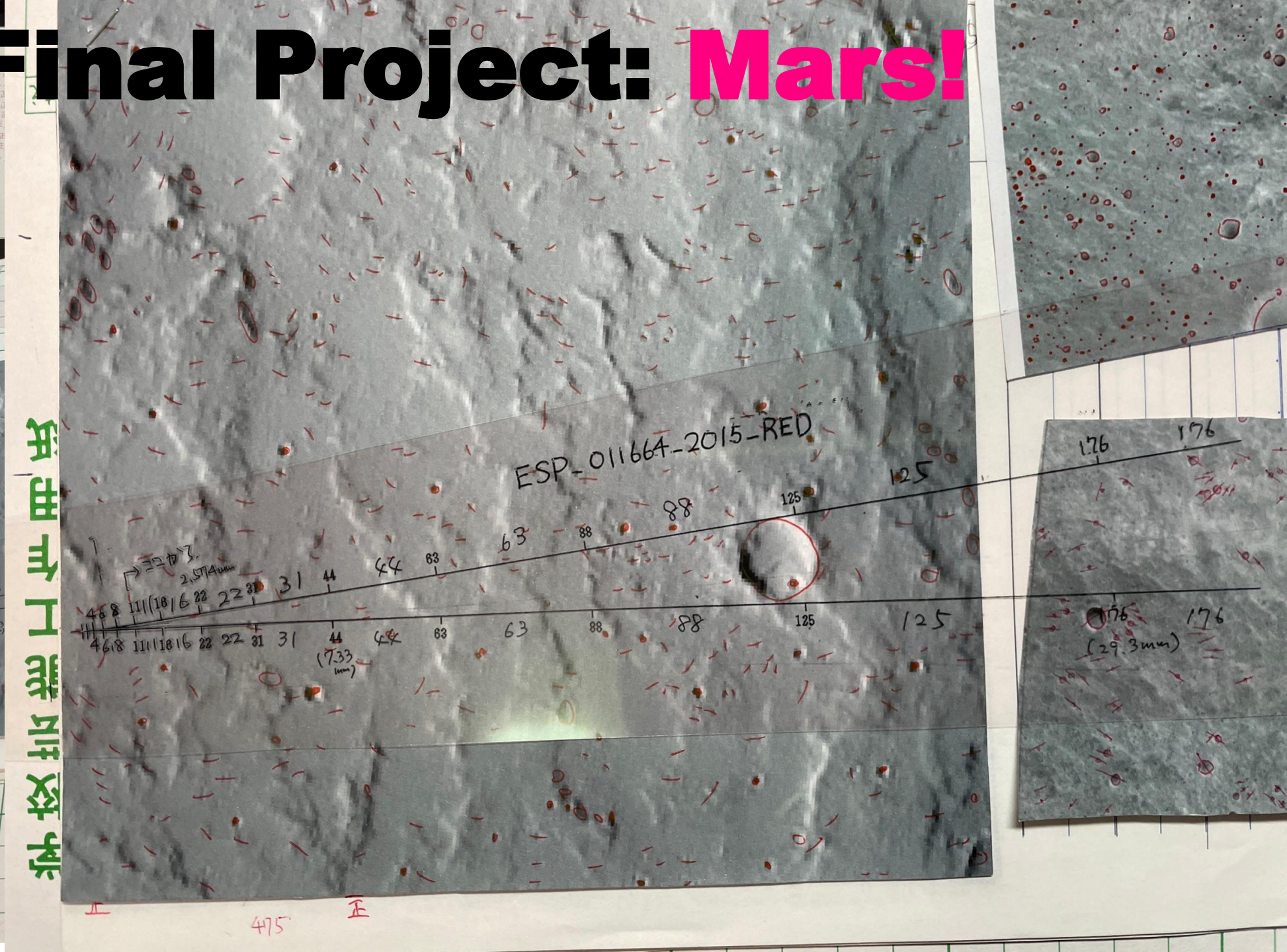
## Hard-earned data set!

This measurements is shown on the text book
But any HS students try it practically ever!
So their work is one of the pioneering attempt in Japan.
They got an exellent award at JpGU2008

# Of course, They were enjoying their school trip ！

# Final Project: Mars!





# Martian Surface Ages using "Crater Chronology"

- Mars is a next target of our exploration.
- Because the planet has a possibility of li
- There are a lot of study method to revea
- My students was interested in a primitiv the Martian surface ages.
- Dr. William Hartmann who is a pioneer Chronology" and is famous his "Giant Im origin of Moon.
- My students used his technique to study

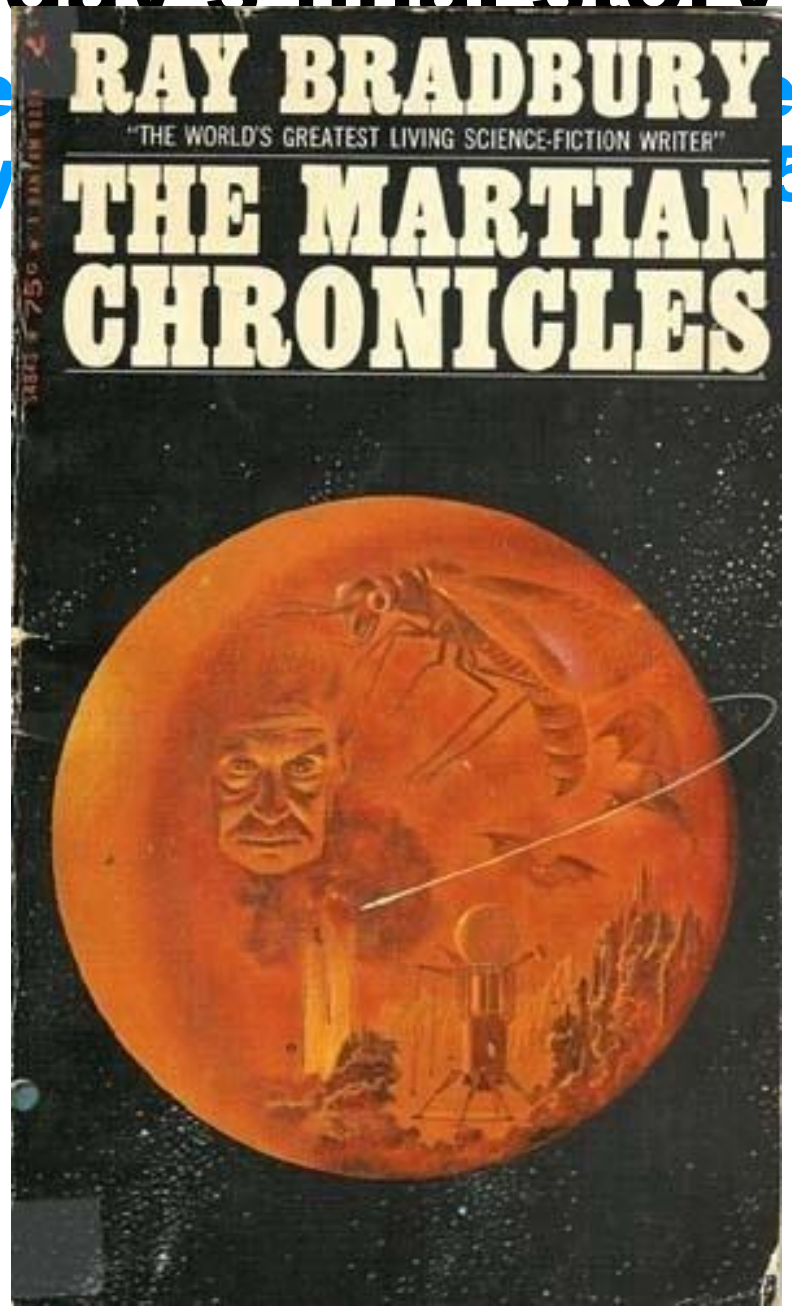
Dr. W.K.Hartmann at PSI 2011 (my photo)

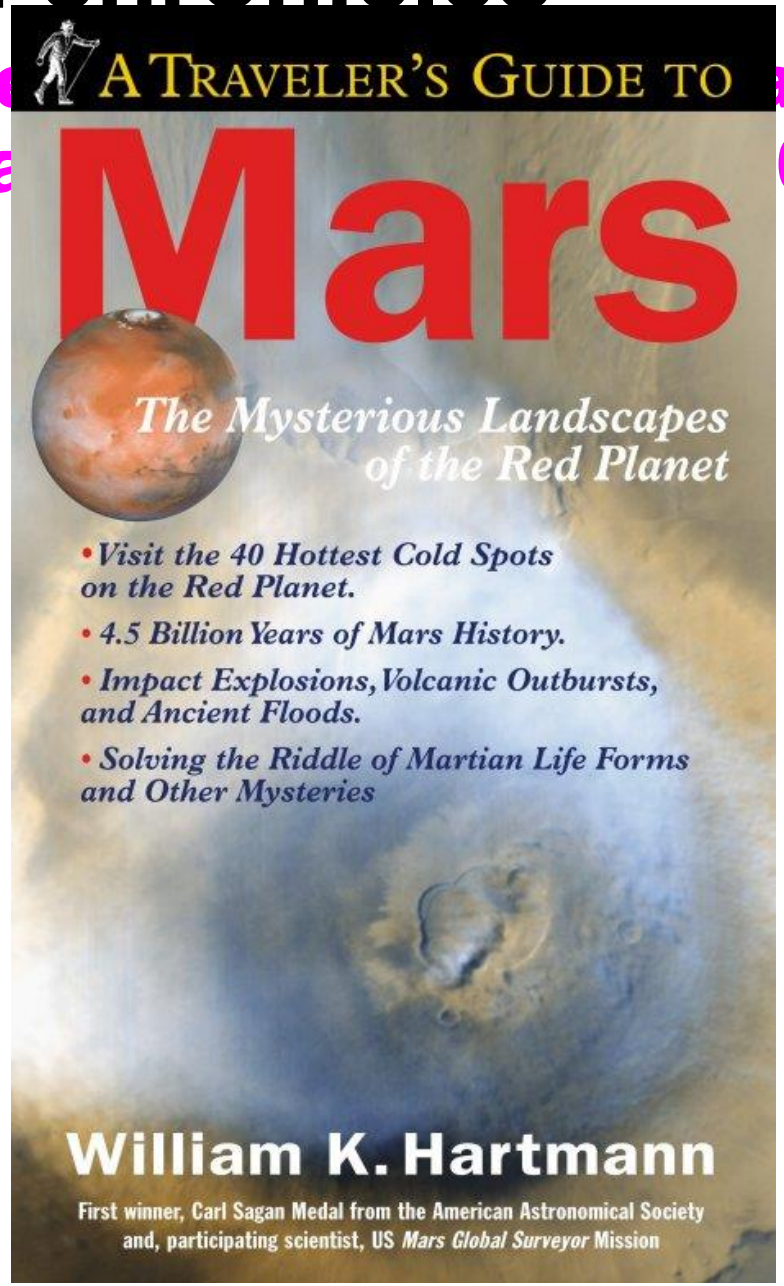
https://www.lpl.arizona.edu/news/2013/fall/2013-shoemaker-award-bill-hartmann

# Today's final story: A Martian chronicles

"The es" "A Trave ars"

by 50. by Willia 003

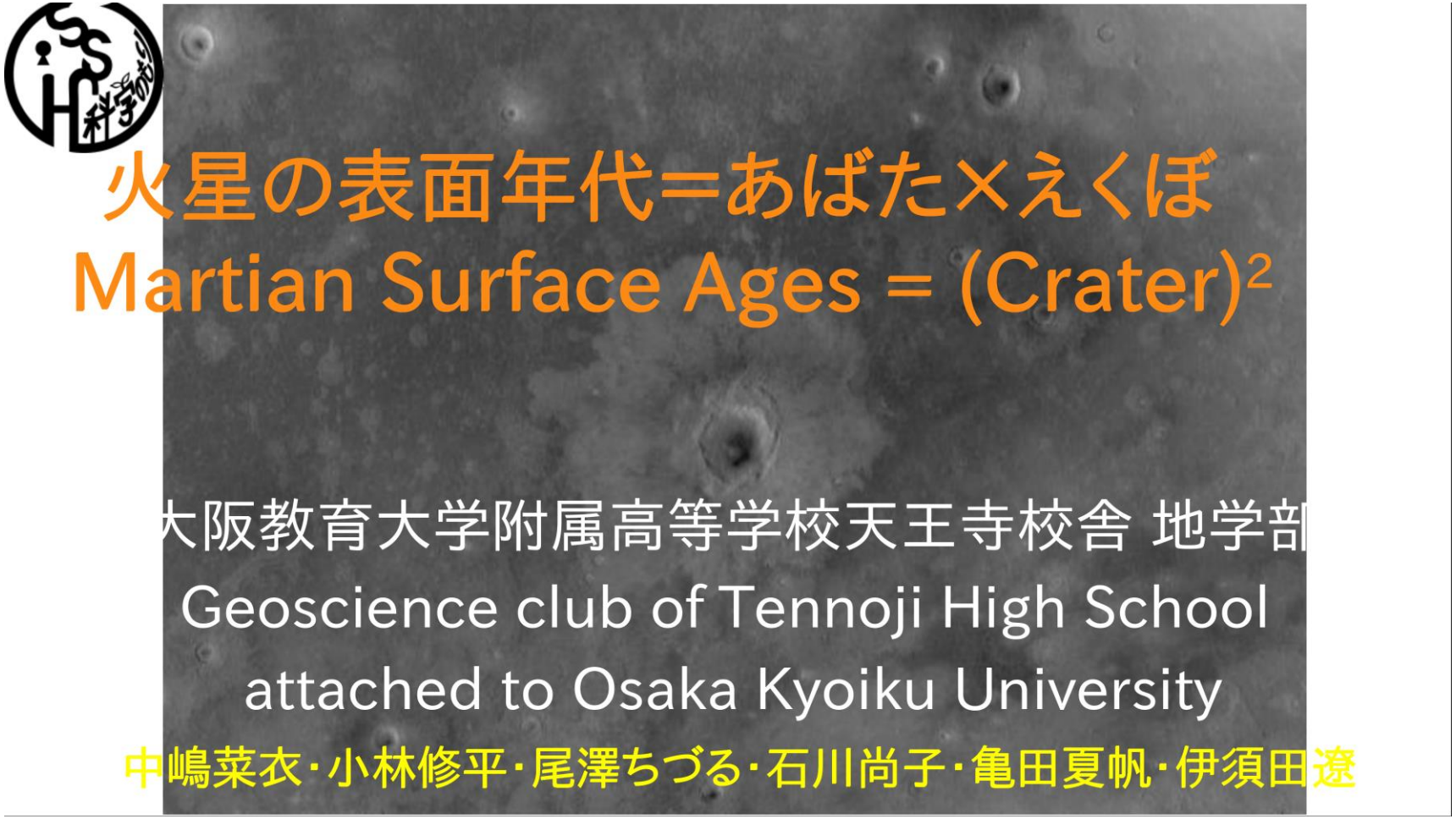


# From here, we introduce our project quoting from the student' PPT

***Super Science Highschool(SSH) competition At 2011 Kobe***

***Slightly modified***

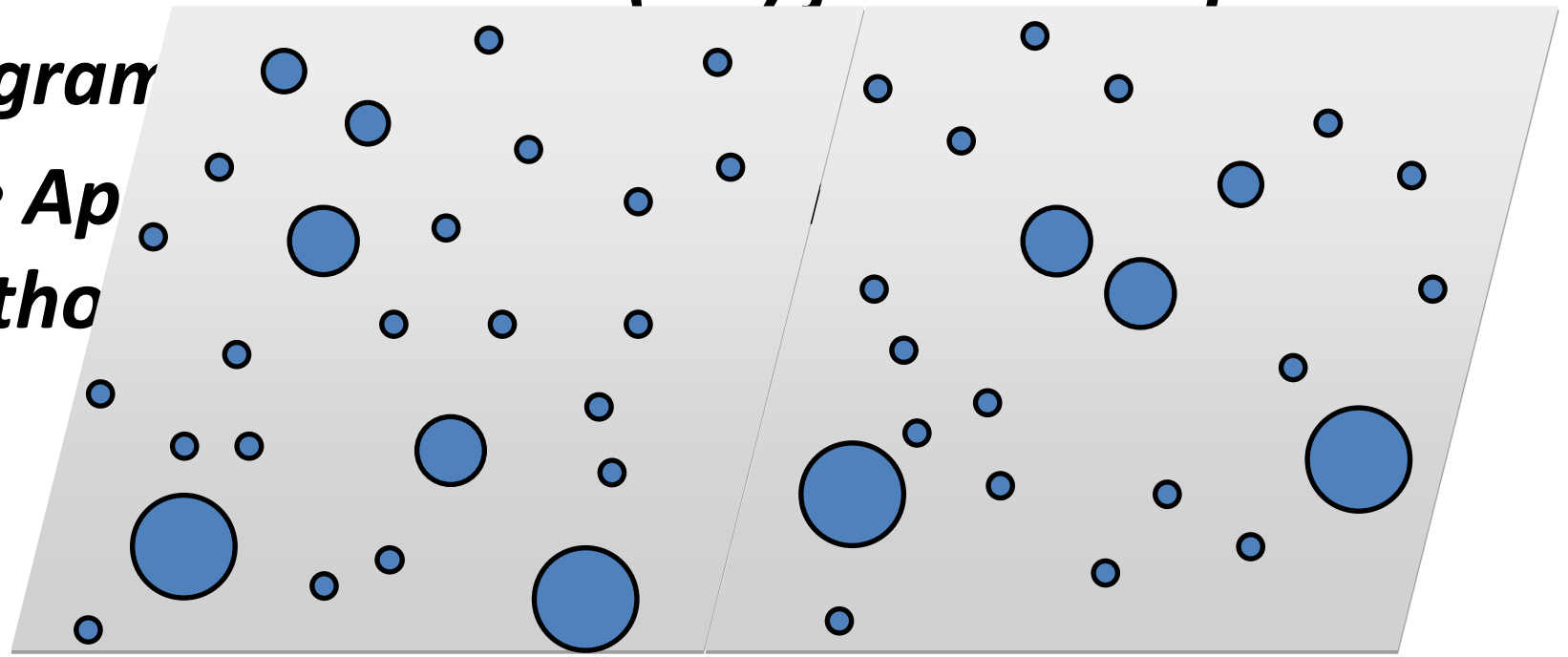


# *Motivation　研究動機*

- *We are interested in “Crater-Chronology”.*
- *Dr. William Hartmann , founder of “Crater-Chronology”*
- *It is generally believed “Mars has died” or “Mars has dried up”*
- *However, is it true?*
- *How do we study using simple method?*

# *What is Crater-Chronology?*

- ***William K.Hartmann (PSI) first developed isochrones diagram***
  - ***The Ap metho***



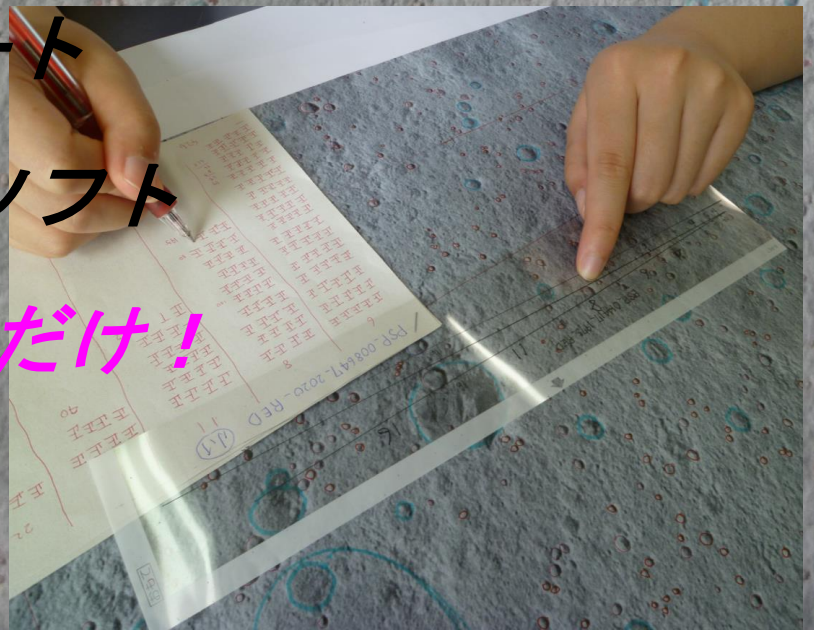
Many → **Old**

Few → **Young**

# Our low-tech tools!!

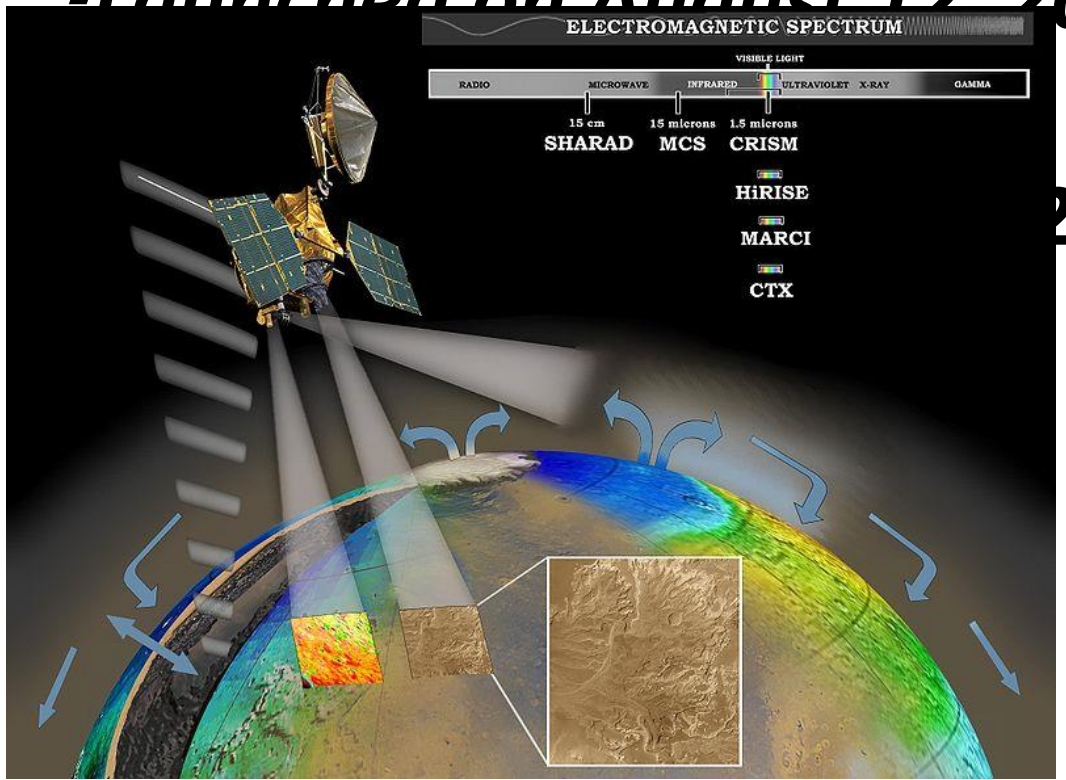
- Printed image 印刷した画像
- Color pens カラーペン
- Handmade ruler 自作のものさし
- Data sheet データシート
- Excel on PC 表計算ソフト

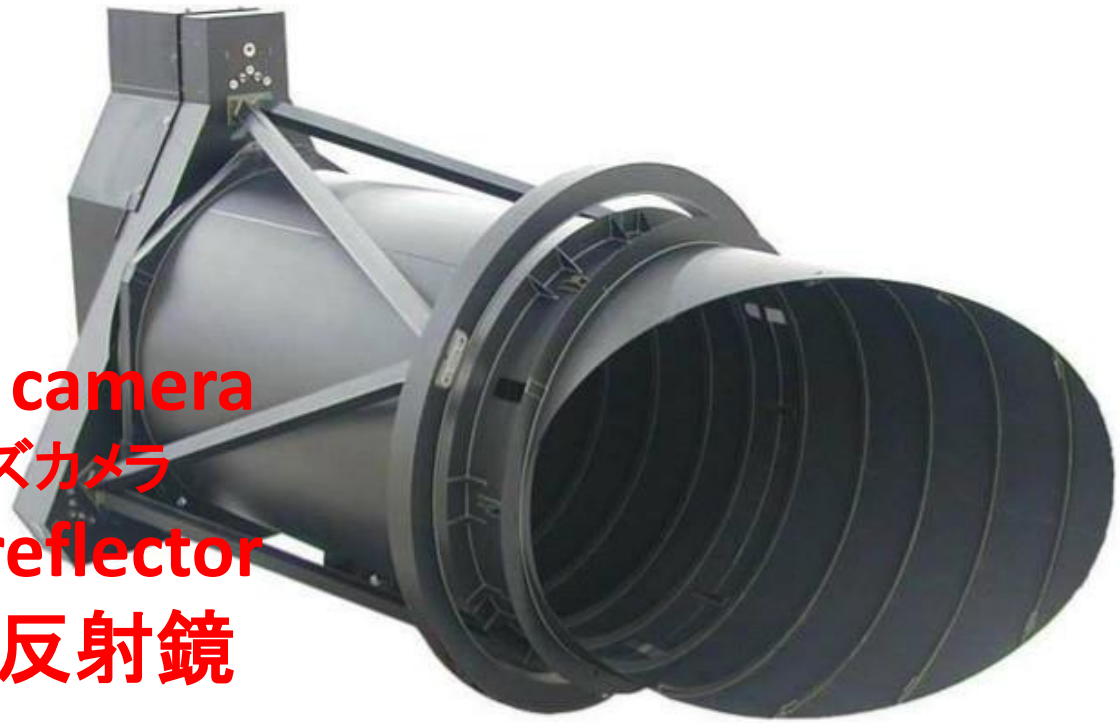
That's all! たったこれだけ！

# *We focus on the most recent Mars images*

- *Mars Reconnaissance Orbiter (MRO) carries the HiRISE camera.　MRO衛星はハイライズカメラを搭載*
- *Launched on August 12, 2005*　　*打ち上げ*
- *Arrived on March 10, 200*
- *Science operations began in November 2006*

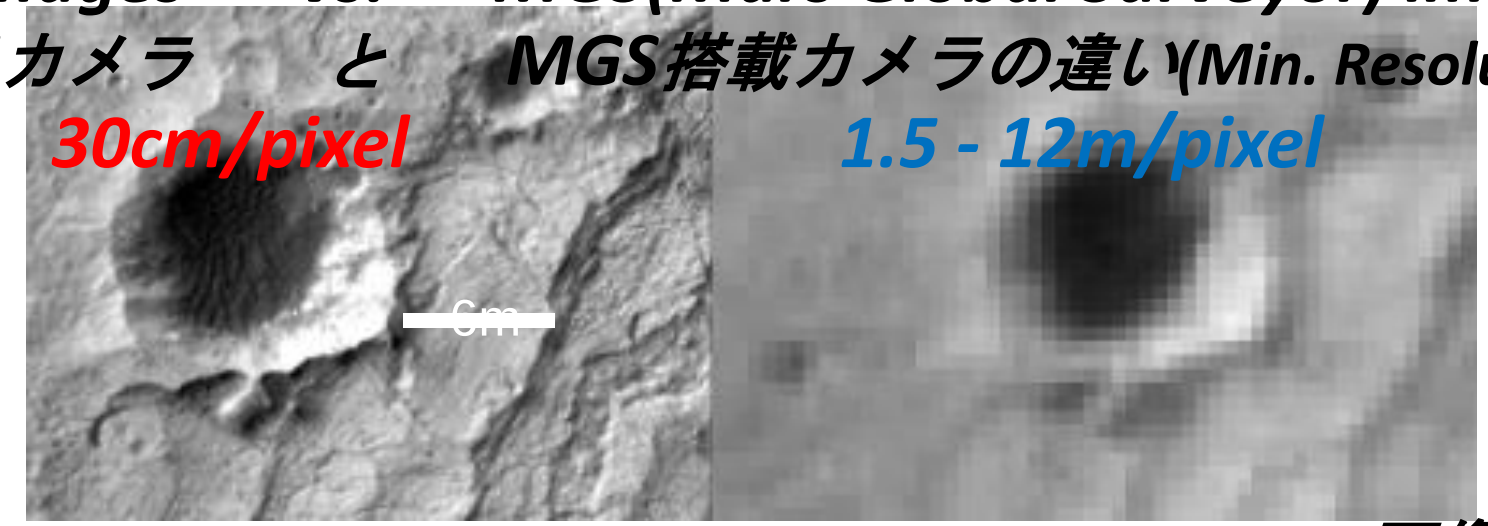


**HiRISE camera**
**ハイライズカメラ**
**50cm reflector**
**反射鏡**

# Comparison of Satellite Images 衛星画像の比較

- HiRISE images vs. MGS(Mars Global Surveyor) images
  HiRISEカメラ と MGS搭載カメラの違い(Min. Resolution 解像度)



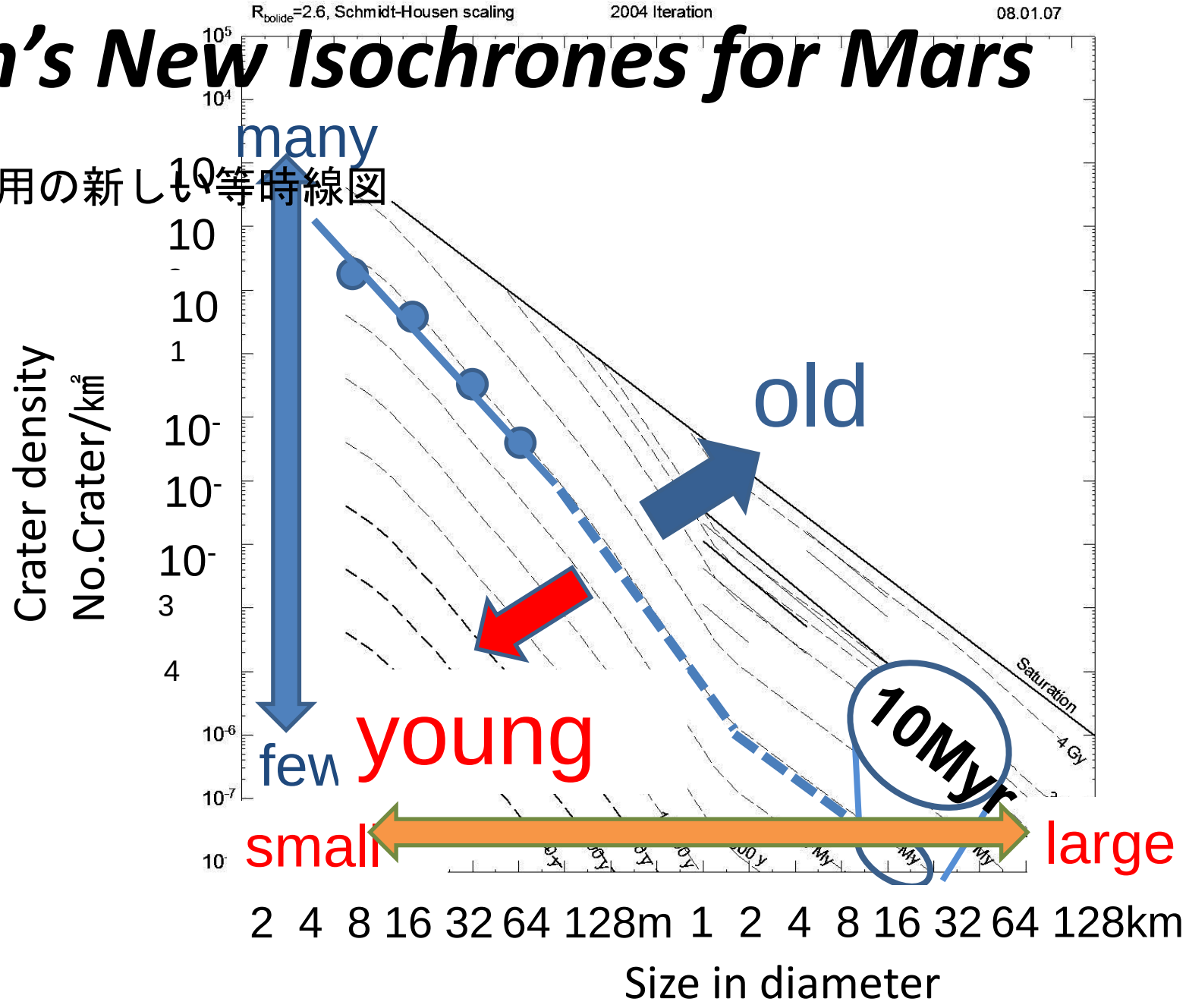

HiRISE images are quite suitable for small crater counting. HiRISE画像は小クレータのカウントに最適である. from HiRISE website

Studies using HiRISE images are quite few yet.
HiRISE 画像を用いた研究は現在のところまだ極めて少ない.

Images are freely downloadable from the HiRISE web site. 画像はHiRISEのウェブサイトから誰でも自由にダウンロードできる.

# The Hartmann's New Isochrones for Mars

ハートマン先生から頂いた火星用の新しい等時線図



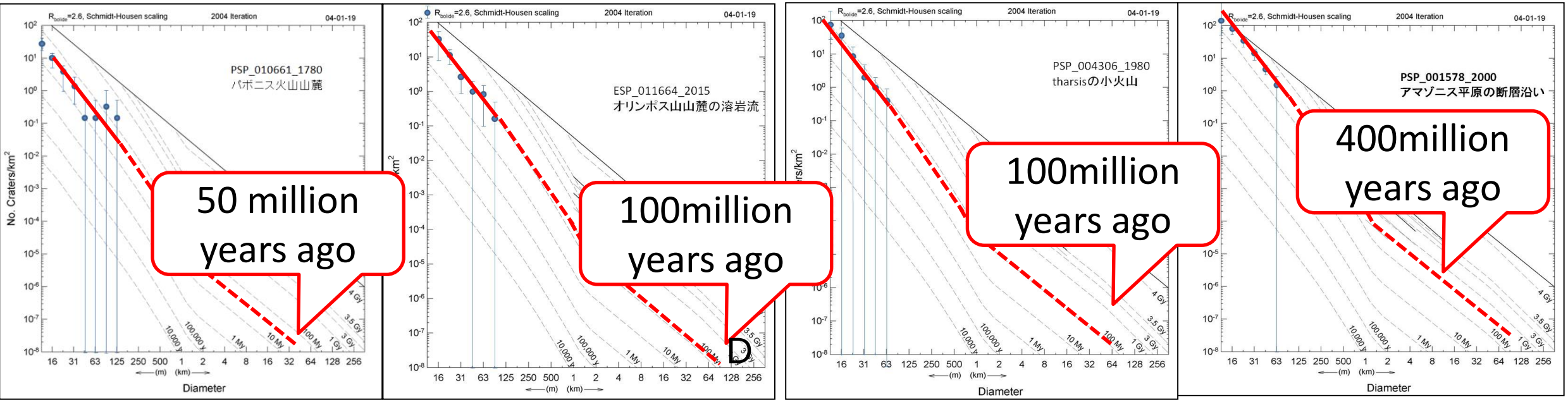

***Erosion or resurfacing makes isochrones complicated.***

# Previous Study　昨年度までの研究

We estimated young lava flows as 50-400Myr;

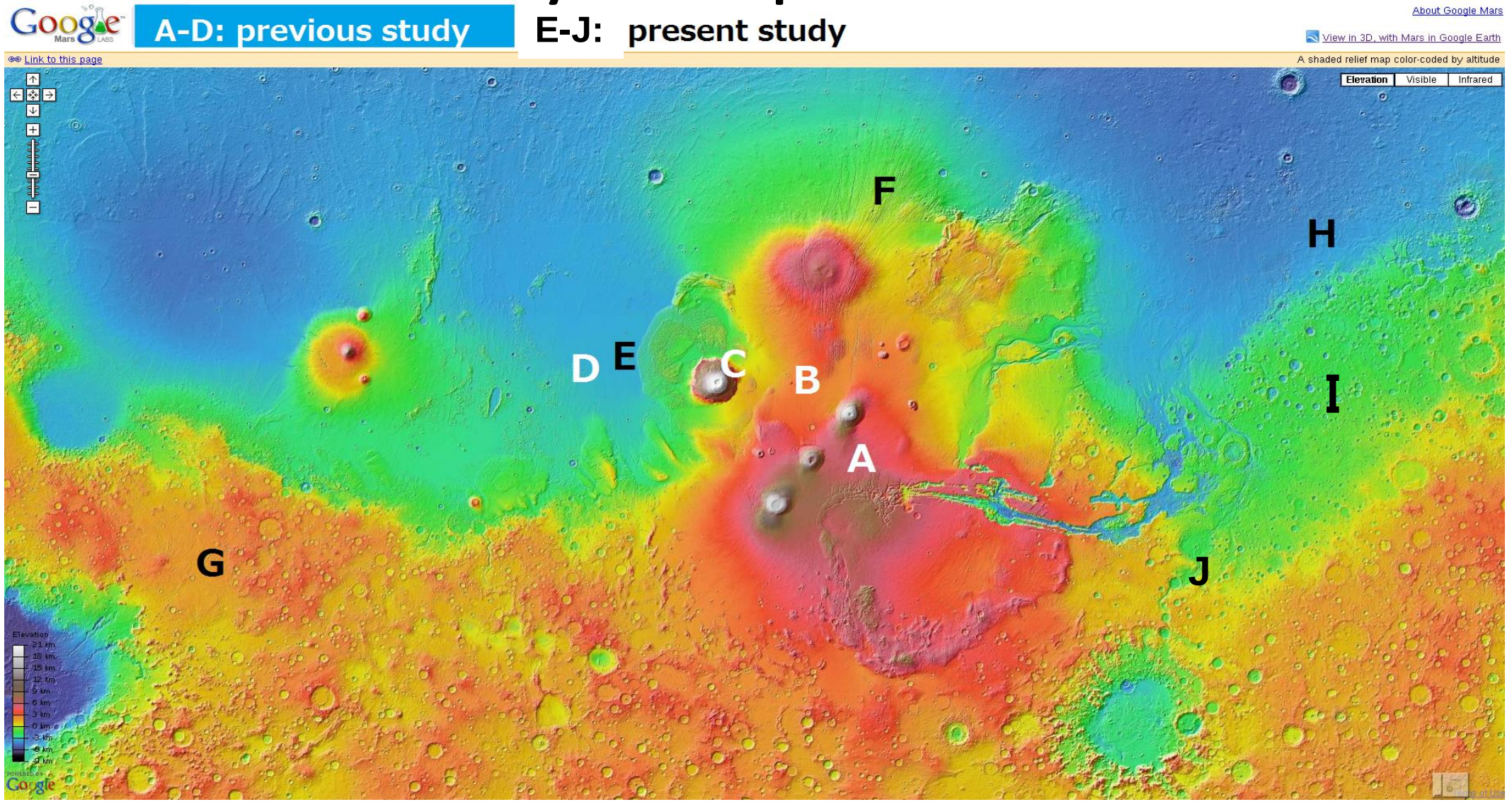
Good agreement with recent studies (Hartmann, 2011, personal comm.).

若い溶岩流の年代を5000万年から4億年と推定した．これは最近の研究とよい一致を示す（ハートマン2011私信）

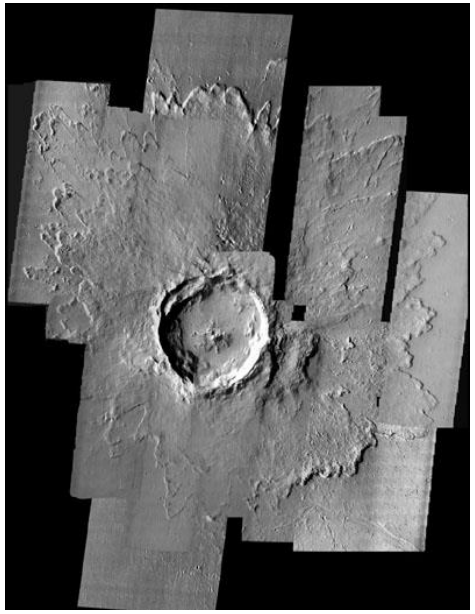


# Previous Study: young lava flows A-D

# Present Study: rampart craters E-J

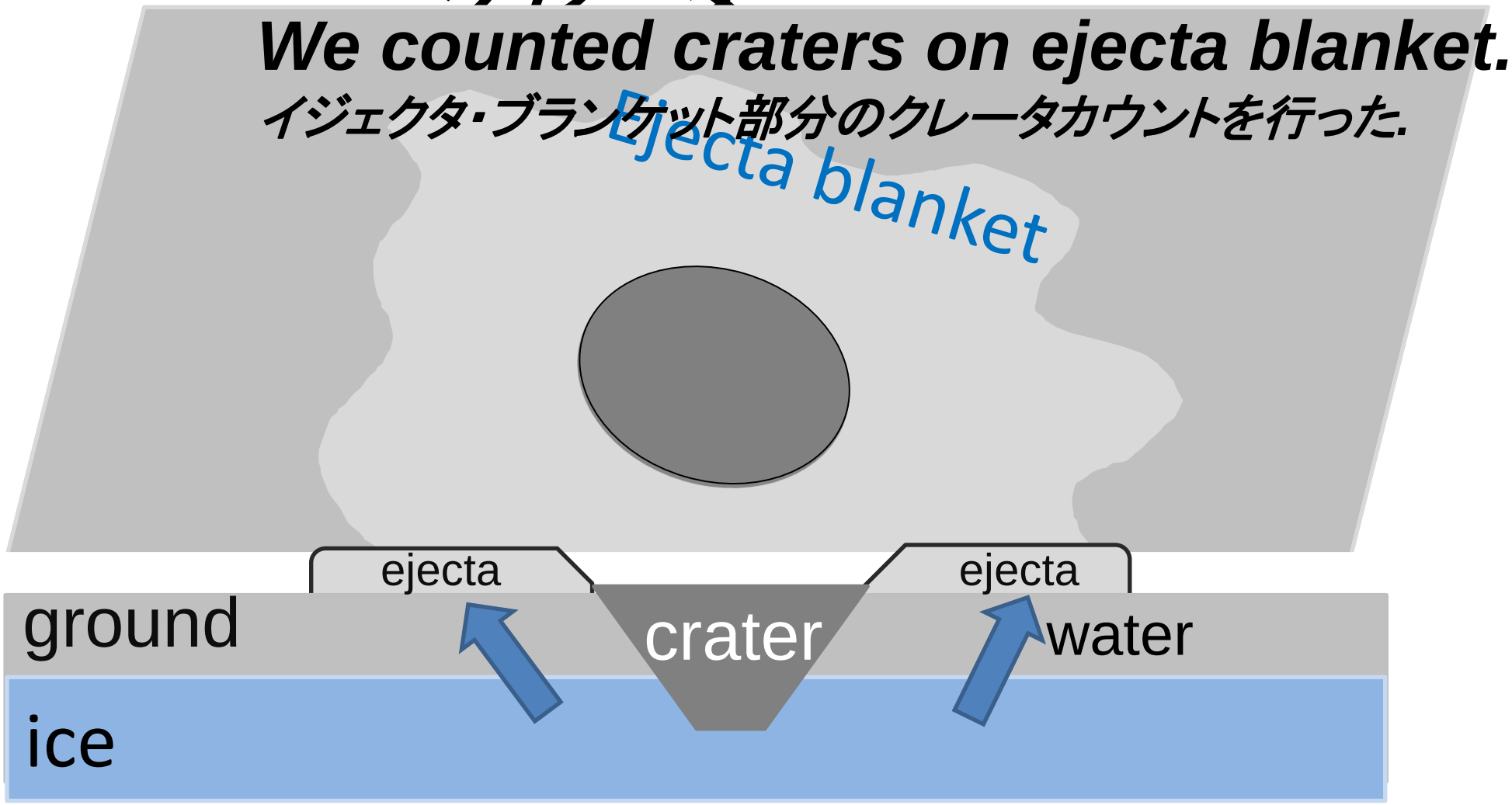


# Rampart crater having ejecta blanket
# イジェクタ・ブランケットを持つランパート・クレータ



**We counted craters on ejecta blanket.**

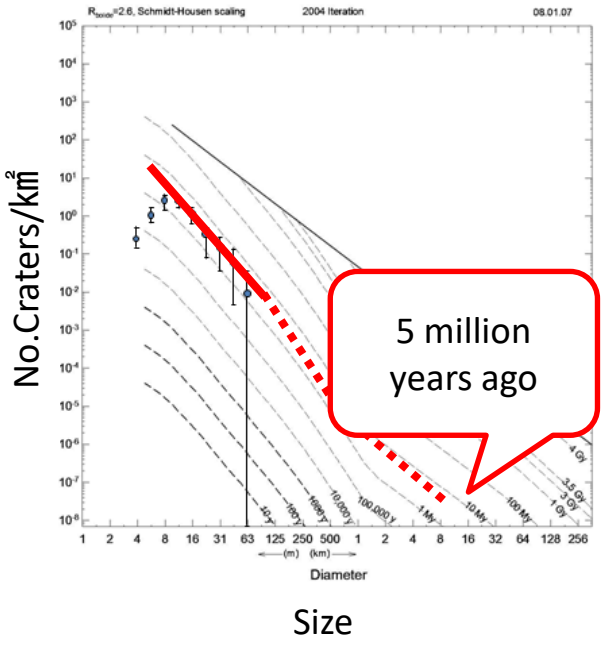
**イジェクタ･ブランケット部分のクレータカウントを行った.**



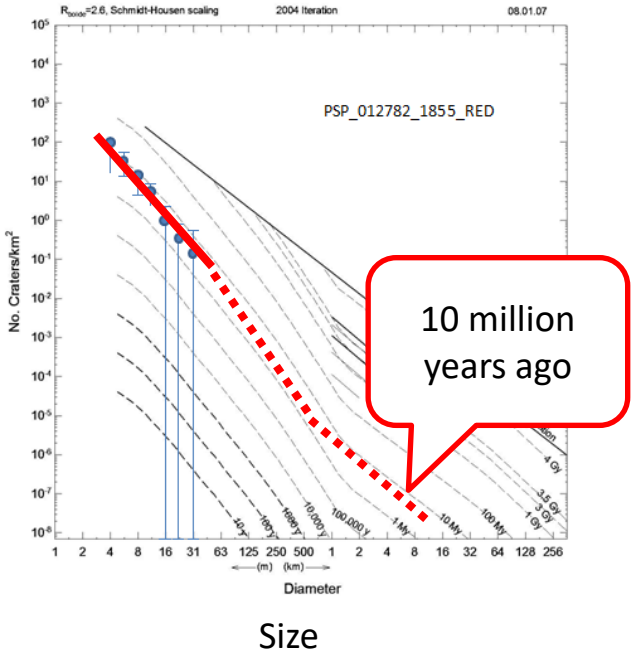

**⇒Existence of underground ice!**

# *Rampart crater ages ランパート・クレータの年代*

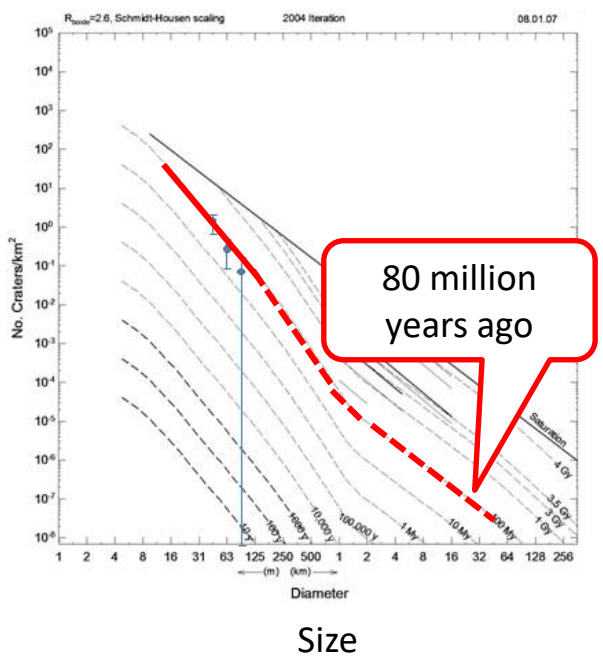
E ESP_013089_2040_RED



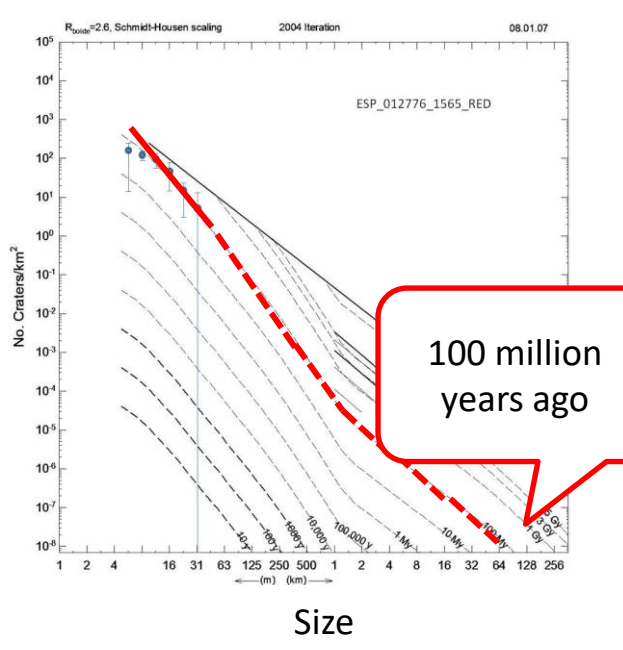

F PSP_012782_1855_RED



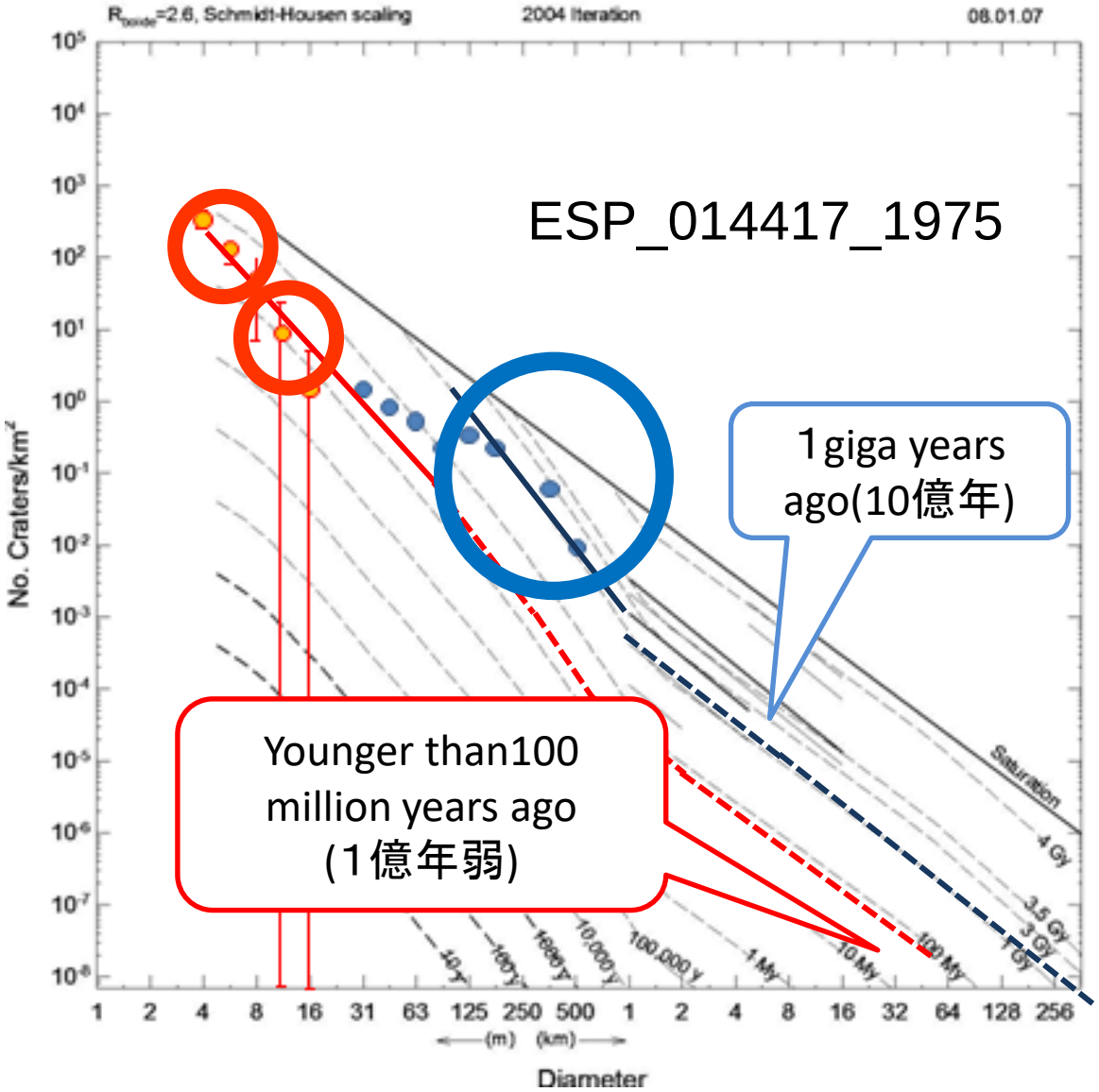

G ESP_001747_2330_RED




H ESP_001776_1565_RED



# Interesting results　興味深い結果




- Orange: small craters with sharp edges
  オレンジ色：ふちがくっきりした小クレータ
- Blue: mid to large craters with degraded edges
  青色：ふちがぼんやりした中大クレータ
- **Mysterious isochrones**
  **不可思議な等時線！**
- Reiss et. al.,(2006) suggest older ages 1.5-3.6 Gyr, conflicting with our results.
  Reissら(2006)は我々の結果と は異なる15-36億年の古い年代を示唆している

# Okonomiyaki Hypothesis　お好み焼き仮説


Blu

# Discussion 考察

- Estimated ages of young lava flows span **from 50 to 400Myr. -> in good agreement with recent analysis.**
- Ejecta ages of rampart craters obtained from counting of small craters range **from 5Myr to 1Gyr.**
- Counting areas must be chosen less resurfaced or degraded.
- Some rampart craters show **mysterious isochrones** ages.
- Our proposal is one of the solutions.

# Conclusions

- Ejecta of rampart craters:  some isochrones indicate complicated process of their origin and evolution.
- HiRISE images and **our low-tech exercises** are quite useful for **“Crater chronology” on Mars.**
- Our **“quite simple but painstaking approach”** reveals Mars’ mystery, especially “young lava flows” and unique “rampart craters”.

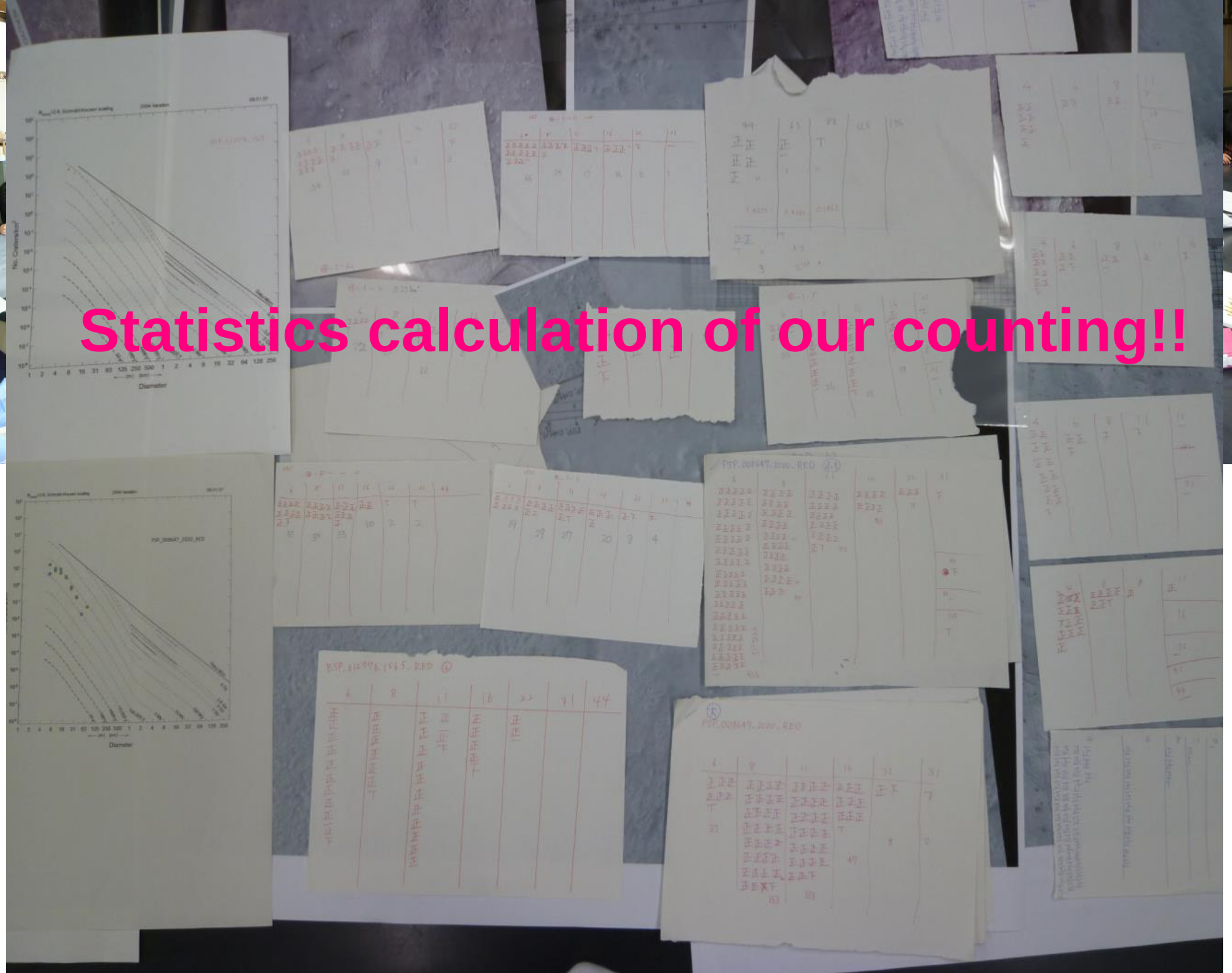
# Epilogue

- Mars has not died out

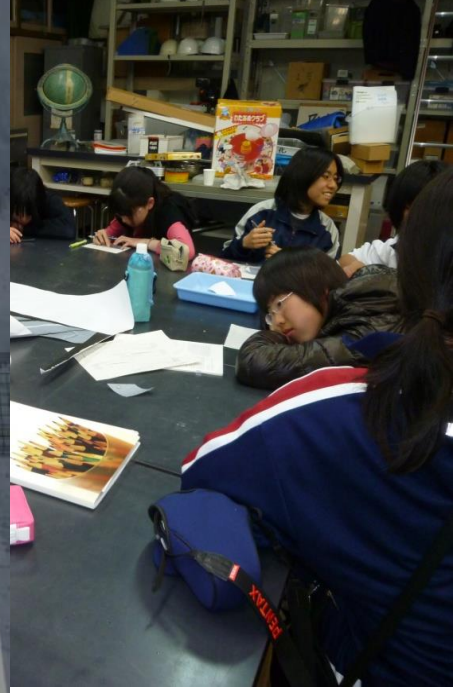
  **but still Alive!! Active!!**
- Martian water has not dried up

  **but remains as ground ice!!**
- Our results will be confirmed in 2030's by the future piloted space missions toward Mars!
- We, **"crater boys and girls"**, are looking forward to hear **The Big News confirming our hypothesis!!**

# Members of Martian Crater Project



# Statistics calculation of our counting!!




Very frustrating!


Finally, Our team got the silver medal at the SSH competition at Kobe in 2011 summer.

# Examples_1 *Using sugar sweets!*

*Fig1. "Sugar Calmera" as a mimic of basalt lava*

*Fig2. Sugar candy models cool joints of lava flow*

# Examples_2 *Karst related*

*Fig3. Stalactite using Sodium thio-sulphate($Na_2S_2O_3$) aqua.*


*Fig4. Doline like surface using powder and spray.*

**From GeoSciEd VI _Germany_Bayreuth 2006**

# Example_3 *'Air mirage' is examined---*

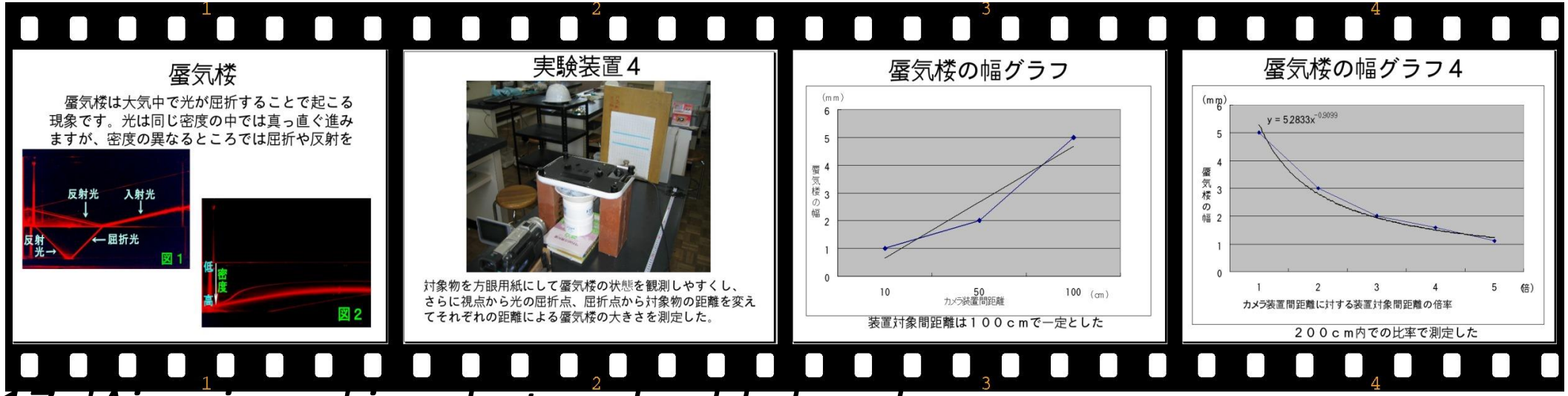



*Fig17. 'Air mirage' in a hot and cold chamber .*


*Fig18. An example showing inverse layer and failed examples.*

# Example_4 *Plate tectonics*

*Fig7. Plates collision (Himalayan orogen model with flour).*

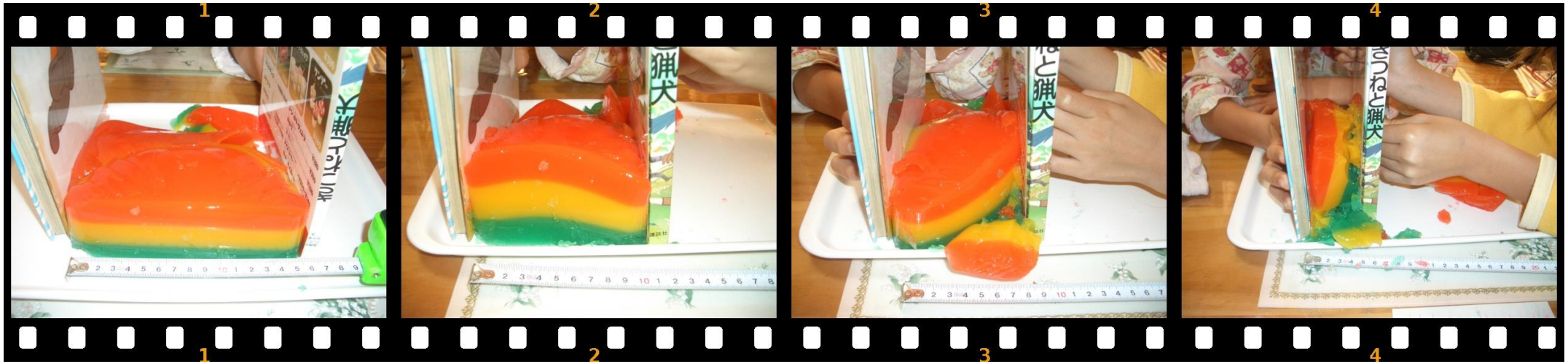


*Fig8. A gelatin reverse fault failed.*

# Example_5 *Volcanic eruption*

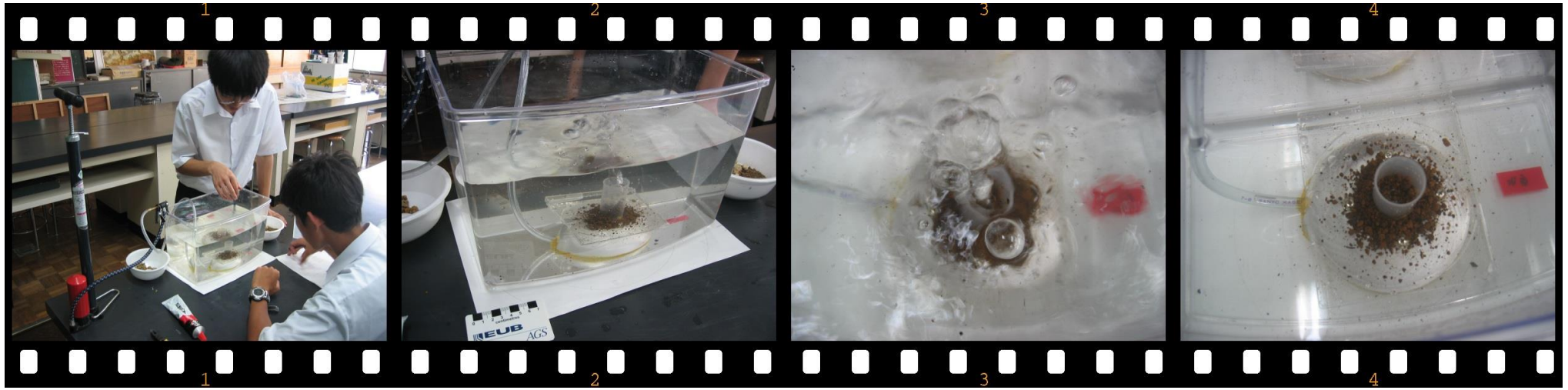


*Fig9. Water bottom volcano showing inverse distribution of pumice.*


*Fig10. A Video capture of a bath sparkler and hot water volcano.*

# Example_6 *Pyroclastic flow in a water tank*

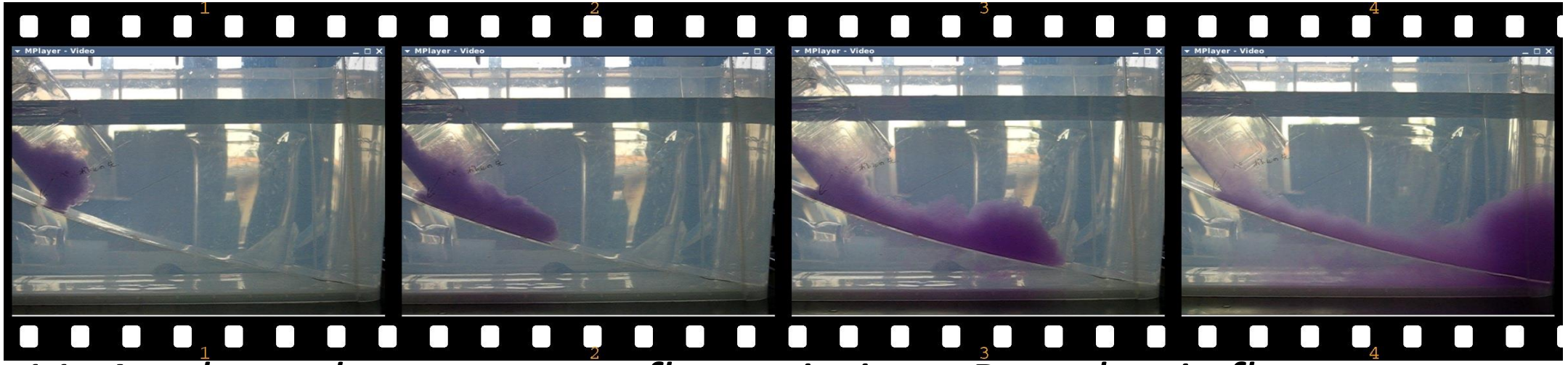



*Fig11. A coloured sugar water flow mimics a Pyroclastic flow.*

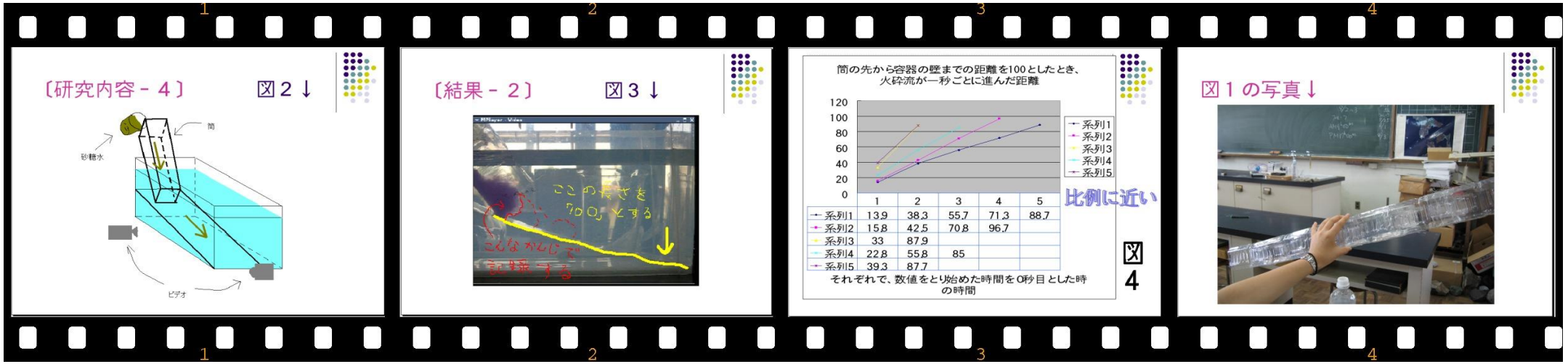



*Fig12. An analysis about "Sugar water pyroclastic flow".*

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# Example_7 *Liquidization and sand_dune*


*Fig13. Mixture of plastic balls with vibrate-motor mimic ground liquidizing.*

*Fig14. A sand dune model using polyethylenes balls.*

# Example 8 The 'Japan Island' is sinking---





*Fig15. 'Japan island' sinks into the pacific plate! After ice cream melting.*


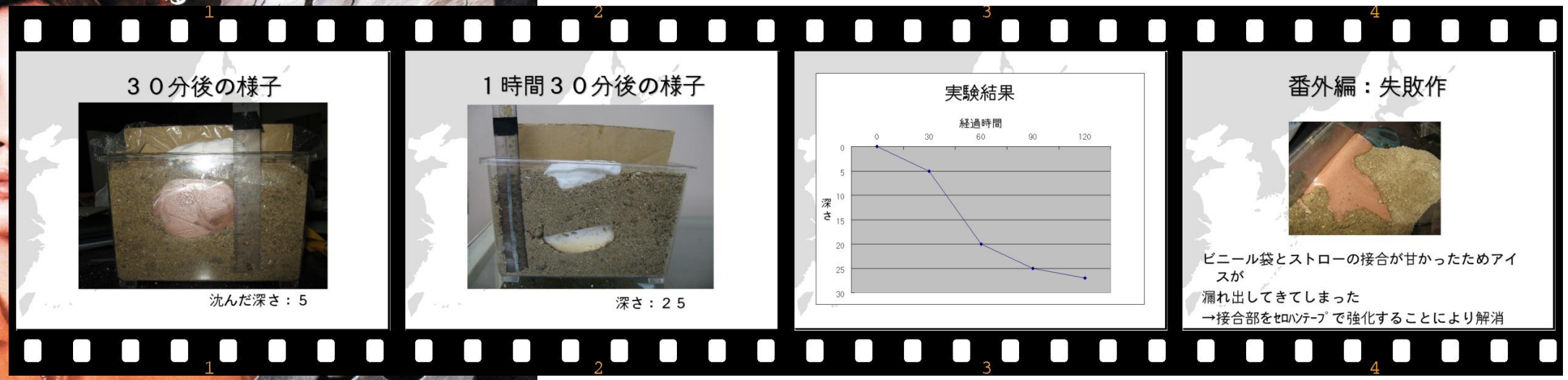


*Fig16. Clips, an analysis and a failed example .*

https://www.imdb.com/title/tt0473064/mediaviewer/rm4073767169/?ref_=tt_ov_i

# Example_10 *K/T asteroid impact!!!*


*Fig20. Baby powder in a 'Fish tank' and a Japanese food 'Fu' .*


*Fig21. Volt-meter shows a depletion of sun ray with an impact.*

# Failed experiments:


*Fig19. Shake the bottle but not stand. And shake---, succeed!*

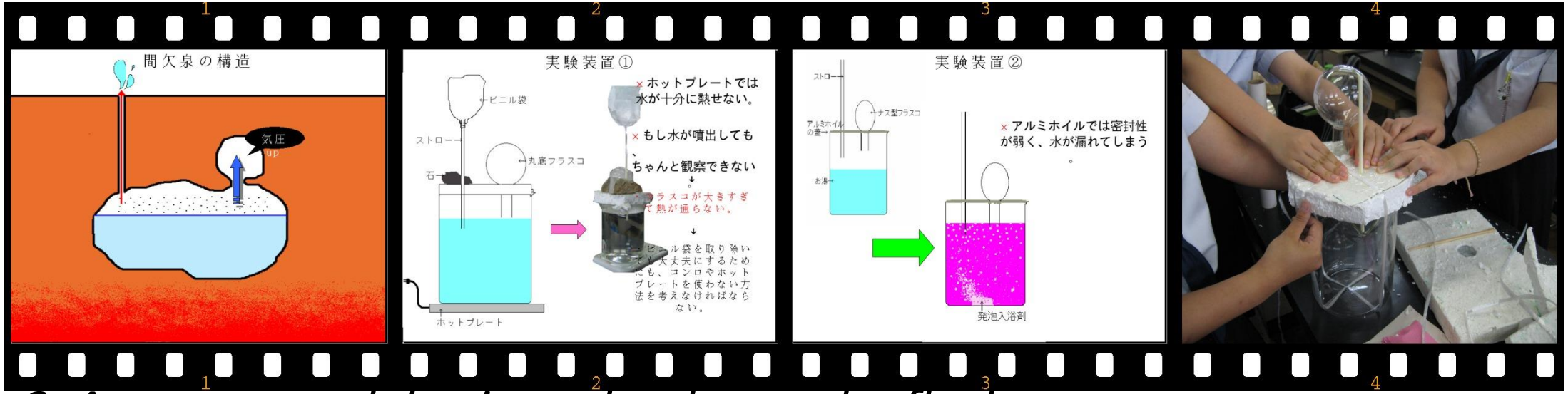


*Fig6. A geyser model using a beaker and a flask.*

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# Let's cook!

*Fig20. Making chocolate fan???  Too sweet!!!!!*

*Fig21. Various food materials and items for experiments.*

# Policy of Our Projects

- Learn about scientific  method through their practices.
- To make tools and data by themselves.
- The methods how to acquisition the real data.
- Trials and errors are main driver.
- Enjoying their process is important.
- Evaluation or discussion methods are testing in situ.
- Learn how to facilitate is a teacher-side goal too.

Not too much teach or suggest!

# References / Acknowledgments


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- This report relies heavily on their efforts.
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- **Dr. Isao Iizawa** (a geoscience teacher at Horikawa HS in Kyoto) provided me with a very informative lecture.
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Thank you very much
for your attention!!