

自由研究のテーマえらび

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2025年5月24日堺教育センター

Who am I ? (Webサイト参照)



- 40年にわたり 高校で地学担当教員（今は退職）
- この間大阪府教育センター，大学で研究も行う
- 地学教育とりわけ地震や海外の地質などに興味
- 日本と世界の地質サイトを行脚
- 地学教材を開発（地震計，3D震源地図，岩石薄片など）
- Linux上の**Programing**と**英語**を勧める
- 2012年より，特任准教授および非常勤で本学で教養「地球と災害」，専門「固体地球科学II」担当

2017年より夏～秋の2ヶ月，タイの先進科学高校（KVIS）の高3生の地学を英語で担当（2019年まで．COVID-19期間で中断）

- 2022年からあらたにタイのサイエンス高校（PCSHS Mukdahan校 Loei校など）のvisiting teacher で現在に至る．

私の研究れき

- こどものころから もけい飛行機, 望遠鏡 など
工作が大好きです





教材	研究報告	巡検紀行(海外)	巡検紀行(国内)	雑文など
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地学教材のサイト。授業などに活用ください。活用は自由ですが、著作権は保持します。商用利用は相談ください。

[English Page](#)

What's New (31 Jan. 2024) <古いものは更新記録(過去分)へ>

- 2024-01-31 2024年能登地震関連教材
- 2024-01-28 2023Dec-2024Jan Thailand visit Whole_List
- 2024-01-24 MUIGC2024 巡検記
- 2024-01-21 Satun Geo Park 巡検記
- 2023-12-07 私の地震計開発小史
- 2023-12-03 1997年神戸地震後の野島断層の写真を公開します。
- 2023-11-07 Webサーバーを切り替えました。
- 2023-11-03 GoPro動画用手ブレ補正スクリプトを追加
- 2023-10-02 2023年Aug-Sep. タイ日記と資料
- 2023-09-21 2023年度地学教育学会「スケルトン地震計」製作レシピ。
- 2023-07-15 古い附属高時代のWebPageを復活させました。
- 2023-03-29 「マグデブルグ半導体事件」顛末を公開
- 2023-03-29 2023北海道巡検(函館・日高)を公開
- 2023-01-29 3Dプリンタ地震計を更新
- 2023-01-29 T3-SIF2016の思い出を公開
- 2023-01-03 2022_Dec_タイ日記を公開
- 2022-11-16 大学過去講義資料置き場 に資料を追加
- 2022-08-28 GeoSciEdIX 地学教育学会 微気圧計製作レシピを公開
- 2022-08-07 Olympus偏光顕微鏡照明装置を公開
- 2022-08-01 堺大和川教員研修を更新
- 2022-06-28 古いクラス演劇脚本公開
- 2022-06-05 堺自由研究のサイトを更新

講義資料など

[堺サイエンスクラブ\(更新\)](#)

[for Thai students](#)

[堺大和川教員研修\(2023\)](#)

[大学過去講義資料置き場](#)

[中高理科研修「火山口の観察」](#)

古いMisc資料

[古いHPの記録](#)

[科研費教材資料](#)

[地震関係教材資料](#)

[教材の小ネタ\(研修資料など\)](#)

Seagull Lab

[Seagull Labとは](#)

プロフィール (April 2022)

岡本 義雄 (OKAMOTO, Yoshio)

yossi.okamoto <atmark> gmail.com



at Cape Town (2016, South Africa trip.)

現在高校教員リタイヤ後

タイ王国KVIS ([Kamnoetyidya Science Academy](#)) visiting teacher (2017年8月～)
タイ王国Princess Chulabhorn Science High School (PCSHS) Mukdahan visiting teacher and adviser (2019年9月)
2020-2021年度のタイの仕事はCOVID-19禍で中止。

大阪教育大学非常勤講師(2013年4月～2022年2月で定年のため終了)

<社会的活動>

日本地震学会学校教育担当理事(2012年4月～2014年3月, 2002年4月～2007年3月)

<所属学会>

日本地震学会

日本地学教育学会

AGU (American Geophysical Union)

NAGT (National Association of Geoscience Teachers)

<受賞歴>

1989年度東レ理科教育賞奨励作「高感度地震計システムの製作と活用」

日本地学教育学会 渡部景隆奨励賞

<職歴>

大阪産業大学環境理工学科非常勤講師(2019年10月～2020年3月)

大阪教育大学 非常勤講師(科研費研究員, 2013年4月～2016年3月)

大阪教育大学 科学教育センター特任准教授(2012年4月～2013年3月)

大阪教育大学附属高等学校天王寺校舎地学科教諭(2000年4月より2012年3月まで, および2015年7月から2017年3月まで)

大阪府教育センター科学教育部地学研究室研究員兼指導主事(1996年4月から2000年3月まで)

大阪府立東百舌鳥高等学校地学科教諭(1992年4月から)

大阪府立横山高等学校地学科教諭(1978年4月から)

<学歴>

大阪市立大学大学院理学研究科後期博士課程中退(2012年4月～2016年3月)

岡山大学理学部地学科卒業(1976年3月)

もっと古い[プロフィール紹介](#)。

科学がベースとするもの

- これから2つの動画をごらんに入れます。
- いずれも火山の噴火をあつかったものです。
- この2つの動画のもっとも根本的なちがいは何だと思いませんか？

気づいたら、手を上げてください！

1991 Unzen Pyroclastic Flow



24 AUGUST 79 AD

2つの動画の根本的，本質的なちがい？



33年前46名の犠牲者を出した！
6月3日がもうすぐ訪れます！

解像度低い，しかし真実

解像度高い，しかしCG（嘘）！

- 真実 (Fact)

科学がベースにするもの！

- つくりもの (CG, AI)

Artificial Intelligence

なぜ波は沖から来るのに----

http://www.jpcoast.com/img/201007/20_DSC_0258.jpg



浜辺は水でいっぱいにならないのか？



<https://www.youtube.com/watch?v=hq387m0PRac>

波とは？

物体（物質）が移動するわけではない！

物質の変化（状態）が移動する！！

密度変化，位置変化など

波の種類あるいは例？

海の波，スタジアムのウェーブ，音，光，電波

地震など

波の基本的な性質

屈折

音の屈折（狸ばやし）

反射

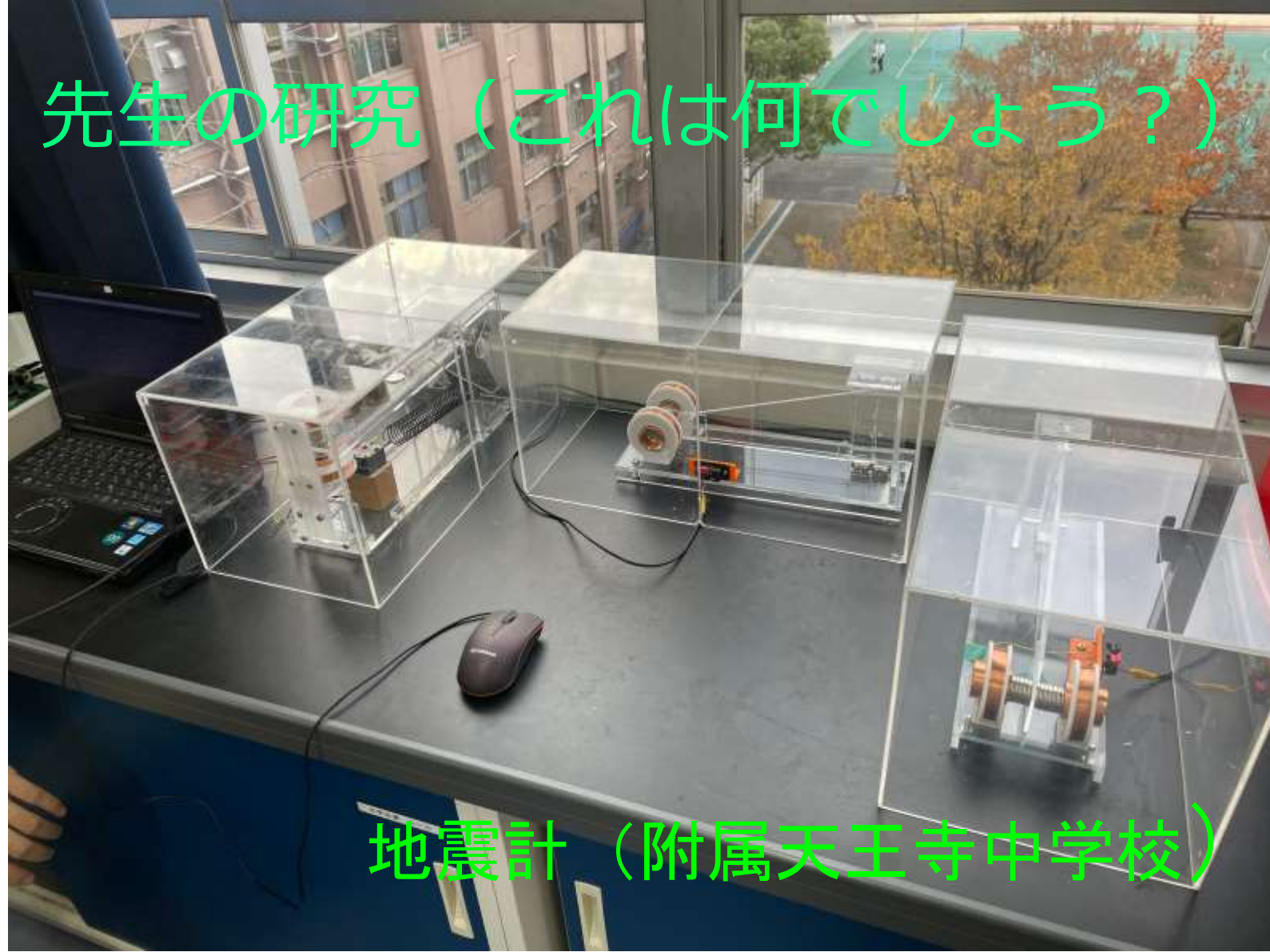
音の反射（泣き龍）

共鳴（共振）

干渉

回折

先生の研究（これは何でしょう？）



地震計（附属天王寺中学校）



公益社団法人 日本地震学会
THE SEISMOLOGICAL SOCIETY OF JAPAN(SSJ)

[投稿・お問合せ](#)

[標準](#)

[大](#)

[特大](#)

[組織紹介](#)

[イベント](#)

[出版物・資料](#)

[学会賞](#)

[公募・助成](#)

[インフォメーション](#)

[地震に関するFAQ](#)

[トップページ](#) » [出版物・資料](#) » [資料](#) » [なみふる文庫](#) » [教室でできる地学実験](#)

教室でできる地学実験 Publications

身近な素材で地震を体験？！岡本義雄氏による「なみふる」の名物コーナー。



[フィルムケースで地震計を作ってみよう](#) [第1回](#) [第2回](#) [第3回](#) [第4回](#)



[ココアと小麦粉で断層を作ろう!!!](#)



[「トランスフォーム断層ペーパーモデル」](#)



[「大陸移動ペーパーモデル」](#)



[「簡単に作れる『簡易磁力計』」](#)



[ANB地震計を作ろう！](#) [第1回](#) [第2回](#) [第3回](#)

2024.01.01 11:00:00 ~ 11:03:00

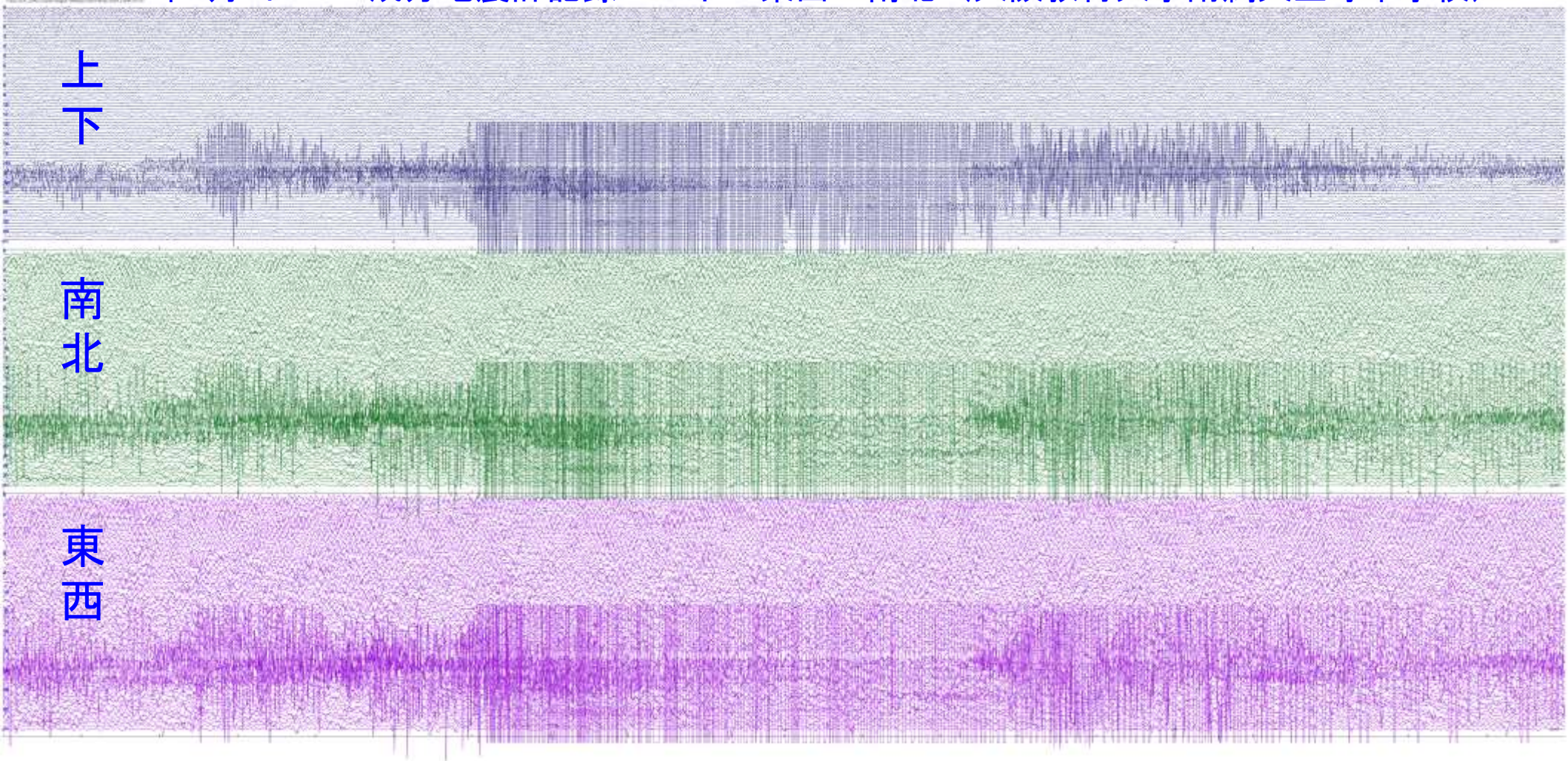
地震波形（大阪教育大学附属天王
寺中学校） 2024.01.01

2024年1月1日 3成分地震計記録：上下・東西・南北（大阪教育大学附属天王寺中学校）

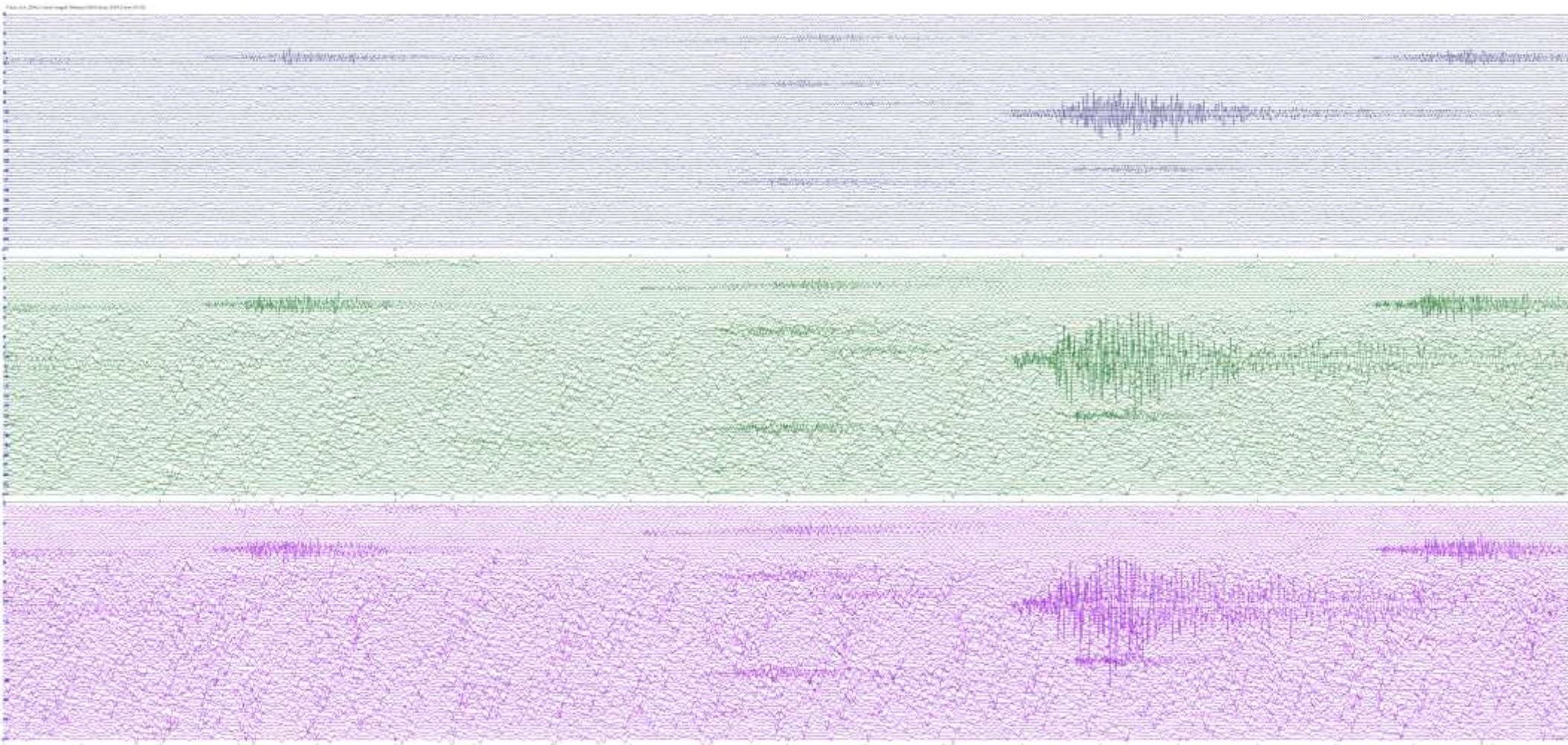
上下

南北

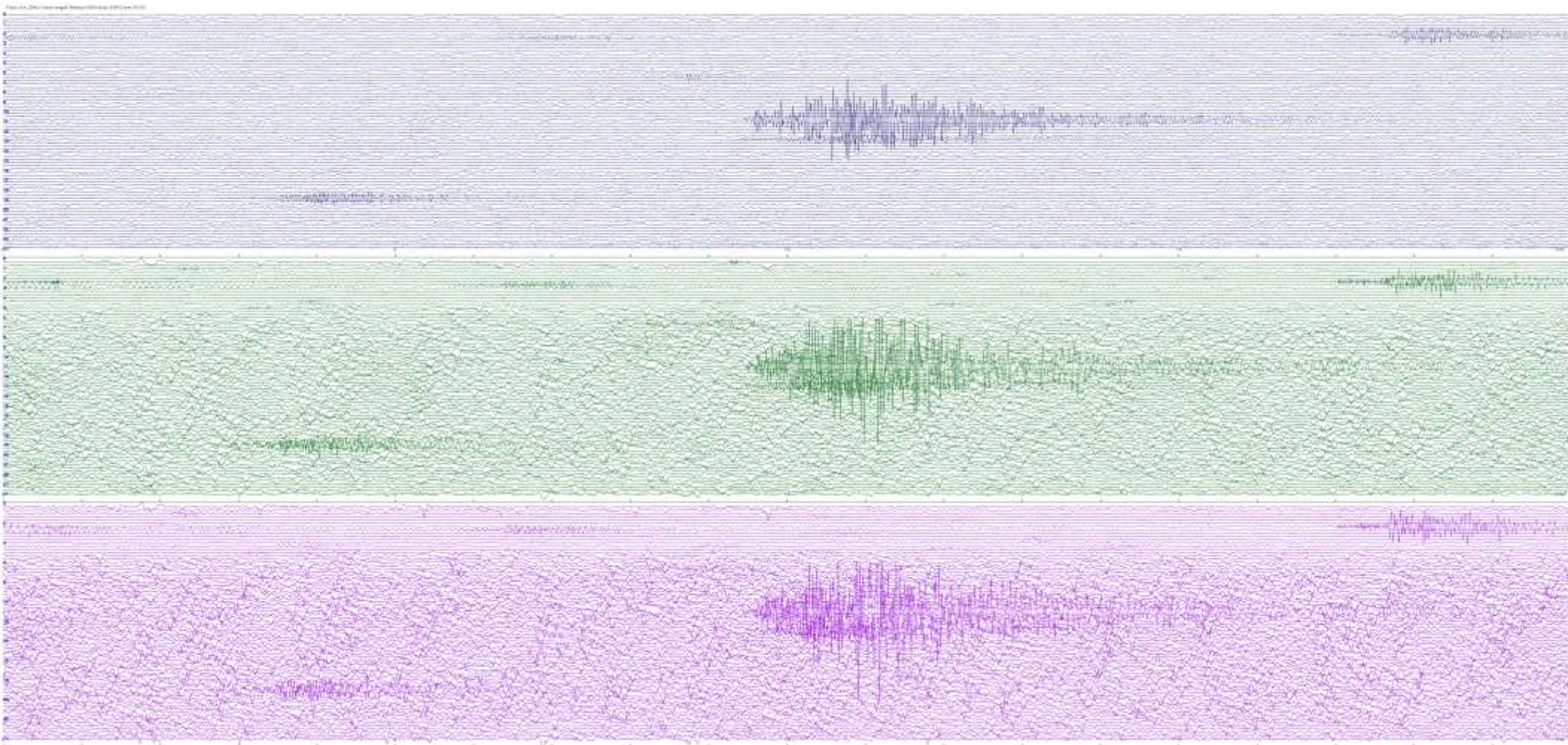
東西



2024年1月2日



2024年1月3日



ふだんは地震のない国での地震

- 2025年3月28日, ミャンマーで発生したM7.7の地震
- ふだんは地震を経験したことのない, タイのバンコクで身体に感じる地震！
- 次に地震の波形と, YouTubeに上げられた動画をごらんいれます.

タイの科学高校での授業

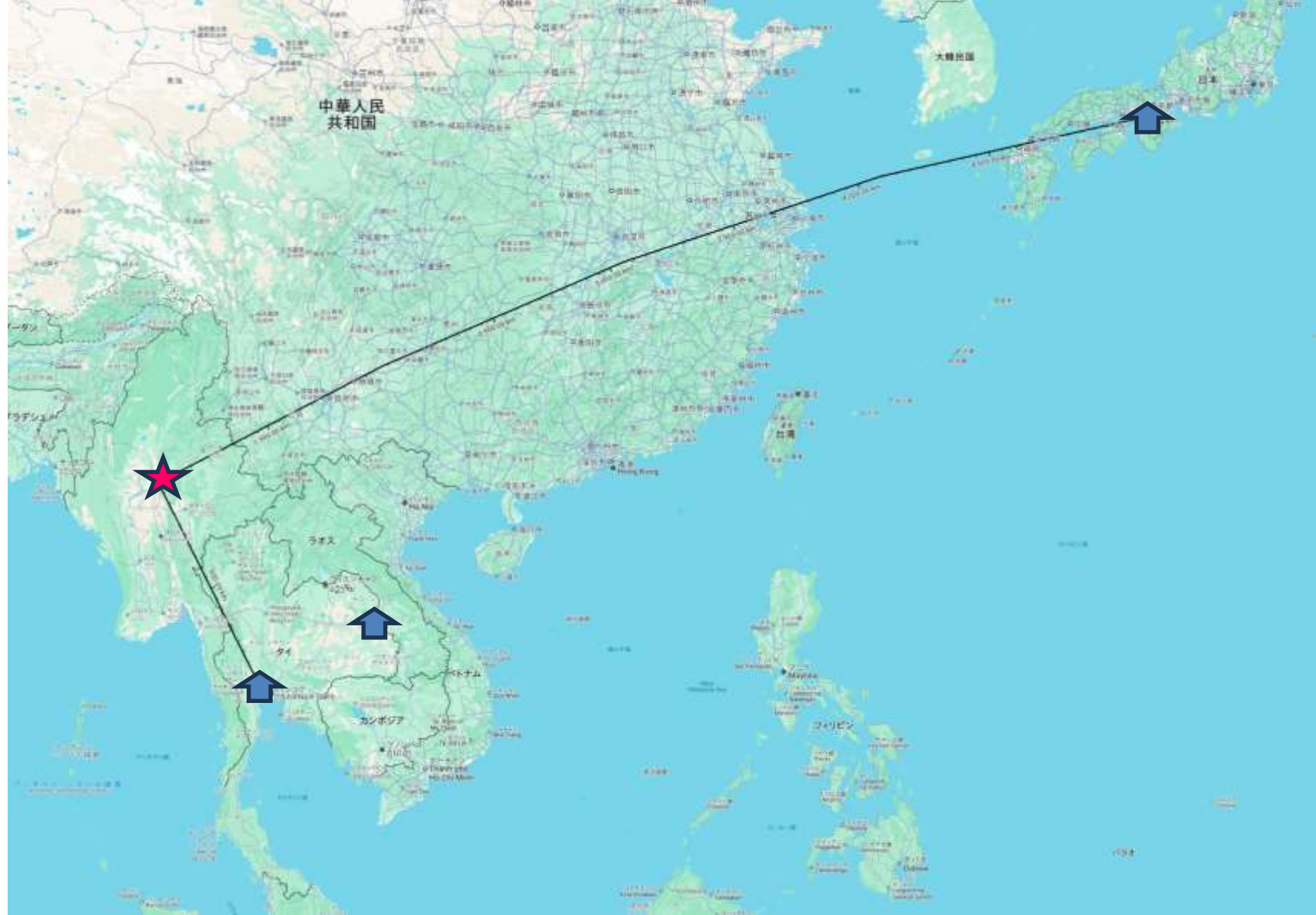


地震波形（タイ東部の科学高校）PCSHS Mukdahan 2025.03.28





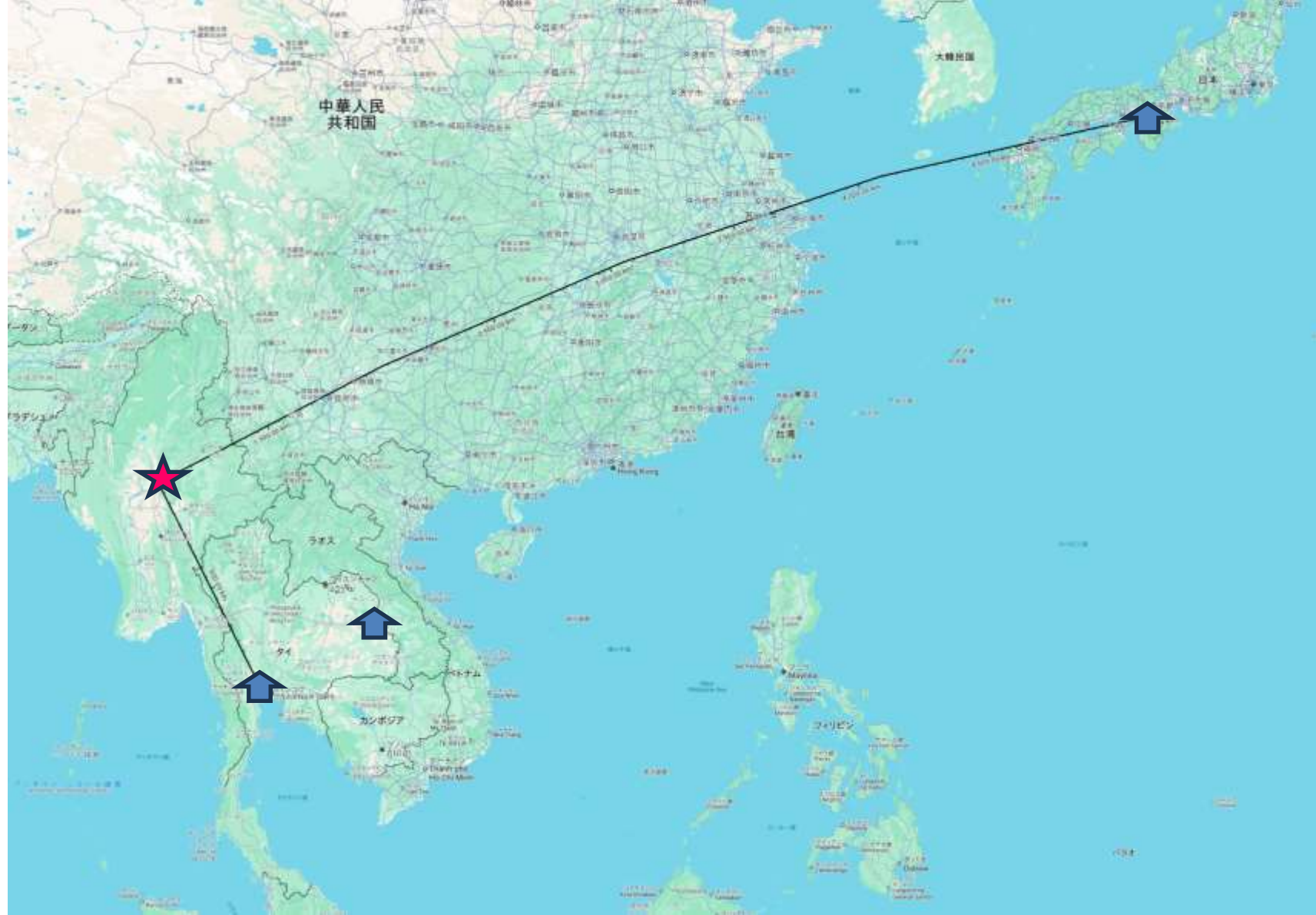
地震波形（タイ東部の科学高校）
PCSHS Mukdahan 2025.03.28





地震は地面を波が伝わる現象

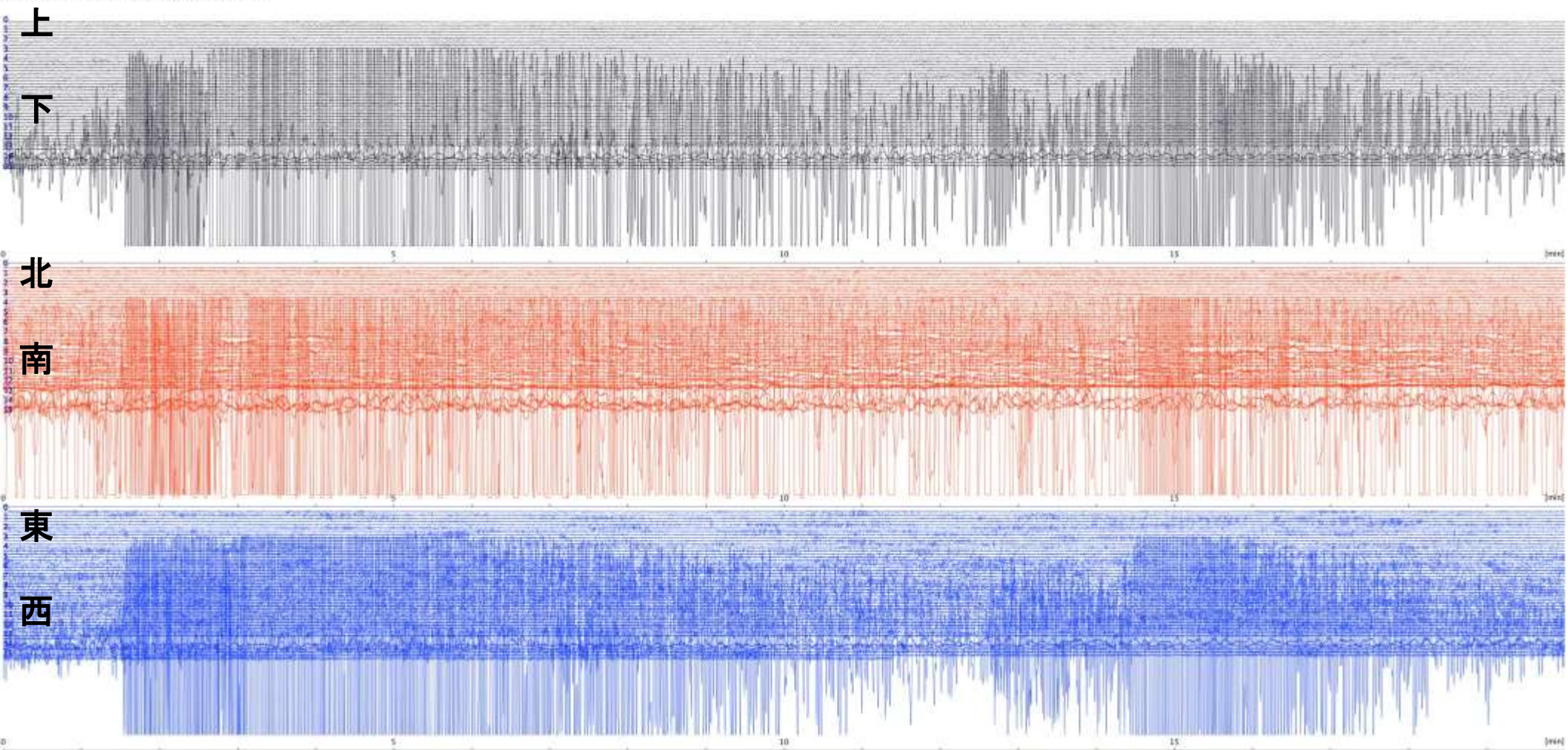


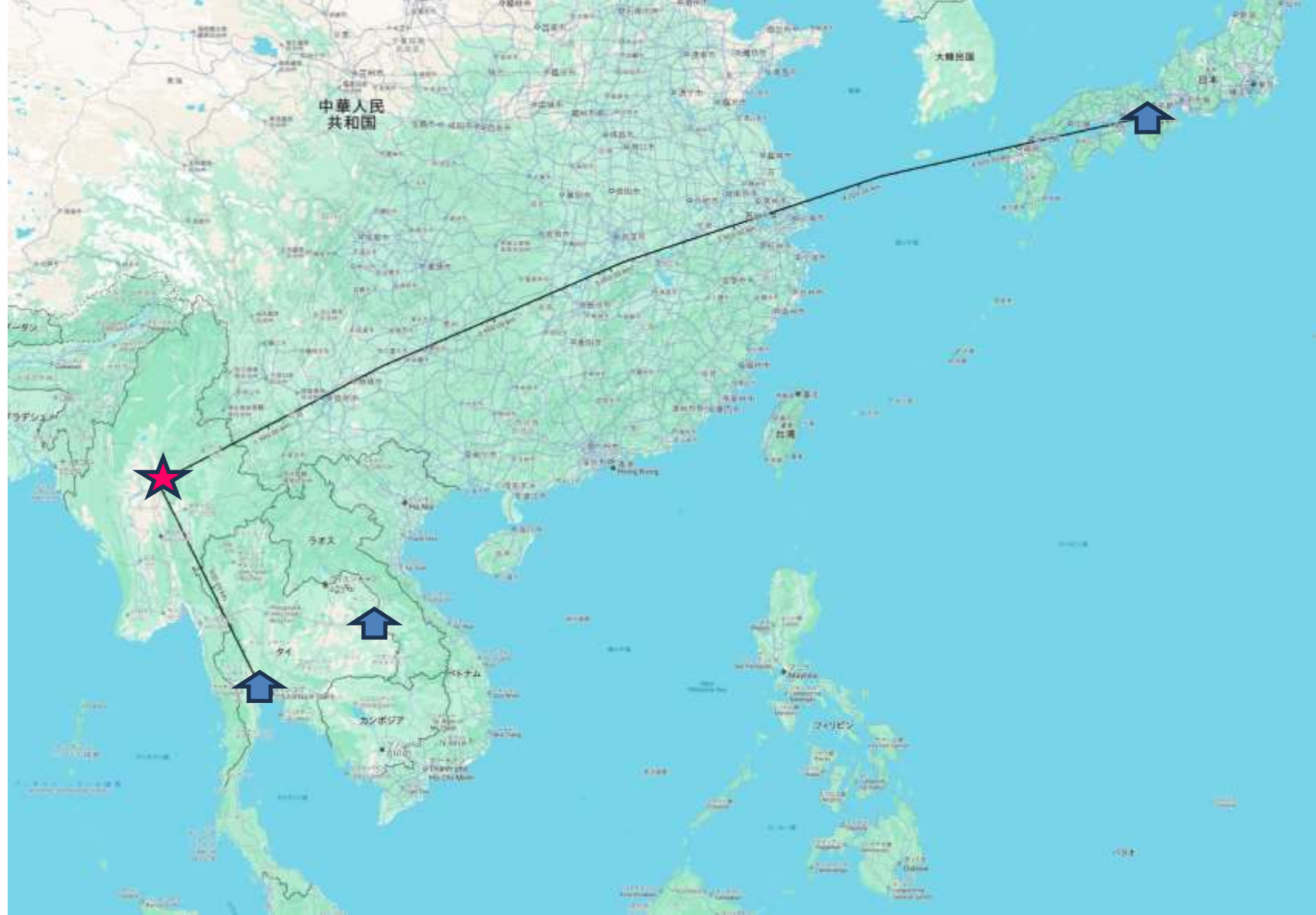


バンコクの近くの大学で記録したミャンマー地震



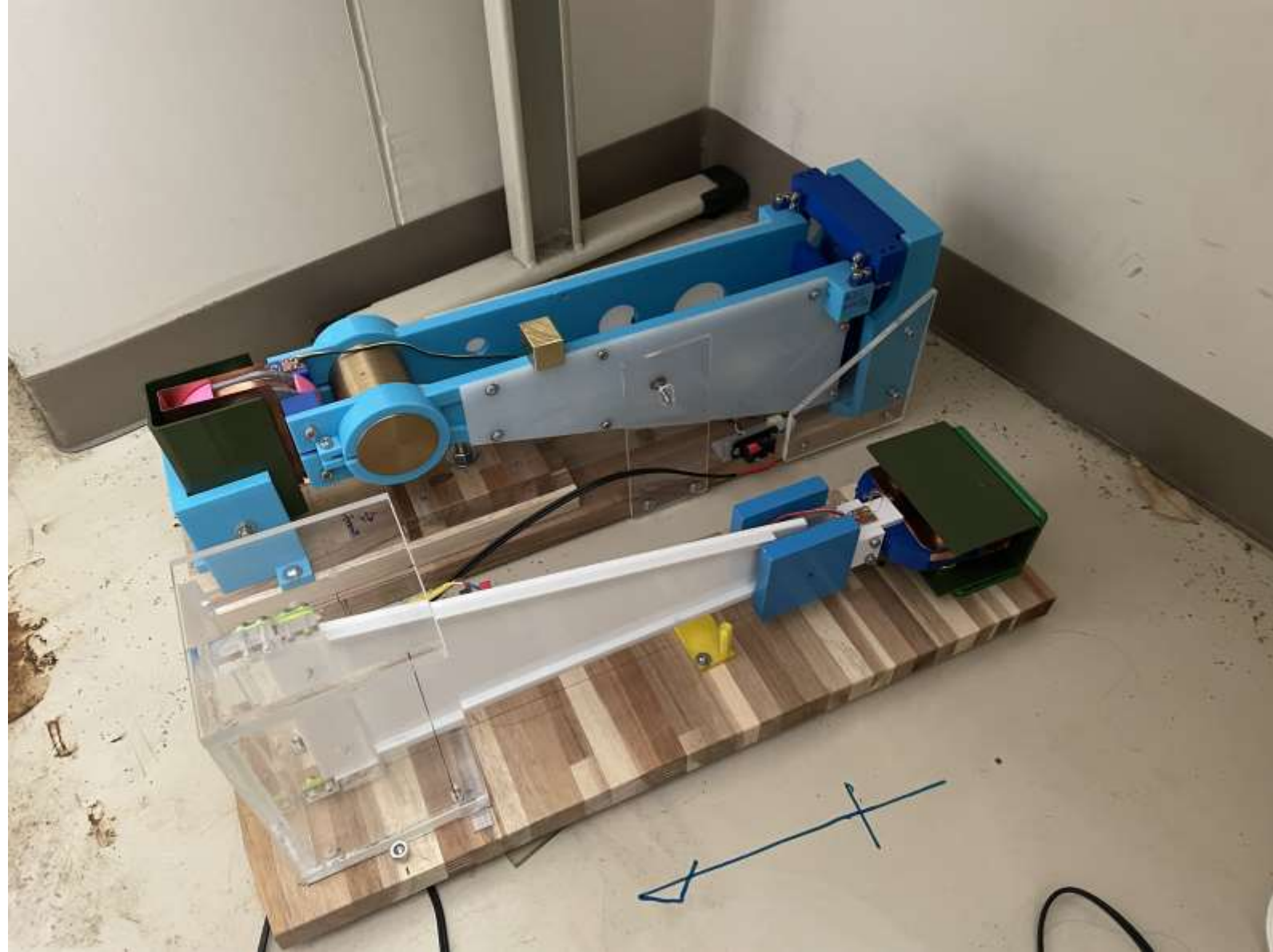
タイのシルパコーン大学物理学教室オーム教授

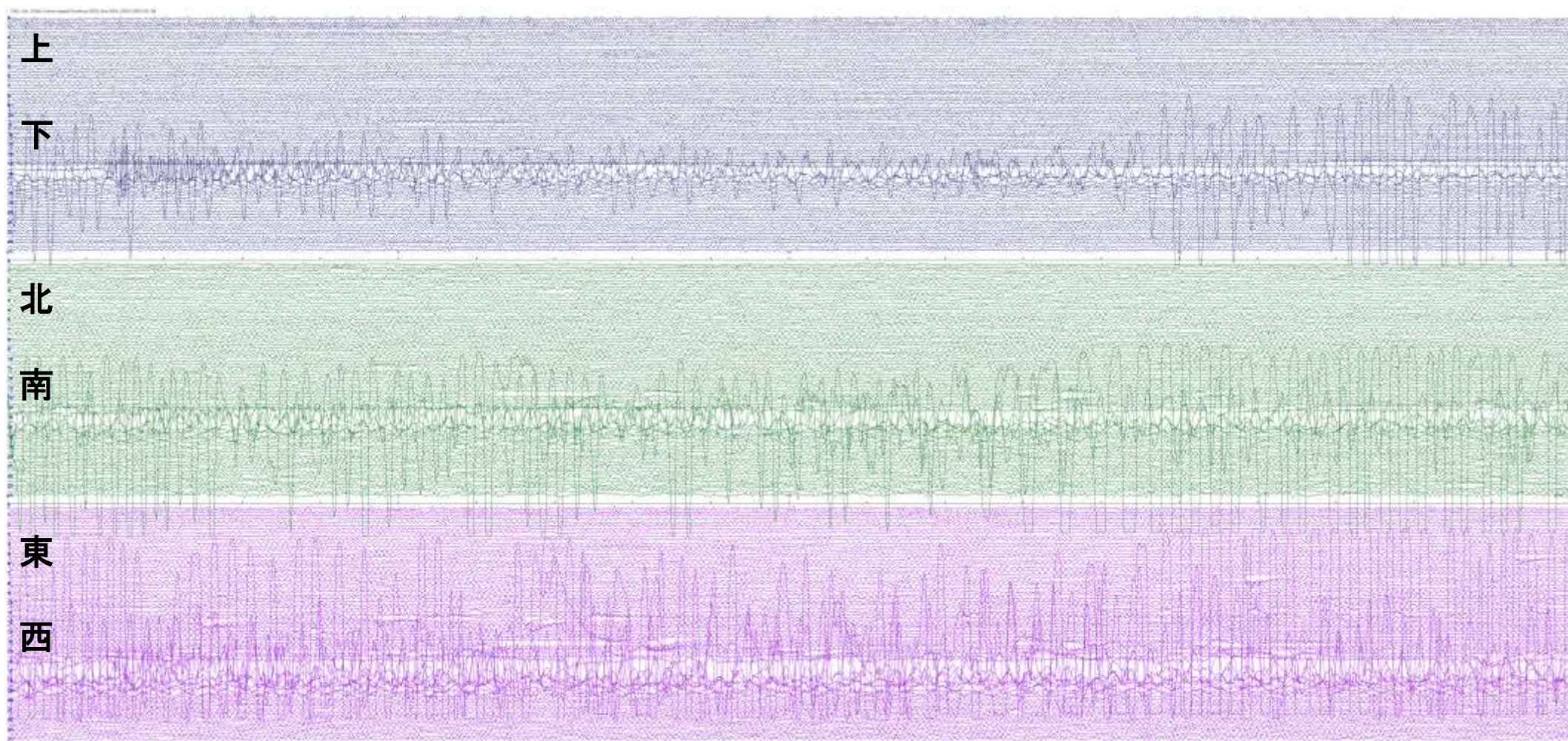


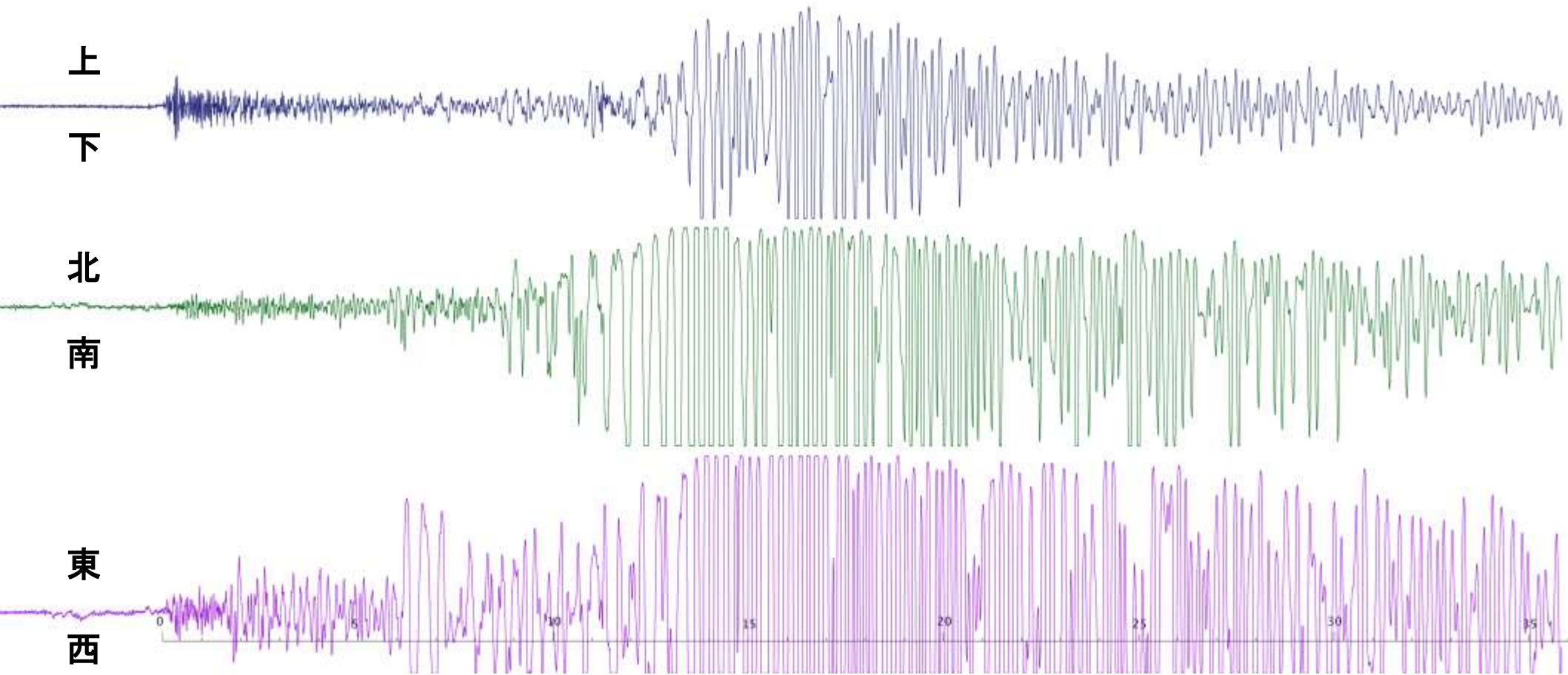


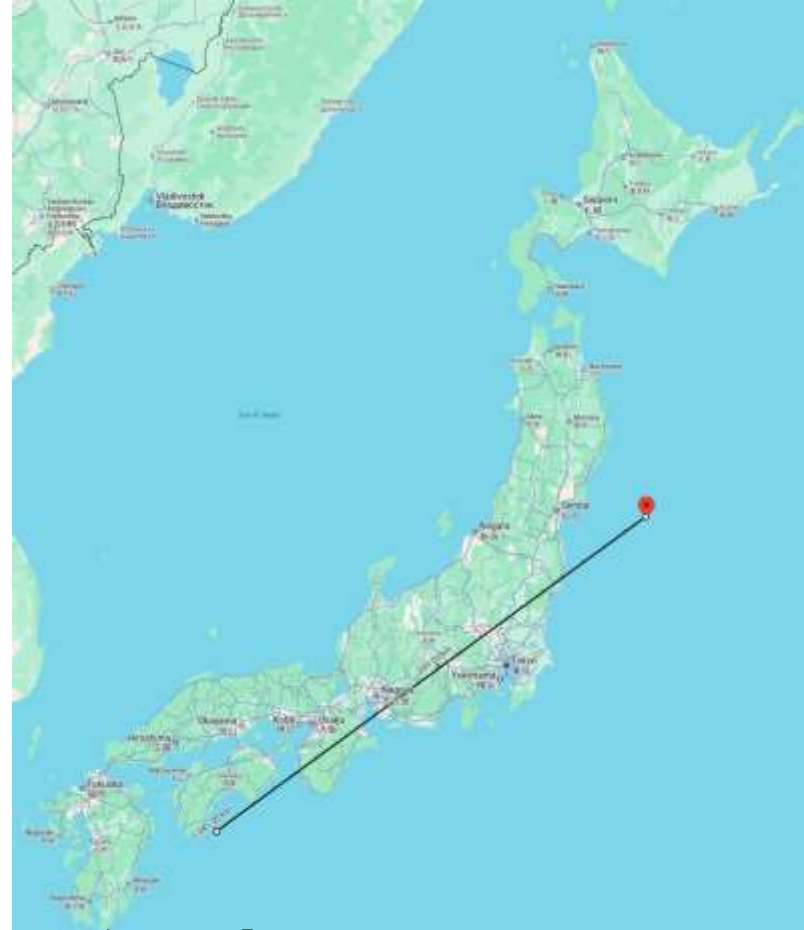
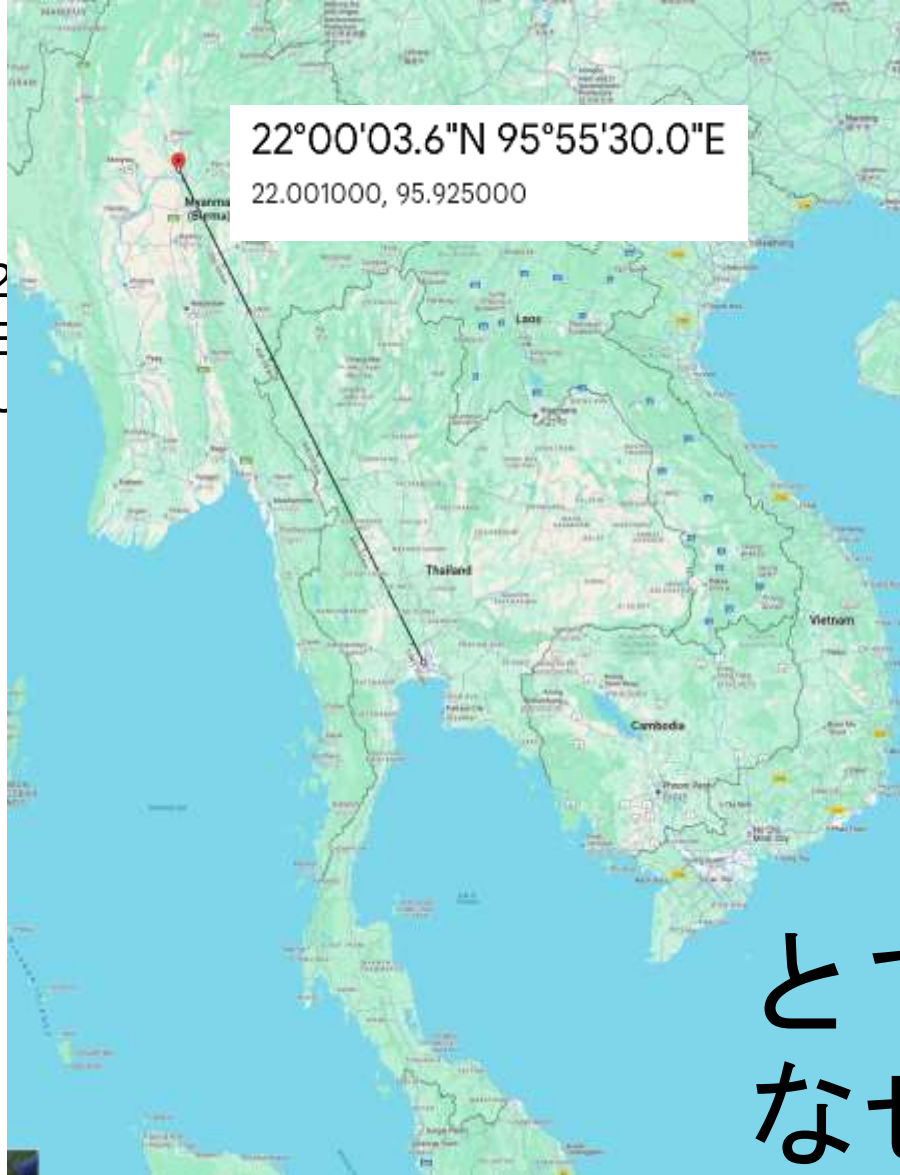
大阪教育大学（柏原市）で記録したミャンマー地震











とても遠い震源なのに
なぜ被害が出たのか？

波の共鳴， 共振の実験！！

SUN

1 Sunlight is white, made of all the colors of the rainbow.

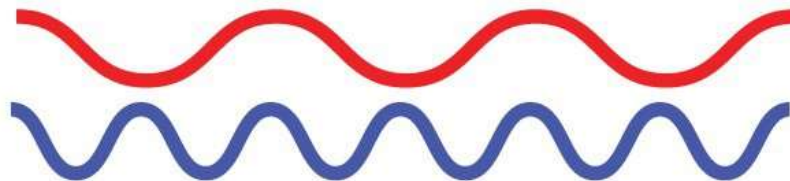
夕焼けが赤い理由？

2 Space is black because there is almost nothing in the void to reflect sunlight.

3 Blue and violet light is scattered by Earth's atmosphere, turning the sky blue (we don't see violet well).

Why the Sky is Blue (and sunsets are red)

The longest wavelength of light we can see is red.



The shortest we see are blue and violet.

4 At sunrise and sunset, the light passes through more atmosphere to reach you, so even more of the blue and violet is scattered, along with some of the green, but orange and red still get through.



AIR



YOU

GRAPHIC BY ROBERT ROY BRITT
Not to Scale



SOURCES: NOAA; NASA; The Weather Book;
Stephen F. Corfidi; Phil Plait

ビデオはPhayao大学の
Chachawal先生よりいただいた

震源から遠いタイのバンコクで 大きなゆれがあった理由？

https://www.youtube.com/shorts/P8_P18_BPzk



<https://www.youtube.com/shorts/BWukpxZE3PA>

1) 波の性質から，長い周期の波が
遠い距離を伝わった！

2) 超高層ビルが，長い周期の波だ
けに共振した！

⇒ 波の科学的な性質で説明できる！

ここで休憩タイム

さあいよいよ今日のおはなし！

- 研究テーマについて
- 自由研究のカン違い
- テーマの探し方
- みんなで実験してみよう！

ビー玉と 2 B 弾を混ぜる

- れきと砂（すな）と泥（どろ）をまぜて，水の中に入れて，かきまわす
- れきが一番下に，砂がつぎ，さいごがどろになる。（私の実験ではガラスビーズを使っています）
- ところが，-----
- 研究には**意外性（いがいせい）**がだいじ！

ウィキペディア フリー百科事典

メインページ
コミュニティ・ポータル
最近の出来事
新しいページ
最近の更新
おまかせ表示
練習用ページ
アップロード (ウィキメディア
・コモンズ)

ヘルプ

ヘルプ

井戸端

お知らせ

バグの報告

寄付

ウィキペディアに関する
お問い合わせ

印刷/書き出し

ブックの新規作成

PDF 形式でダウンロード

ブラジルナッツ効果

ブラジルナッツ効果(ブラジルナッツこうか)とは、異なる大きさからなる粉粒体を振ると、最も大きな粒子が表面に浮き上がってくる現象のことである。ミックスナッツでは最も大きな粒はブラジルナッツであることが多いことからこのように呼ばれる。この現象は、同じような密度で大きさの異なる粒からなる朝食のシリアルの中에서도見られることから、**ミューズリー効果**と呼ばれることもある。

最も大きくおそらく一番重い粒子が浮き上がってくるのは直感に反するようにも思われるが、これにはいくつかの説明が考えられている。

- 小さな粒は振られるごとに大きな粒の下の隙間に落ちることができる。それを繰り返すことで大きな粒が浮き上がる。ミックスナッツを含む系全体の任意の状態を考えると、その重心はブラジルナッツの周りに空間があるため最適とは限らない。ナッツが振られると、重力は系全体の重心を下方方向に移動するように働き、それはブラジルナッツを上を動かすことのみ可能になる。重力は上にあがったものをその位置に保つようにも働く。



他のナッツの上に乗ったブラジルナッツ



At a sale recently held by Mr. Stevens in King Street, Covent Garden, a great auk's egg in fine condition was sold for two hundred guineas... This is a considerable falling-off from the three hundred guineas obtained for the last specimen sold by Mr. Stevens, the reason being attributed to the fact that several other fine examples are in the market. From *Nature* 26 May 1904.



Figure 1 Nuts: why do brazils always rise to the top?

Granular materials

The brazil nut effect — in reverse

Troy Shinbrot

In a box of mixed nuts, the brazils rise to the top. In granular mixtures in general, depending on their size and density, the 'brazil nuts' may sink instead. This reverse effect has now been explored further.

Every farmer can attest to the curious fact that the largest crop each spring is the boulders that appear, untended, on open fields. Common wisdom holds that this crop is loosened from the soil by frost heave, and rises because small pebbles can slip beneath large boulders, but not vice versa¹. This is the 'brazil nut effect' — named for the fact that, in a container of mixed nuts, the brazil nuts always seem to rise to the top (Fig. 1). Because similar processes and effects occur in pharmaceutical, chemical and food processing, the problem of granular segregation has earned serious attention² — and now, in *Physical Review Letters*, Huerta and Ruiz-Suárez³ add the latest piece of the puzzle.

The first complication to the simple picture of pebbles slipping beneath boulders (termed 'percolation') was the demonstration that a tapped bed of grains 'convects' in a regular pattern: a wide swath of grains rises in the centre of a container, and thin margins correspondingly sink⁴. According to the convection picture, large 'intruder' particles rise with the surrounding bed, and then find themselves simply unable to fit into narrow

downwelling margins. This mechanism was confirmed by a clever experiment in which the convection rolls were reversed and, as predicted, large particles migrated to the bottom of vibrated beds⁴. Later confirmations came from magnetic-resonance-imaging experiments that conclusively demonstrated the presence of segregating convection rolls⁵, and from meticulous computational comparisons that revealed that convection dominates over percolation in producing segregation in deep beds⁶.

Over the past decade, however, our understanding of the segregation of large particles in vibrated beds has been challenged by experiments revealing that although large heavy 'intruder' particles can indeed rise in vibrated beds of finer grains, equally large light intruders can sink, contrary to expectation and common experience. Now termed the 'reverse brazil nut effect', this observation⁷, made by myself and Fernando Muzzio, is explained by neither the convection nor the percolation description. It is so counterintuitive that a reviewer of the original manuscript reporting the effect insisted that it could not be correct; and the

土石流（どせきりゅう）のたいせきぶつ ノルウェイの島のちそう



自由研究のテーマ選び

みんながよくするまちがい（その１）

- 「研究」と「調べ（しらべ）学習」はちがう
- 研究とは、まだ誰も知らないことを調べる。
⇒「オリジナリティ」という
- そのためには、過去の研究をまず調べる。
- 今ではインターネットでかんたん！
- だれも発表していないことをさがす
⇒でもけっこうむずかしい！

よくあるまちがい（その2）

- じぶんの興味（きょうみ）でテーマを選んでしまう
- 宇宙に興味があるから「ブラックホール」を研究する！
⇒大人でもむずかしい研究テーマ
- 虫に興味があるから、「蜘蛛（くも）の研究」
⇒たくさんのひと（専門家やこどもたち）がすでにおこなってしまっている！
- 自分の興味からすこし注目点をずらす！

よくあるまちがい（その3）

- 「研究」というのは何かむずかしい装置でむずかしい実験をすることだと思っている.
- 専門家と同じような研究ができると思っている.
- 実は専門家でも「研究」はほんのささいなこと（おおきな研究のごく一部）を調べたもの
- 一人ですごい研究がすぐにできるわけではない！
- **ほんのちょっとしたこと**をまず調べてみる.
- これはとても大事なこと.

じゃあどうするか？

- ほんのみじかにある，ふしぎに着目する
- とりあえず何か測定してみる！
- 台所などにもテーマはころがっている！
「キッチン科学」⇒専門家も注目
(あとでみんなに実験をしてもらう予定！)
- 自分で何か工作をする！
- 誰かの研究を“参考”にして条件や材料をかえてみる.

誰かの研究を参考に

<http://nature-sr.com/Image/>

- 誰かが蜘蛛（くも）の研究をのはり方を研究して賞を取った
- 私の教えた高校生の例
- 同じ糸でも彼女は

• 綿菓子（わたがし）

⇒これで彼女は何と神戸大学のAO入試に合格した！

<http://www.watagasi.com/blog/wp-content/uploads/2012/10/023-e1349164902805.jpg>



研究テーマを決めるのは難しい！

- 研究の9割は「研究テーマ」のよしあしでできる。
- 自分で面白そうなテーマを5個考えてくる。
- その中で研究して、うまくいきそうかどうかを学校の先生や専門家の先生に選んでもらう！
- そうするとテーマは自分で選んだことになる。
- テーマまで親や先生に決めてもらうのは反則！
- そして研究テーマを選んだら、かならず賞に応募したり、
- **どこかで発表する**ことを考える！
- ほかに人が興味を引く、研究名を考える（これはあとで）

考えてもなかなかいいテーマが みつからないときは-----

- とりあえず何か身近なものを測定してみよう！
- 私が数年前に，この講座の準備を考えていて
10分ほどで発見した「研究」！-----
- 私の家の近所にある「狭山池」に何か研究テーマ
がないかさがしに行った.
- 池で水鳥が遊んでいた.
- それを見た私は-----

ここで動画をみてください



IMG_4050



2017 6 8

熊山池 水試

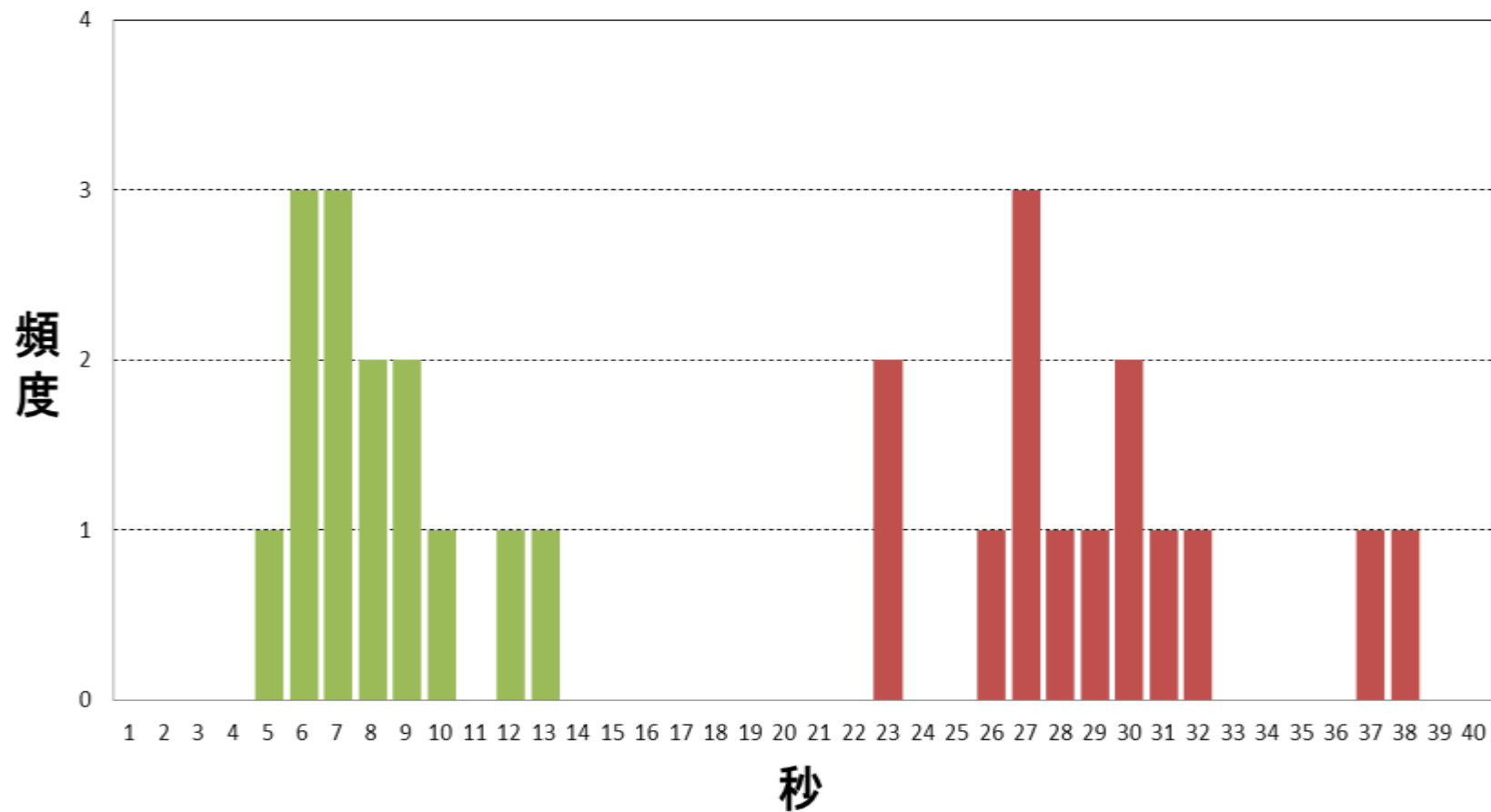
潜水

00:23	溜	浮
00:30		7
1:00	30	78
1:08		
1:37	28 29	10
1:47		
2:14	28 27	13
2:27	30	
2:57		6
3:03	37	
3:40		12
3:52	23	
4:15		7
4:22	32	
4:34		6
5:00	31	
5:31		9
5:40	28	
6:08		7
6:15		
6:38	23	
6:44		6
7:11	27	
7:16		5

7:62	26	
7:57		9
8:18	27	
8:26		8
9:04	38	

狭山池 水鳥
潜水時間と浮上時間の度数分布
2017年6月8日午後3時ころ

■ 潜水
■ 浮上



先行（せんこう）研究と比較する

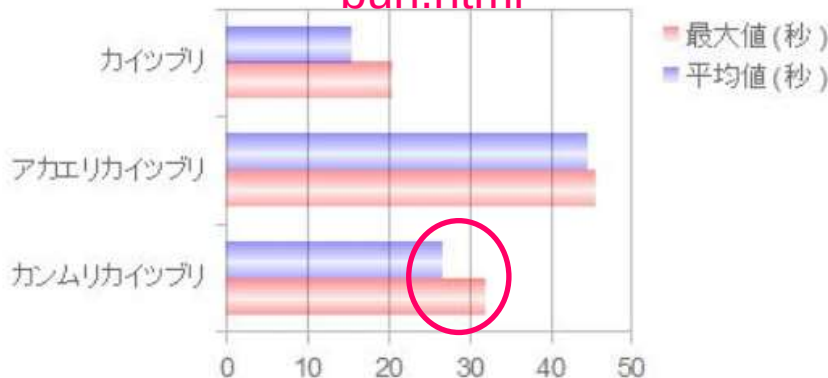
- もうすでに同じことを考えた人がいる！

【グラフで見る】鳥類の潜水時間 - カイツブリ類 -
カイツブリ アカエリカイツブリ カンムリカイツブリ

カイツブリ類の潜水時間を測定しました。カイツブリ、アカエリカイツブリ、カンムリカイツブリの潜水時間の最大値と平均値とをグラフに示します。

なお、カイツブリ、カンムリカイツブリは京都・洛西（らくさい）の桂川（かつらがわ）で、アカエリカイツブリは関東の海でそれぞれ観察しました。

http://www.geocities.jp/dst_tx/sr1331c_diving_kaitu_buri.html



潜水時間の最大値と平均値(単位:秒) - カイツブリ類

私の研究を発展させるには？

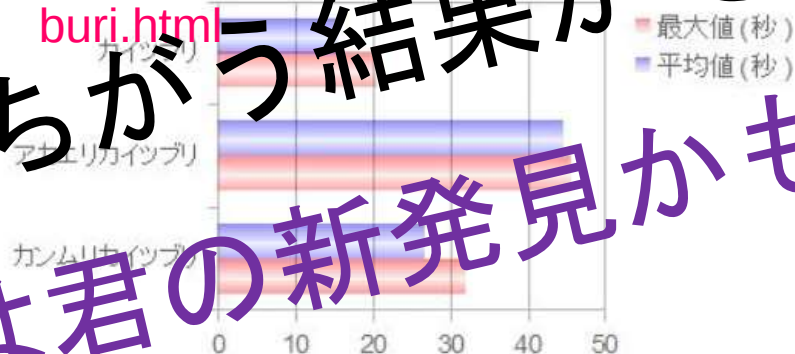
- 条件：場所や季節、時刻などを変えてみる！

【グラフで見る】鳥類の潜水時間 - カイツブリ類 -
カイツブリ アカエリカイツブリ カンムリカイツブリ

カイツブリ類の潜水時間を測定しました。カイツブリ、アカエリカイツブリ、カンムリカイツブリの潜水時間の最大値と平均値とをグラフに示します。

なお、カイツブリ、カンムリカイツブリは京都・洛西(らくさい)の桂川(かつらがわ)で、アカエリカイツブリは関東の海でそれぞれ観察しました。

http://www.geocities.jp/dst_13310_c_diving_kaitu_buri.html



潜水時間の最大値と平均値(単位:秒) - カイツブリ類

もしちがう結果がでたら？
それは君の新発見かも知れない！

2017 6 8

熊山池 サイクリング

潜水

00:23

潜

浮

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1:37

~~28~~ 29

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9:04

なぜこのデータは
貴重か？

台所（キッチン）は研究の宝庫！

http://magazine.shokuikuclub.jp/wp/wp-content/uploads/2015/09/IMG_0009.jpg



OPINION

Open Access

Physics in the kitchen

Peter Barham

Abstract

The kitchen is a laboratory and cooking is an experimental science. When we cook we generally follow a recipe (either written or from memory); we select, quantify and process the ingredients and then serve the food to our friends, family or guests. A good cook (or scientist) will keep records in a notebook of exactly what they do so that they can repeat the experiment (recipe) as required.

During the meal, as we eat we note how good the food is, where there is room for improvement and what is particularly liked. In effect we analyse the results of the experiment – the good scientific cook will keep notes of these discussions and use them to draw preliminary conclusions about how to improve the recipe. After several more tests of the recipe, we may then begin to derive a model to explain our results and to understand how and why making small changes to the recipe produces different qualities in the final dish – we can then use that understanding and apply it to other recipes, so continually improving our cooking skills.

This is nothing more than the application of the scientific method to cookery – simple but highly effective. If taken seriously and applied properly there is no excuse for any scientifically trained person not to become a superb cook.

But is there more to physics in the kitchen than ensuring physicists are good cooks? Can physics help chefs with no scientific background improve their own cook-

ensure some degree of consistency between cooks there is a need to have some assurance that the temperatures used in different kitchens are closely similar (if not the same). Without the use of expensive scientific equipment the only easy way is to use a phase transition that occurs at a fixed temperature – and the simplest and most accessible of these is to use boiling water. Common practice when cooking vegetables, for example, is therefore simply to put them in boiling water for a fixed time. This can provide a system which is sufficiently reproducible that the same recipes can be used by cooks around the world and ensure they get similar results. But is it? We teach our children that water boils at 100°C, but it is only much later when those who progress on to higher levels of education begin to learn that the boiling point of water is not fixed, but actually quite variable – for example, in Denver, Colorado, which is about 1.6 km above sea level and where the atmospheric pressure is around 85 kPa, water boils at around 94°C.

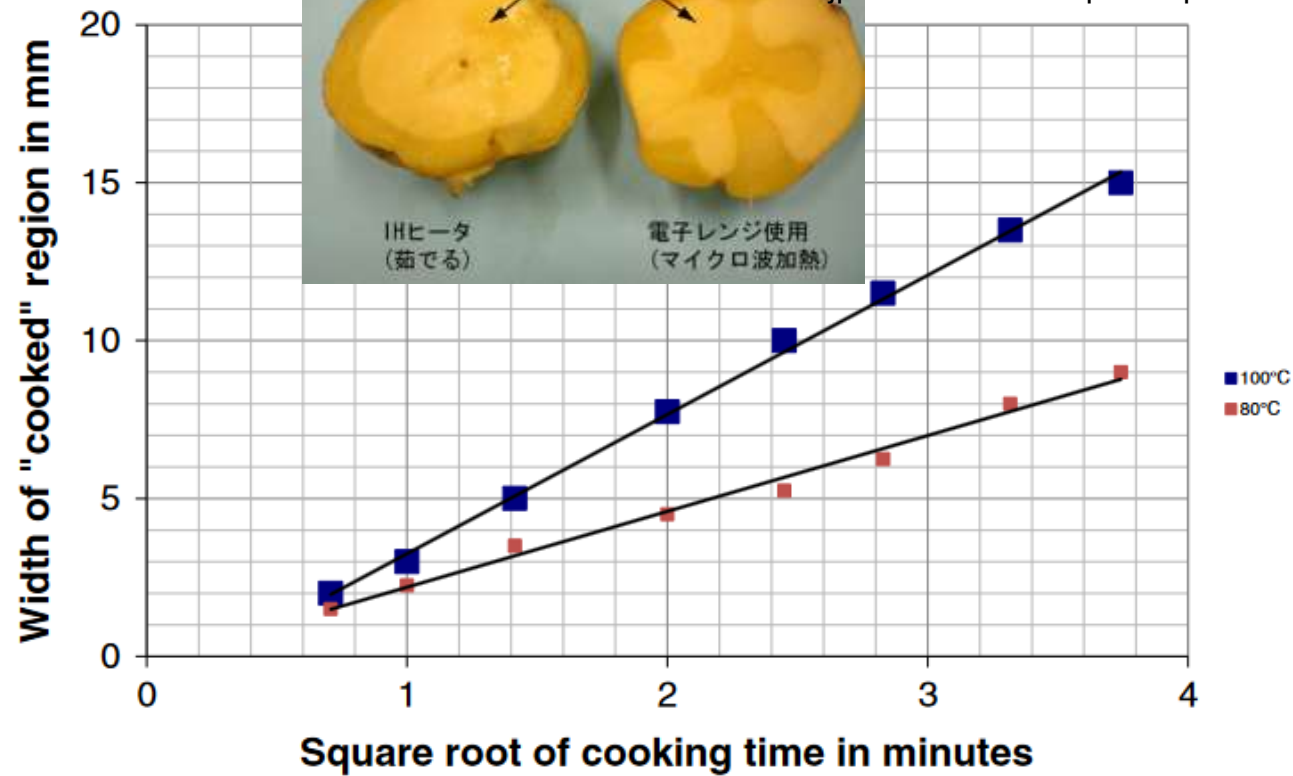


Figure 1 Cooking potatoes. Graph of the measured width of the cooked region of a potato as a function of the square root of the cooking time in minutes at two different temperatures.

そしてもしテーマが決まれば

- じぶんの研究にとっても大事なタイトルを考えよう！
- その言葉でみんながふりむいてくれるようなタイトルを考えよう！

たとえば「くもの糸の研究」

- どこまで行っても くものいと！
- スパイダーネットのひみつ！
- 糸をつむいで “三代目！”
- くももん がやってくれました！
- くも がおしえてくれたこと！
- くも はちいさな繊維工場（せんいこうじょう）
- くも VS. かいこ 強い いと はどっち？
- などなど.

研究発表の重要性（じゅうようせい）

- どんな研究をしても，それをどこかで発表しないと誰もふりむかない.
→学生科学賞など.
- 有名な研究の例を紹介.

Novel prize 2012 • Shinya Yamanaka 山中伸弥

He is a graduate of Tennoji High school
attached to Osaka-Kyoiku University



Induction of Pluripotent Stem Cells from Mouse Embryonic and Adult Fibroblast Cultures by Defined Factors

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DOI: 10.1016/j.cell.2006.07.024

SUMMARY

Differentiated cells can be reprogrammed to an embryonic-like state by transfer of nuclear contents into oocytes or by fusion with embryonic stem (ES) cells. Little is known about factors that induce this reprogramming. Here, we demonstrate induction of pluripotent stem cells from mouse embryonic or adult fibroblasts by introducing four factors, Oct3/4, Sox2, c-Myc, and Klf4, under ES cell culture conditions. Unexpectedly, Nanog was dispensable. These cells, which we designated iPS (induced pluripotent stem) cells, exhibit the morphology and growth properties of ES cells and express ES cell marker genes. Subcutaneous transplantation of iPS cells into nude mice resulted in tumors containing a variety of tissues from all three germ layers. Following injection into blastocysts, iPS cells contributed to mouse embryonic development. These data demonstrate that pluripotent stem cells can be directly generated from fibroblast cultures by the addition of only a few defined factors.

INTRODUCTION

Embryonic stem (ES) cells, which are derived from the inner cell mass of mammalian blastocysts, have the ability to grow indefinitely while maintaining pluripotency and the ability to differentiate into cells of all three germ layers (Evans and Kaufman, 1981; Martin, 1981). Human ES cells might be used to treat a host of diseases, such as Parkinson's disease, spinal cord injury, and diabetes (Thompson et al., 1998). However, there are ethical difficulties regarding the use of human embryos, as well as the problem of tissue rejection following transplantation in patients. One way to circumvent these issues is the generation of pluripotent cells directly from the patients' own cells.

Somatic cells can be reprogrammed by transferring their nuclear contents into oocytes (Wilmut et al., 1987)

or by fusion with ES cells (Cowan et al., 2005; Tada et al., 2001), indicating that unfertilized eggs and ES cells contain factors that can confer totipotency or pluripotency to somatic cells. We hypothesized that the factors that play important roles in the maintenance of ES cell identity also play pivotal roles in the induction of pluripotency in somatic cells.

Several transcription factors, including Oct3/4 (Nichols et al., 1998; Niwa et al., 2000), Sox2 (Avilion et al., 2003), and Nanog (Chambers et al., 2003; Mitsui et al., 2003), function in the maintenance of pluripotency in both early embryos and ES cells. Several genes that are frequently upregulated in tumors, such as *Stat3* (Matsuda et al., 1999; Niwa et al., 1998), *E-Ras* (Takahashi et al., 2003), *c-myc* (Cartwright et al., 2005; Kikuchi et al., 2005), and *l-catenin* (Kleiman et al., 2002; Sato et al., 2004), have been shown to contribute to the long-term maintenance of the ES cell phenotype and the rapid proliferation of ES cells in culture. In addition, we have identified several other genes that are specifically expressed in ES cells (Miyazawa et al., 2005; Mitsui et al., 2003).

In this study, we examined whether these factors could induce pluripotency in somatic cells. By combining four selected factors, we were able to generate pluripotent cells, which we call induced pluripotent stem (iPS) cells, directly from mouse embryonic or adult fibroblast cultures.

RESULTS

We selected 24 genes as candidates for factors that induce pluripotency in somatic cells, based on our hypothesis that such factors also play pivotal roles in the maintenance of ES cell identity (see Table S1 in the Supplemental Data available with this article online). For *l-catenin*, *c-Myc*, and *Stat3*, we used active forms, *Δ33Y-Δ-catenin* (Sadok et al., 2002), *T58A-c-Myc* (Cheng et al., 2000), and *Stat3-C* (Bromberg et al., 1998), respectively. Because of the reported negative effect of *Grb2* on pluripotency (Burdon et al., 1999; Cheng et al., 1998), we included its dominant-negative mutant *Grb2ΔSH2* (Miyamoto et al., 2004) as 1 of the 24 candidates.

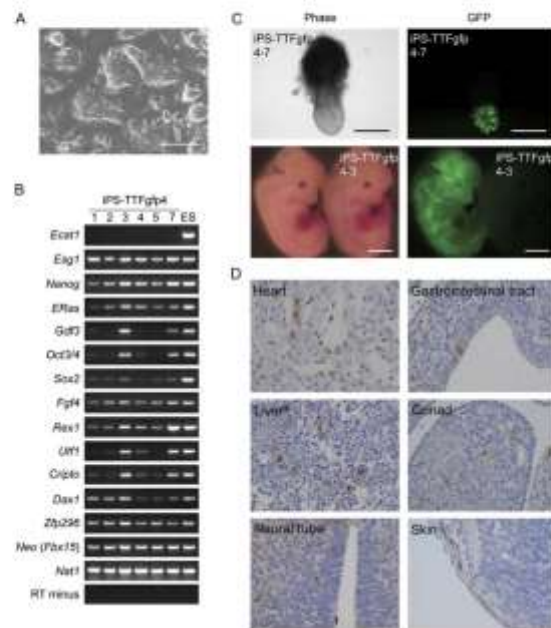


Figure 6. Characterization of iPS Cells Derived from Adult Mouse Tail-Tip Fibroblasts

(A) Morphology of iPS-TTFgp4-5 on STO feeder cells. (B) RT-PCR analysis of ES marker gene expression in iPS-TTFgp4 cells (clones 1–5 and T). We used primer sets that amplified endogenous but not transgenic transcripts. (C) Contribution of iPS-TTFgp4-7 and iPS-TTFgp4-3 cells to mouse embryonic development. iPS cells were microinjected into C57BL/6 blastocysts. Embryos were analyzed with a fluorescence microscope at E7.5 (upper panels, iPS-TTFgp4-7) or E13.5 (lower panels, iPS-TTFgp4-3). Scale bars: 250 μ m (upper panels) and 2 mm (lower panels). (D) The E13.5 chimeric embryo was sectioned and stained with anti-GFP antibody (brown). Cells were counterstained with eosin (blue).

showed that iPS-TTFgp4wt cells also expressed most of the ES cell marker genes (Figure S6).

We transplanted 2 iPS-TTF4 and 6 iPS-TTFgp4 clones into nude mice, all of which produced tumors containing tissues of all three germ layers (Table S6 and Figure S3). We then introduced 2 clones of iPS-TTFgp4 cells (clones 3 and 7) into C57BL/6 blastocysts by microinjection. With iPS-TTFgp4-3, we obtained 18 embryos at E13.5, 2 of which showed contribution of GFP-positive iPS cells (Figure 6C). Histological analyses confirmed that iPS cells

contributed to all three germ layers (Figure 6D). We observed GFP-positive cells in the gonad but could not determine whether they were germ cells or somatic cells. With iPS-TTFgp4-7, we obtained 22 embryos at E7.5, 3 of which were positive for GFP. With the 2 clones, we had 27 pups born, but none of them were chimeric mice. In addition, iPS-TTFgp4 cells could differentiate into all three germ layers *in vitro* (Figure S7). These data demonstrate that the four selected factors could induce pluripotent cells from adult mouse fibroblast cultures.

2002年ノーベル化学賞：田中耕一

彼は受賞当時、博士号を持たない企業の研究者であった。ノーベル賞選考委員会が着目したのは、正式な論文ではなく日本と中国の合同学会に提出した、たった4ページの簡単な報告であった。



DETECTION OF HIGH MASS MOLECULES BY LASER DESORPTION TIME-OF-FLIGHT MASS SPECTROMETRY

Keiichi Tanaka, Yutaka Ido, Satoshi Akita, Yeshikazu Yoshida and Tamio Yoshida

Central Research Laboratory, Shimadzu Corporation, 1 Nissinokyo-Kuwabaracho, Nakagyo-ku, Kyoto 604, Japan

[Introduction]

The laser desorption time-of-flight mass spectrometer has been developed in order to analyze non-volatile, thermally labile and high mass organic molecules. In this spectrometer we have made improvements on all stages of mass spectrometer (ion source, mass separation, detector, electronics).

[Equipment]

The construction of the laser desorption time-of-flight mass analyzer is shown in Fig.1. Figure 2 shows the block diagram of TOF spectrum measurement system.

-- Ion source --

N₂ laser (Wavelength:337nm, Pulse width:about 15nsec, Pulse energy:4mJ Max.) was used for ionization. "Rapid heating" [1] is achieved by irradiating pulsed laser on sample surface. As for sample preparation, "Ultra fine metal powder (UFP) and glycerol matrix method" was found to be very effective for increasing the yield of high mass molecular ions, and decreasing the yield of fragment ions[2].

In comparison with Bulk, UFP has the following features

- High photo-absorption
- Low heat capacity
- Extremely large surface area per unit volume

This UFP matrix method seemed to enhance the speed of heating even further.

-- Mass separation --

Generally, TOF-MS has the following characteristics

- Very high transmission
- Measurement time of less than a few hundreds μsec

DETECTION OF HIGH MASS MOLECULES BY LASER DESORPTION TIME-OF-FLIGHT MASS SPECTROMETRY

Low mass resolution

A new gradient-electric field ion reflector for a time-of-flight mass spectrometer has been developed in order to improve mass spectral resolution by energy focusing [3]. In the TOF mass spectrometer consisting of a free ion drift region and a new ion reflector, the motion of the same m/z ions is quasi-single oscillation of the same period. Therefore, the flight-times of the same m/z ions are focused to a constant even if the initial kinetic energy of the emitted ions are scattered.

The TOF mass separation system was designed to permit easy switching between "Reflector type" (V₀>V₁) and "Linear type" (V₀=0).

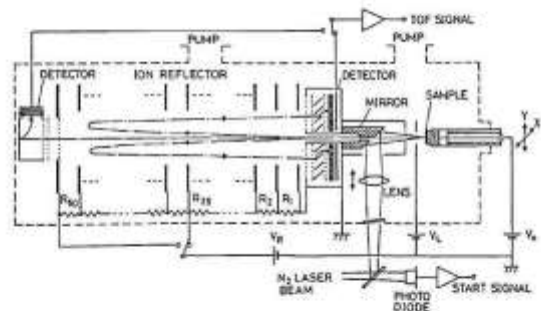


Fig. 1. Construction of the Laser Desorption TOF Mass Analyzer.

-- Detector --

Micro channel plate (MCP) or secondary electron multiplier (SEM) is usually used to detect ions, electrons or photons. Ions of larger m/z generally have low velocities in TOF-MS. So the detection sensitivity of MCP has a tendency to decrease in higher mass regions.

Higher detection sensitivity for high mass ions was

ここで休憩！

きょうの実験！

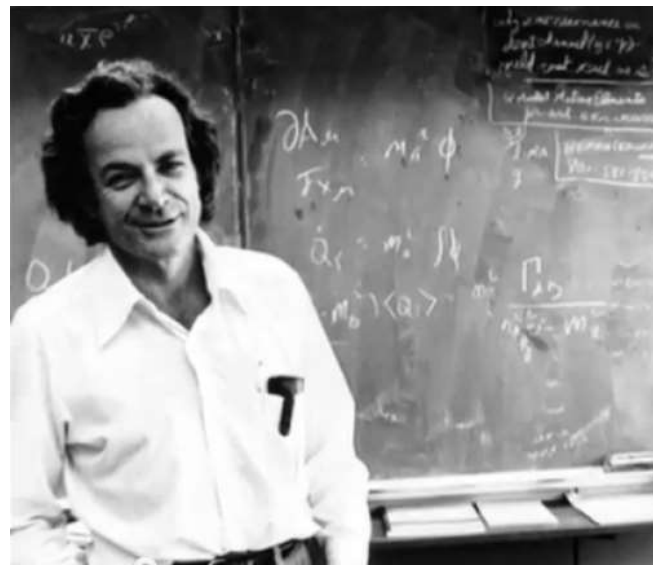
スパゲティを折るとどうなるか？

- 2006年のイグ・ノーベル賞！

有名な物理学者ファインマン先生のぎもん

折れた本数

折れた破片の長さを測定



Fragmentation of Rods by Cascading Cracks: Why Spaghetti Does Not Break in Half

Basile Audoly and Sébastien Neukirch

Laboratoire de Modélisation en Mécanique, CNRS/Université Paris VI, 4 place Jussieu, Paris, France

(Received 22 December 2004; published 25 August 2005)

When thin brittle rods such as dry spaghetti pasta are bent beyond their limit curvature, they often break into more than two pieces, typically three or four. With the aim of understanding these multiple breakings, we study the dynamics of a bent rod that is suddenly released at one end. We find that the sudden relaxation of the curvature at this end leads to a burst of flexural waves, whose dynamics are described by a self-similar solution with no adjustable parameters. These flexural waves locally *increase* the curvature in the rod, and we argue that this counterintuitive mechanism is responsible for the fragmentation of brittle rods under bending. A simple experiment supporting the claim is presented.

DOI: 10.1103/PhysRevLett.95.095505

PACS numbers: 62.20.Mk, 46.50.+a, 46.70.De

The physical process of fragmentation is relevant to several areas of science and technology. Because different physical phenomena are at work during the fragmentation of a solid body, it has mainly been studied from a statistical viewpoint [1–5]. Nevertheless, a growing amount of works have included physical considerations: surface energy contributions [6], nucleation and growth properties of the fracture process [7], elastic buckling [8,9], and stress wave propagation [10]. Usually, in dynamic fragmentation, the abrupt application of fracturing forces (e.g., by an impact) triggers numerous elementary breaking processes, making a statistical study of the fragment sizes possible. This is in contrast to quasistatic fragmentation where a

advance. In the model problem, the rod is initially uniformly bent and at rest. This is achieved by clamping one end and applying a moment M_0 at the other end: M_0 plays the role of the internal moment transmitted across the section that is about to fail; see Fig. 1. At time $t = 0$, this end is suddenly released as the applied moment M_0 is removed instantaneously. The rod no longer is in equilibrium, and we study its subsequent dynamics.

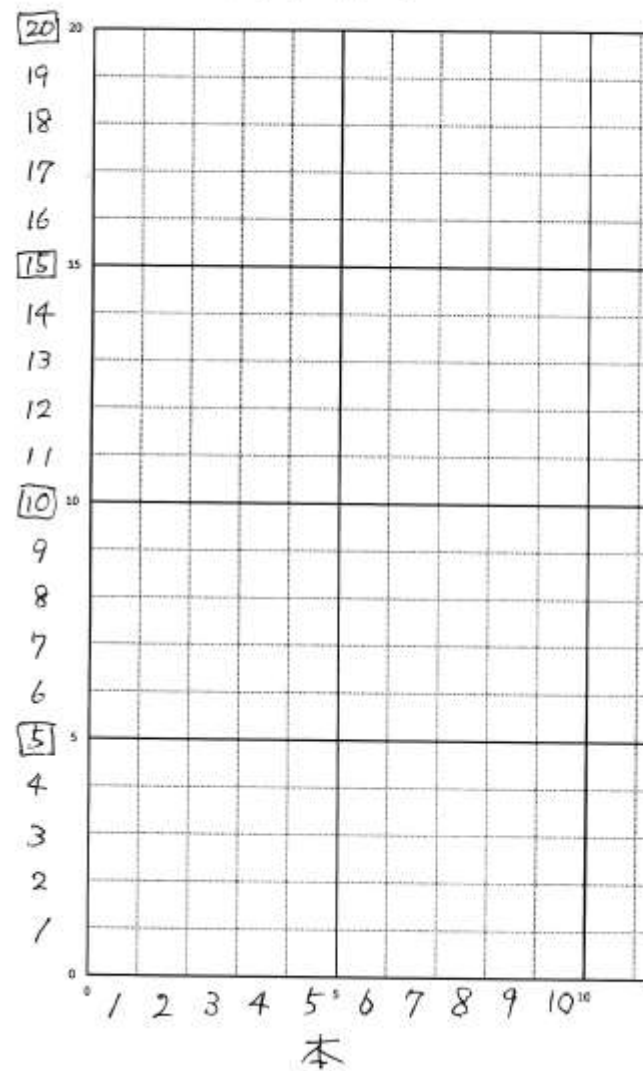
The dynamics of thin rods are described by the celebrated Kirchhoff equations [13], which in the limit of small, planar deflections take the form

$$L^4 \kappa_{,s^4}(s, t) + T^2 \kappa_{,t^2}(s, t) = 0, \quad (1)$$

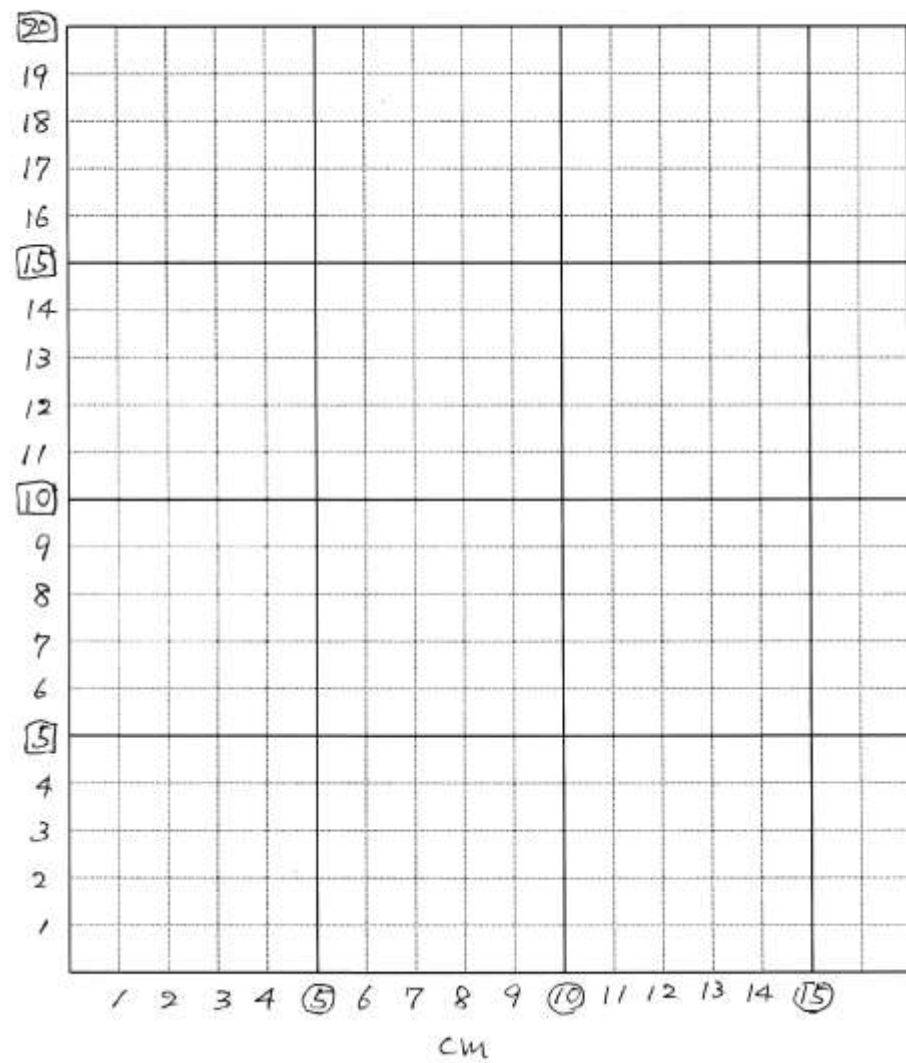
スパゲティを折った結果を調べて
みよう！

- 何本に折れたか
- 何cmに折れたか

折入本数

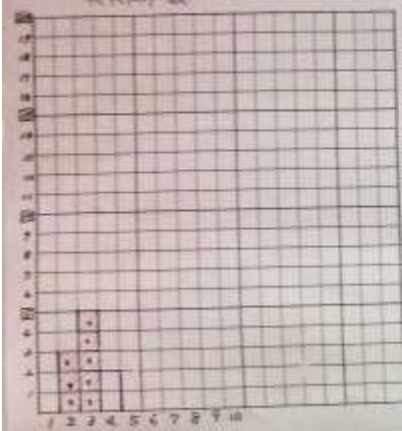


折入長さ



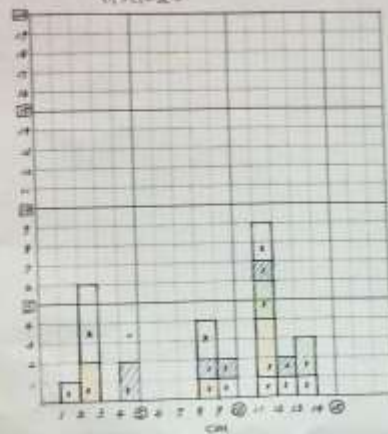
手帳

折れ本数



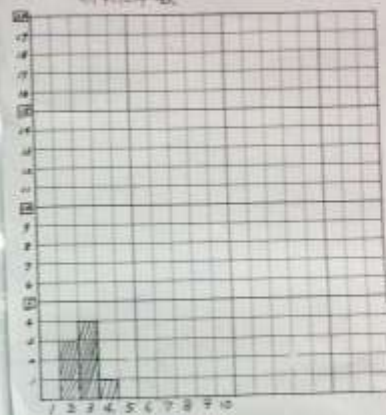
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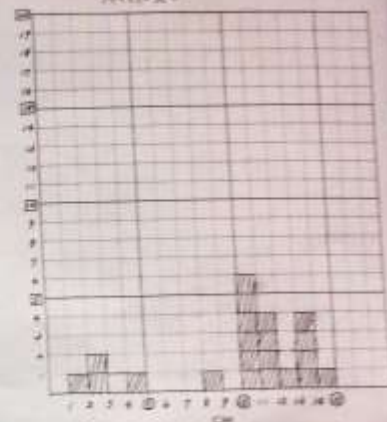
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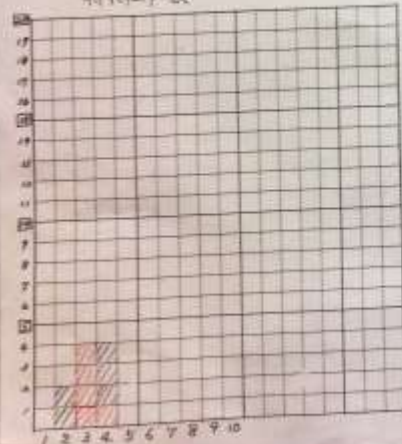
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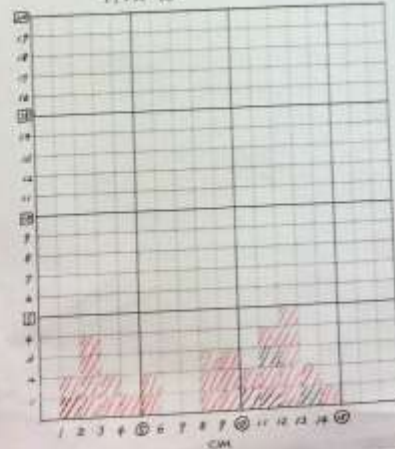
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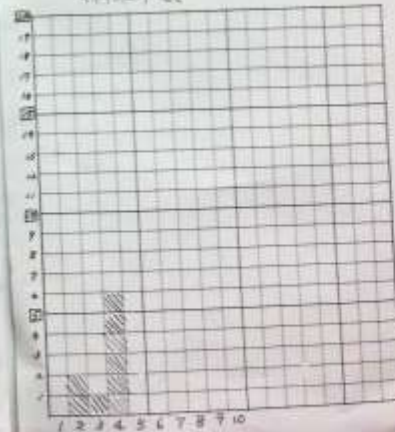
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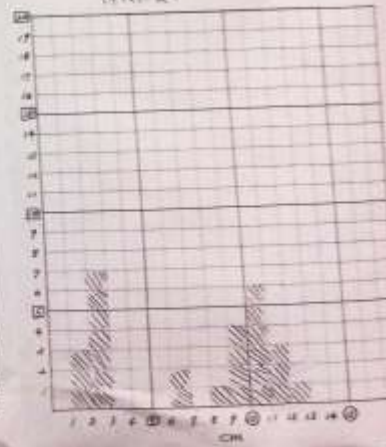
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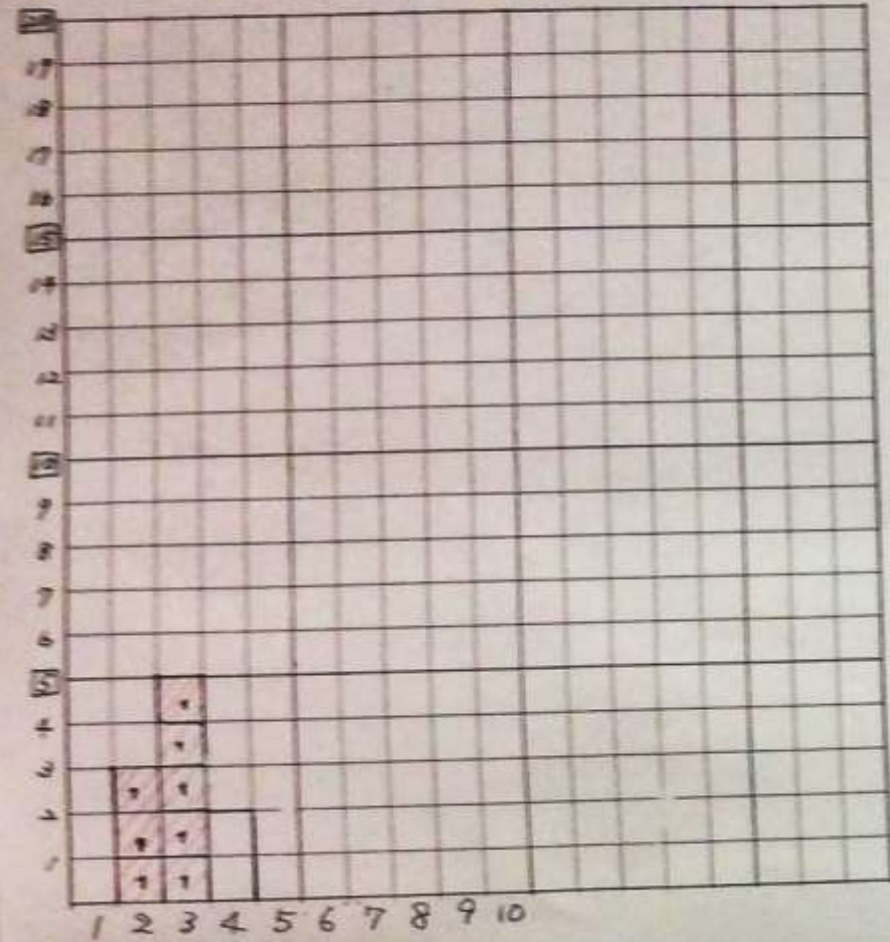
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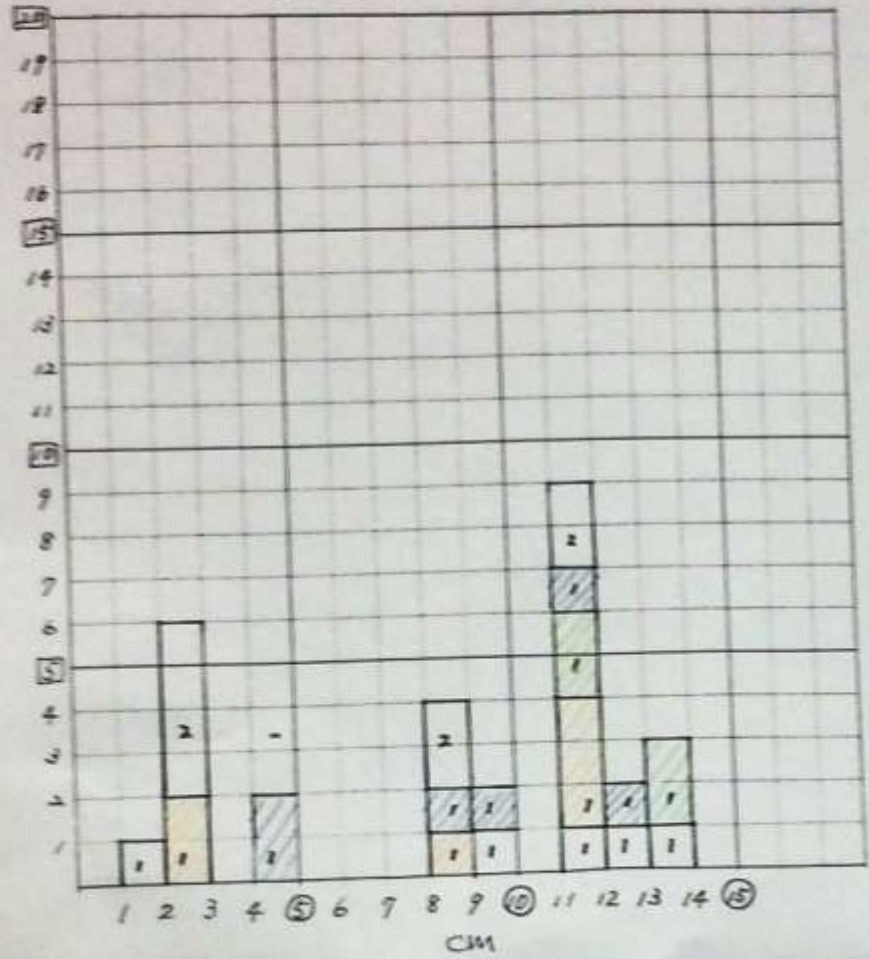
子虫史

正折れた本数



本

正折れた長寸



CM

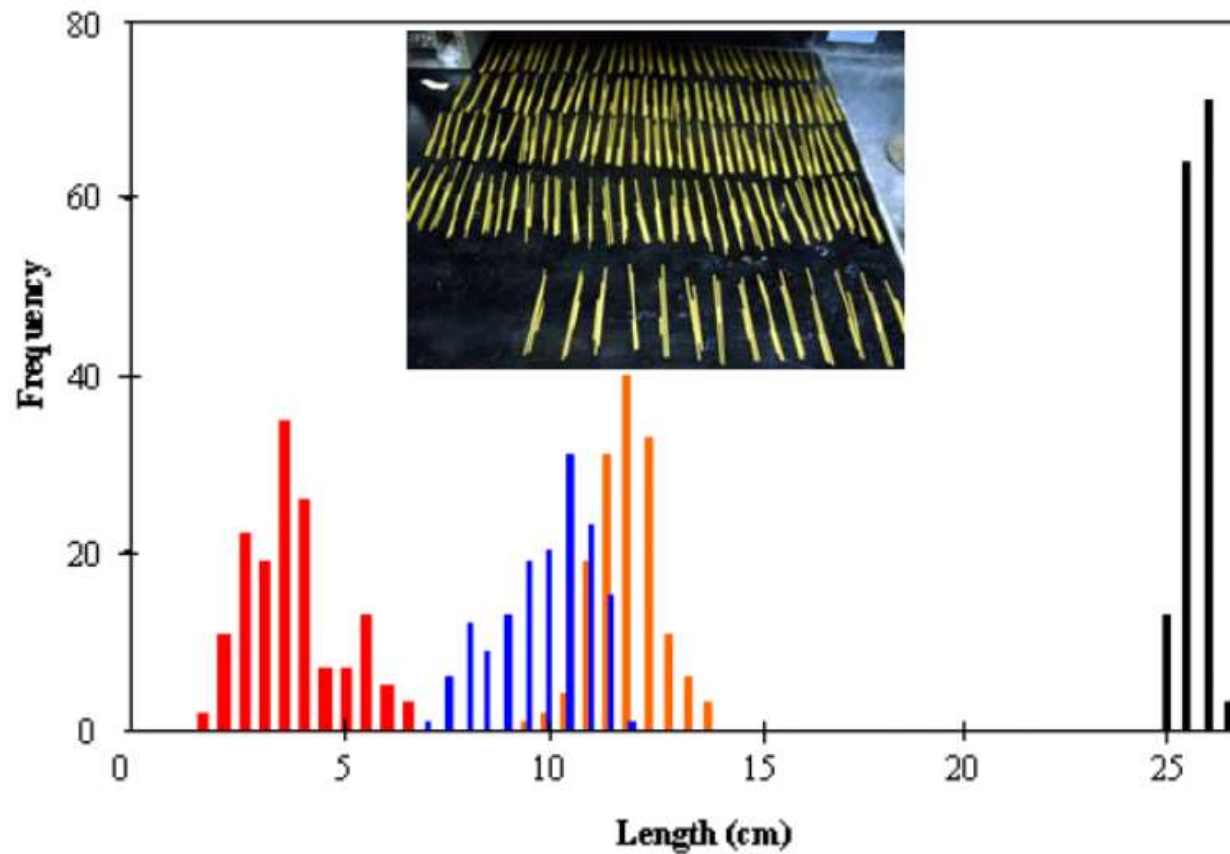


Figure 4.13 Length distribution of spaghetti noodles before (black) and after (red, blue and orange) fracture into three pieces.

[From Zaziski 2003; pages 83–84]

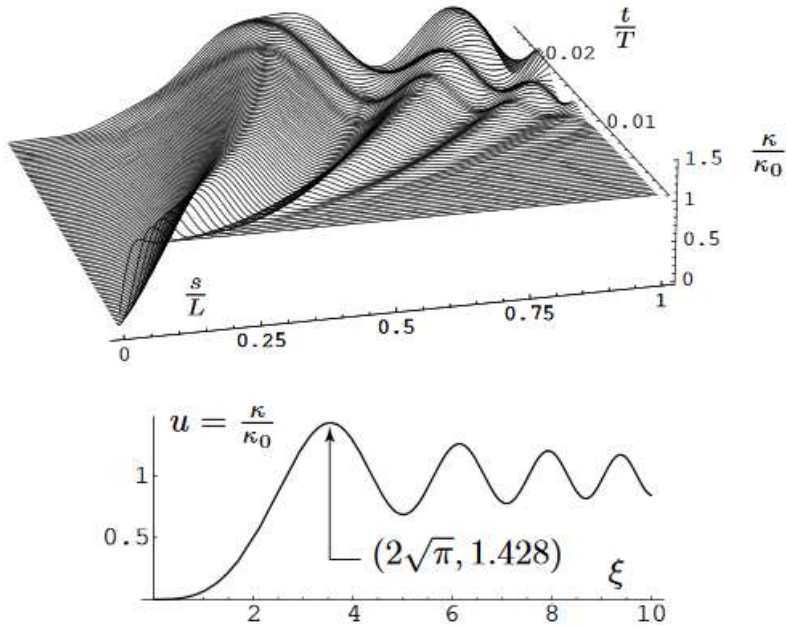


FIG. 2: *Top*: numerical solution of the nonlinear Kirchhoff equations for an initial half-circle configuration, $\kappa_0 = \pi/L$. The curvature at the free end $\kappa(0,t)$ relaxes to zero within the first few time steps (inner solution of the boundary layer problem) while it is given in the intermediate regime (2) by the universal self-similar solution (4) (outer solution). At later times, for $t \sim T$, reflections take place on the clamped end $s = L$. *Bottom*: self-similar solution describing the intermediate regime with $\xi = s/\sqrt{\gamma t}$.

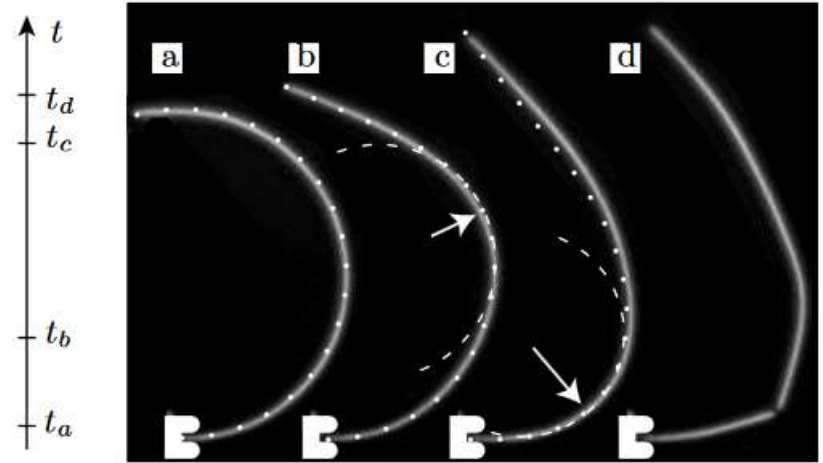
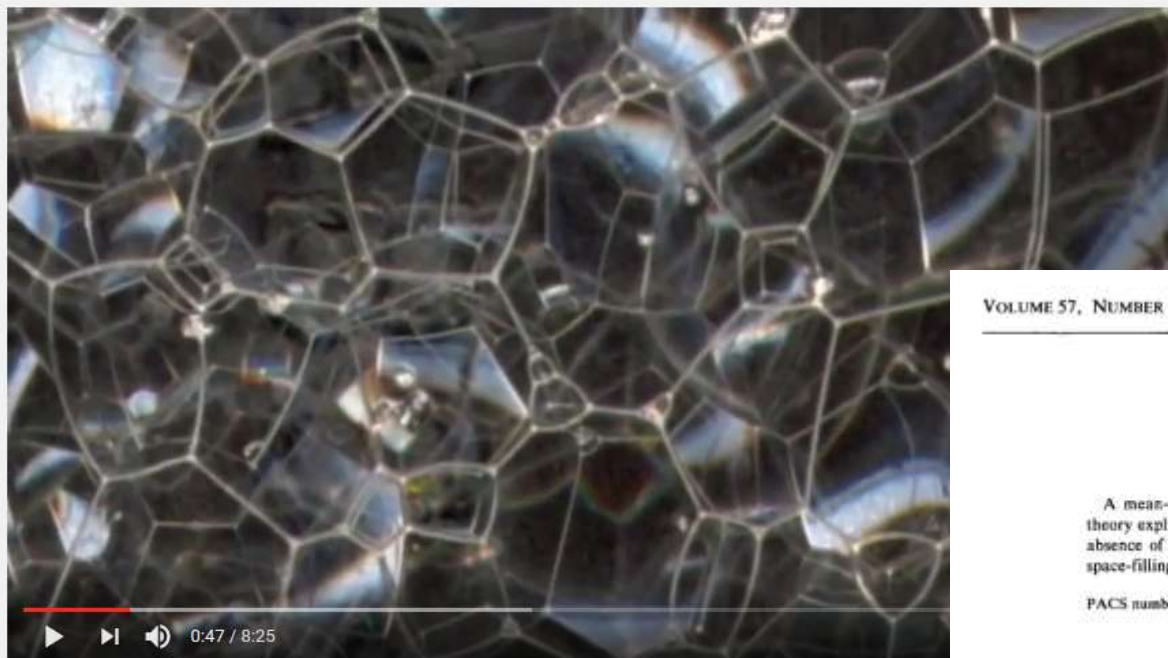


FIG. 3: A dry spaghetti can be broken by releasing one of its ends. The pasta is first bent into an arc of circle with a curvature slightly below its limit curvature. The lower end is clamped. The upper one is suddenly set free at time $t_a = 0$. Selected frames shot with a fast camera at 1000 Hz: (a) release $t_a = 0$, (b) intermediate frame $t_b = 0.0159 T$, (c) frame just before rupture $t_c = 0.0509 T$, and (d) after rupture $t_d = 0.0596 T$. Numerical simulations based on the nonlinear Kirchhoff equations are superimposed, without any adjustable parameters: rod profile (dotted line) and osculating circle (dashed lines) at the point of largest curvature (arrow). Note that the rod breaks at the point of maximal curvature.

面白い例



▶ ⏮ 🔊 0:47 / 8:25

Foam Physics - Sixty Symbols



Sixty Symbols



64.5万

+ 追加 ➦ 共有 ... その他

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Evolution of Two-Dimensional Soap-Film Networks

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A mean-field theory is presented for the coarsening of a two-dimensional soap-film network. This theory explains (1) the correlation between area and number of sides of the cells, and (2) the anomalous absence of dynamical scaling laws, which is shown to have its origin in the topological constraint of a space-filling network.

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Coarsening of soap froths is an interesting and familiar process in which soap cells lower their surface free energy by increasing their average size. Traditionally, metallurgists have studied this process as a model for grain growth in polycrystalline solids.¹ Recently, cellular soap-film networks have appeared in the literature on condensed matter as prototypical systems with topological disorder.² It is, in fact, the topological aspect that distinguishes this process from what is known as Ostwald ripening, which is the coarsening of precipitated grains in a solution. Whereas there one has well-separated, approximately spherical grains, here the cell shapes are constrained by the network topology: Spherical cells cannot fill space. For Ostwald ripening, a very successful mean-field theory was developed around 1960 by Lifshitz, Slyosov, and Wagner^{3,4} (LSW). To my knowledge, there is no comparable theory that incorporates the topological constraints of a network. It is the purpose of this paper to present such a mean-field theory for the coarsening of a two-dimensional soap-film net-

of an n -sided cell, one then easily derives von Neumann's law,^{4,5}

$$dA/dt = k(n-6), \quad (1)$$

with $k = (\pi/3)\sigma\mu$. The total area of the system remains constant in time, as it should, by virtue of Euler's theorem that the cells have six sides on average. The description of the network dynamics consists of two problems, which can be dealt with separately as a result of the separation of time scales mentioned above: (1) What is the relation between the area and number of sides of the cells; and (2) how does the distribution of areas evolve in time? I first turn to problem (1).

It is observed experimentally that large cells tend to have many sides. I attribute this correlation to the relatively low surface energy of a many-sided cell.¹⁰ Consider an n -sided cell bounded by a regular polygon constructed by circular arcs meeting at 120° angles. For a given length S of the cell perimeter, its area A is given by

泡の形や大きさに注目

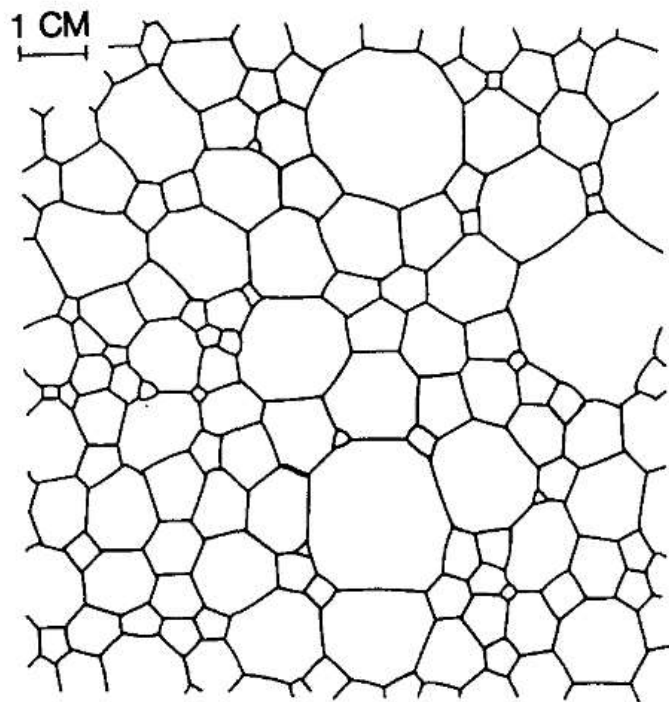


FIG. 1. Two-dimensional soap-film network, traced from an experimental photograph made by Smith (Ref. 5). The froth lies between parallel glass plates, spaced about 4 mm apart.

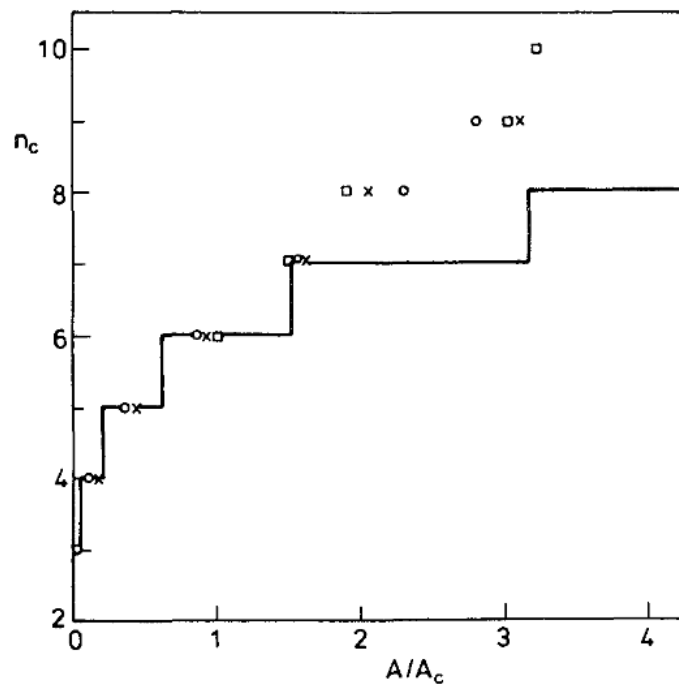


FIG. 2. Plot of the relation between cell area and number of sides, from the minimizing of expression (6). For comparison, markers show $\bar{A}(n)/\bar{A}$ as obtained in the simulation of Ref. 12. (The different markers correspond to three different networks; for $n \leq 5$, squares and circles coincide.)

ようがんのふしぎな形

- 柱状節理（ちゅうじょうせつり）





東尋坊 (とうじんぼう)



ドイツ中部
Rhon山系



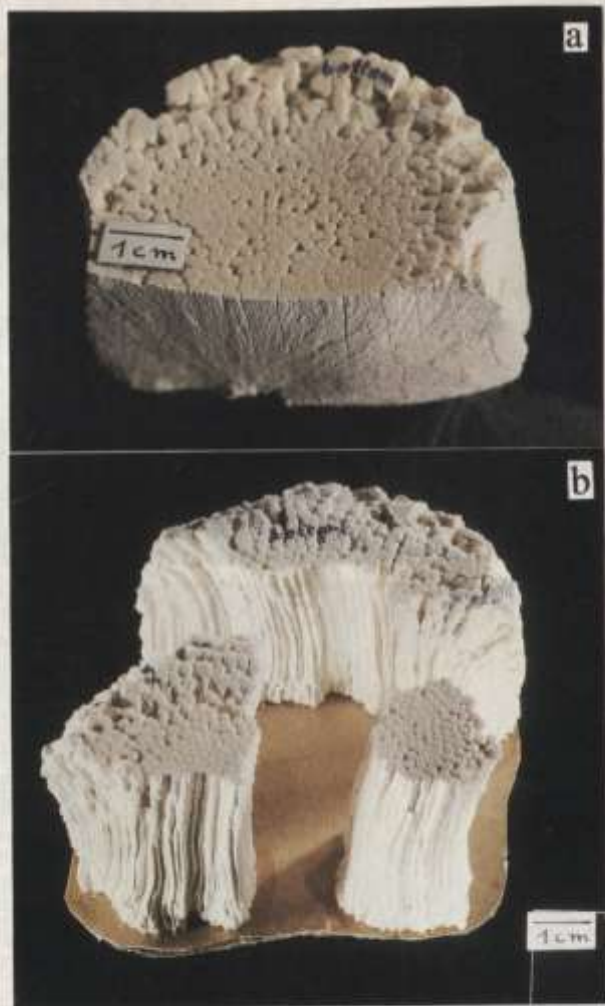


Plate 3. Thick dried-starch layers with columns. View is on the bottomsides of the specimens; lamp drying was performed from the other side. (a) Large first-generation crack visible in front, showing characteristic plumose rupture structures, radiating from the crack hypocenter at the (original) top of the specimen. (b) Specimen broken into pieces. The columns develop regularity within about 5-10 mm from the (original) top. Several cases of joining columns can be seen.

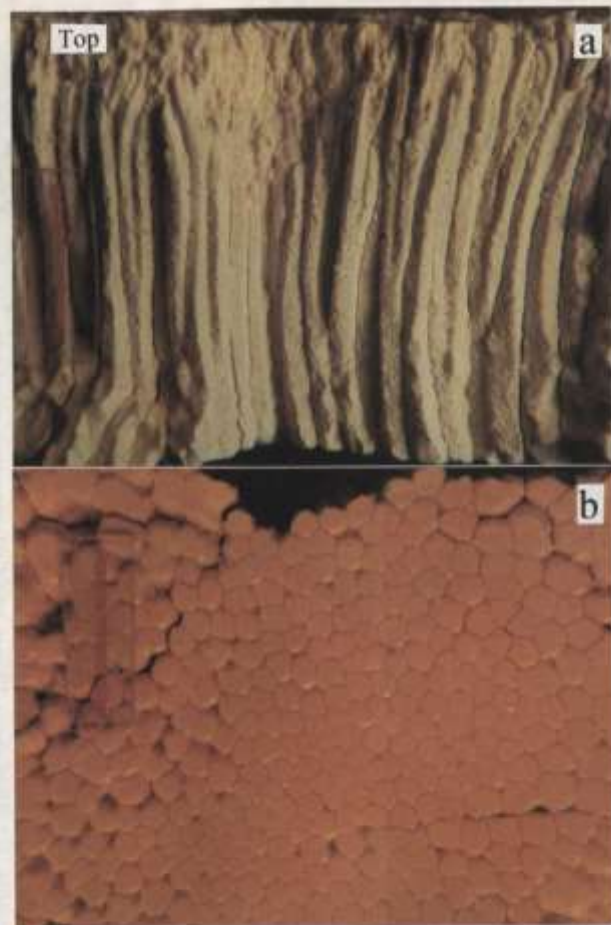


Plate 4. (a) Detailed side view and (b) bottom view of the starch columns of the same specimen (red bar is 1 cm long). The top row of columns in Plate 4b agrees with the columns in Plate 4a.

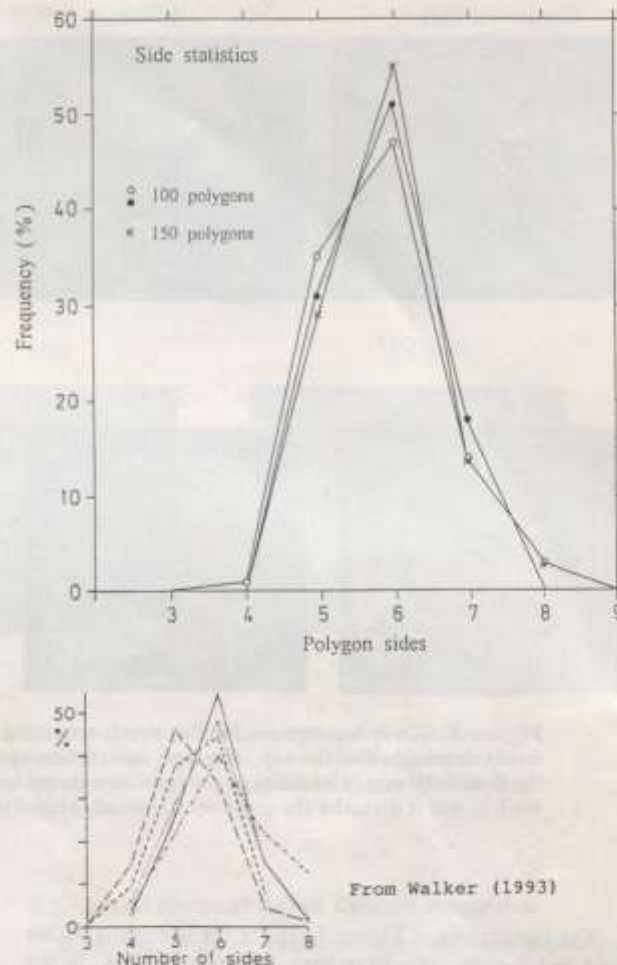


Figure 2. (top) Side statistics of the polygons in three starch specimens. (bottom) Side statistics in different basalt column locations (modified from Walker [1993]; reprinted with permission of Geological Society Publishing House).

Starch columns: Analog model for basalt columns

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Abstract: Desiccation of starch-water mixtures produces tensile-crack patterns which appear to be interesting, but largely unknown study objects for fracture mechanics, structural geology, and volcanology. This paper concentrates on columnar jointing and on patterns in starch. Starch columns have polygonal cross sections and are very similar to basalt columns. They are produced by lamp drying starch specimens with dimensions of several centimeters and have diameters in the millimeter range. The columns develop behind a crack front which propagates from the surface into the interior. The experiments, supported by X ray tomograms, show that polygonal regularity of the crack pattern is not

...is that the ratio $\Delta D / \Delta F = (e(t)/G)/(L/A)$ increases with time approaching unity, or that $e(t)/G$ increases with time and approaches the ratio L/A of total crack length L and total area A . Equivalently, L/A can be taken as the ratio of crack length and area per cell of the crack system. Then, if there is a crack system whose L/A per cell is lower than the actual L/A , there will be a trend toward such a system because less energy is required to realize it. This trend implies straightening of cracks from rugged to smooth and linear segments and a preference for polygonal cells. A crack system without preferential directions then consists necessarily of area-filling equilateral polygons, and among them equilateral hexagons have the lowest L/A ratio. This ideal configuration is, however, not reached in nature, but only a close configuration, consisting of general hexagons and the neighboring polygons, pentagons and heptagons.

6.4. Colonnade-Entablature Problem

Starch experiments so far contribute little to the solution of the colonnade-entablature problem in multitiered basalt flows, where abrupt changes from thin, irregular, non vertical columns (entablature) to thick, regular, vertical columns (colonnade) are observed, often at horizontal planes and corresponding to one (downward) cooling direction [Spry, 1962; DeGraff and Aydin, 1987]. At least some of these cases apparently can be explained by water, flowing through the newly created joints, vaporizing and efficiently cooling the basalt, thereby producing the entablature character, whereas the colonnades correspond to cooling periods without water access. An interesting question, however, is whether such changes can also occur without pronounced environmental variations and reflect transitions between two basic states of a cooling and frac-



Figure 5. Side view of a 5-m thick Icelandic lava flow which has cooled from above and below (from Walker [1993]; reprinted with permission of Geological Society Publishing House). Walker's sketch to the right illustrates the increase in column thickness and decrease in complexity into the interior of the flow from both sides.

to the details of the similarity

experiments design the one hand, help to clarify science on the other discusses simple contraction in which the analog. Section 3 desiccation water mix-



私のポリシー

- 勉強は何かを覚えることではない.
 - 手元にある材料だけで、一生懸命考える、ためしてみる.
 - 失敗の数だけ、アイデアが湧いてくる
-
- ICT, デジタル, ハイテクだけではなく、アナログ, スーパーローテクが子どもたちを育てる.
 - 非効率, 回り道こそ研究や勉強への近道

今日の講座を終えるにあたって 保護者の皆様へ

- 心理学者 岸田秀の一言
- あるお母さんから質問された。 ----
- どうすれば子供を「花を愛するやさしい子供」
に育てることができますか？

その答えはとても簡単です。「お母さん！あなたが
花を愛する、やさしい母親になれば良いのです！」