CPPS

Centre Pédagogique Prévention Séismes

Seismo @ School

Working with the SEP Seismometer

Hanspeter Meier Seismo@School

Trainings Course, Sion Oct. 2014

Working with the SEP Seismometer

A school project with 10th graders
from Bülach/Switzerland
using Geosience
in cooperation with the GLOBE-project

Trainings Course, Sion Oct. 2014

Earthquakes in Switzerland are registered since 250 A.C.

CPPS

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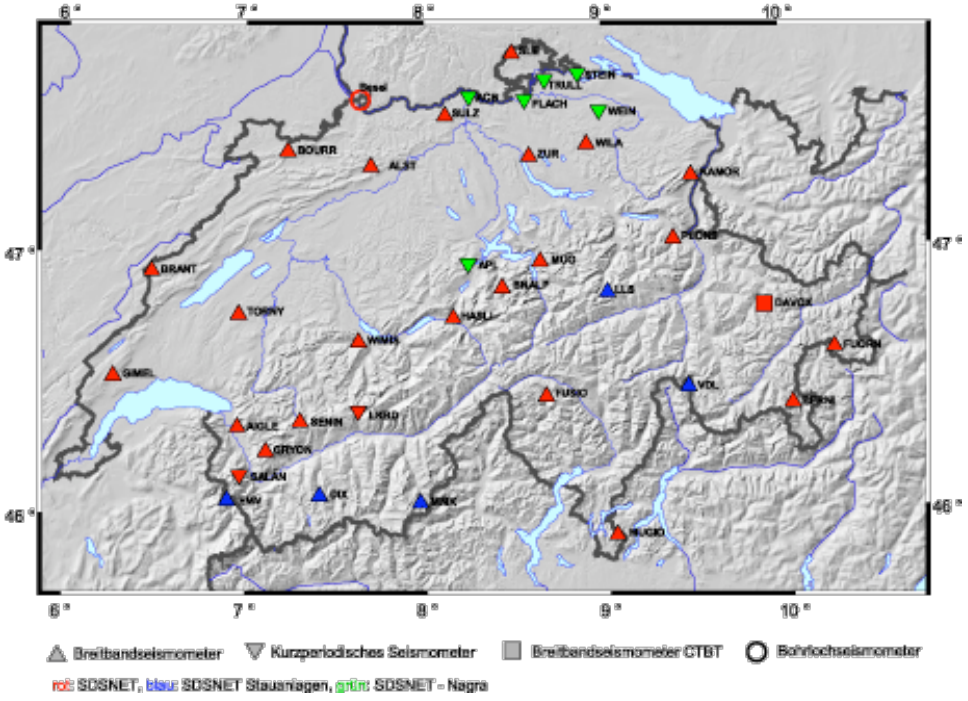
Seismo @ School

Module 1:
Understanding Theory



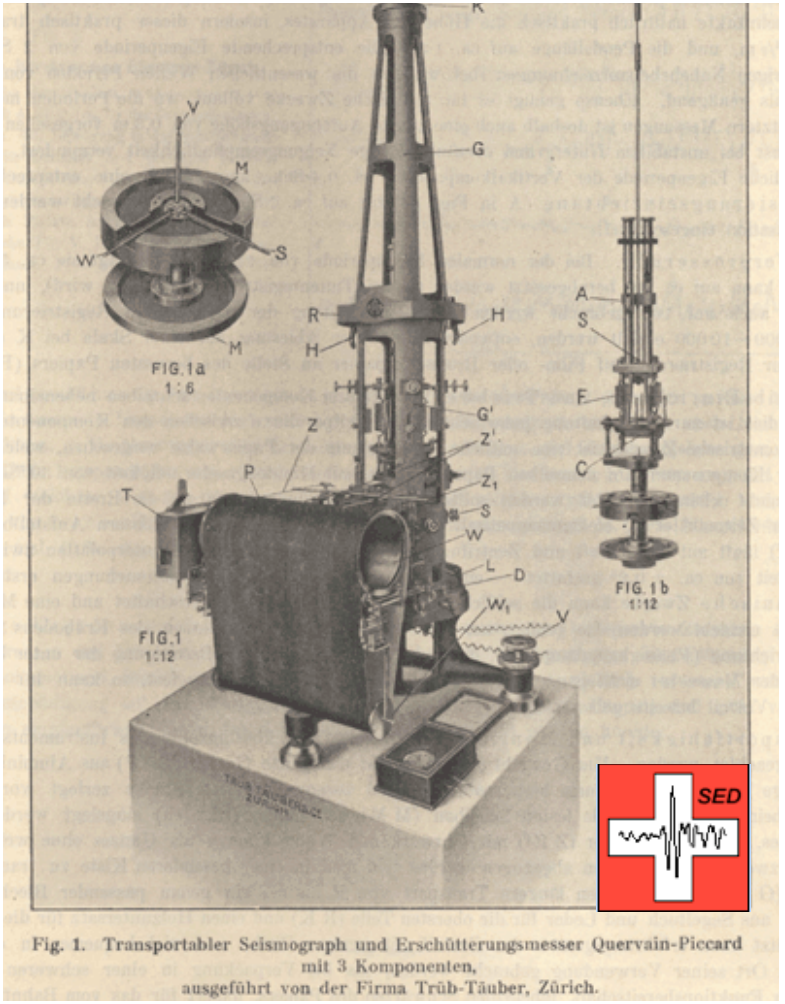
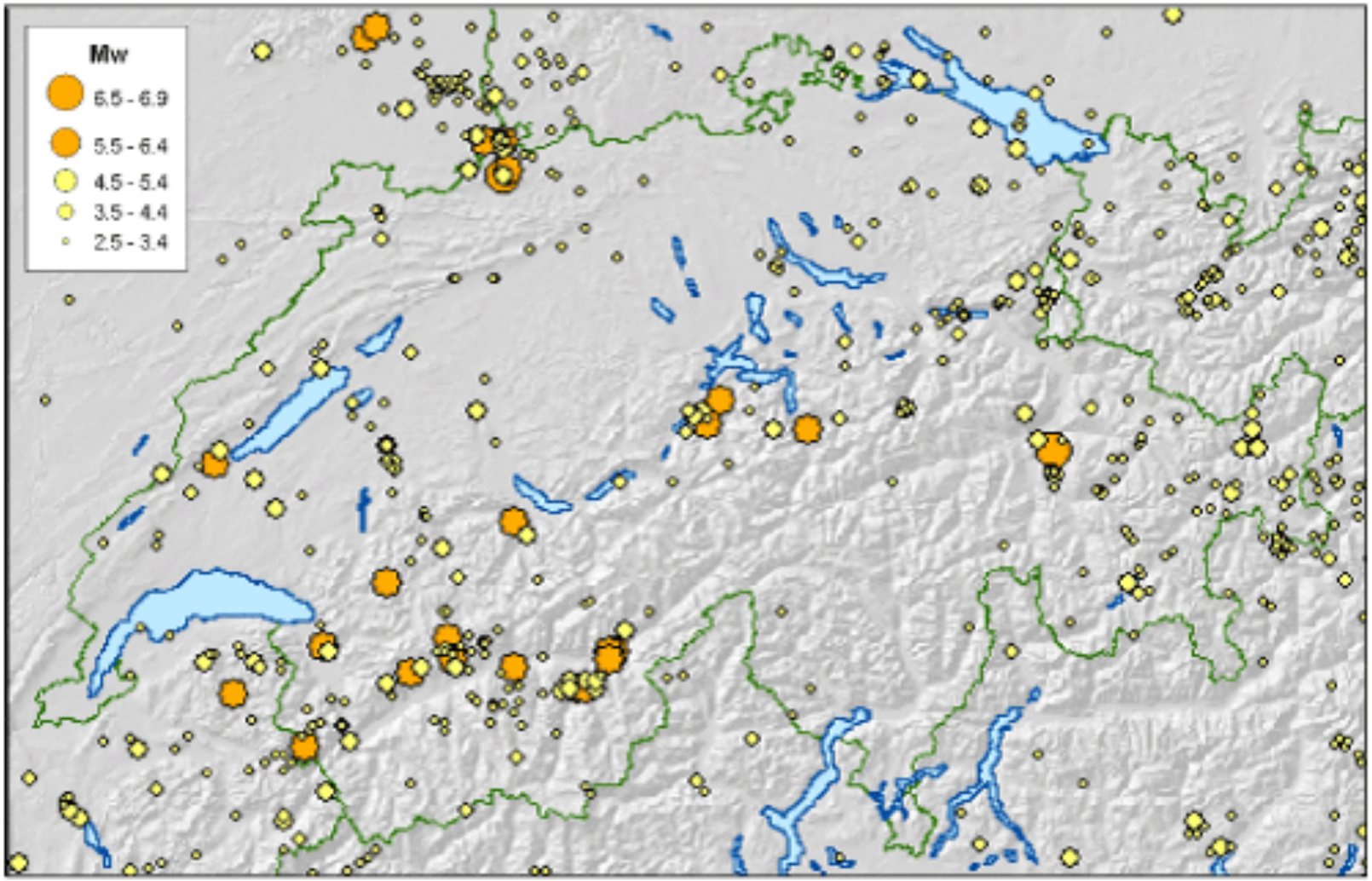


Fig. 1. Transportabler Seismograph und Erschütterungsmesser Quervain-Piccard mit 3 Komponenten, ausgeführt von der Firma Trüb-Täuber, Zürich.

Epicenter – Map of Switzerland since 1300



Seismo at School

Frequency of earthquakes

Value on Richterscale / Earthquakes per year
Typical effects of shocks in populated areas

< 3,4 / 800 000
only be registered by seismographs

3,5 - 4,2 / 30 000
by a few people felt only

4,3 - 4,8 / 4 800
felt by many people

Frequency of earthquakes

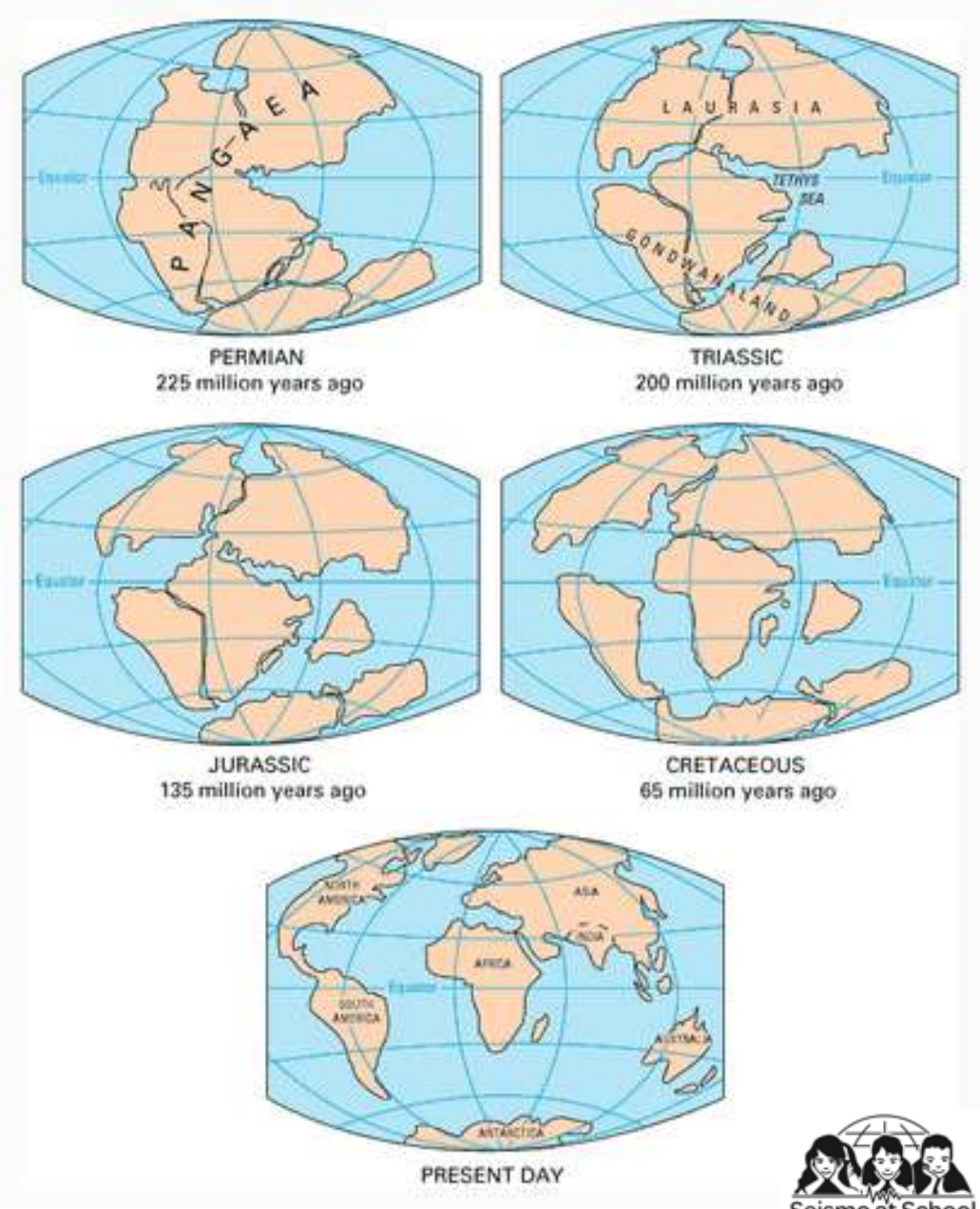
Value on Richterscale / Earthquakes per year
Typical effects of shocks in populated areas

4,9 - 5,4/ 1 400
felt by everyone

5,5 – 6,1 / 5 000
little damage to buildings

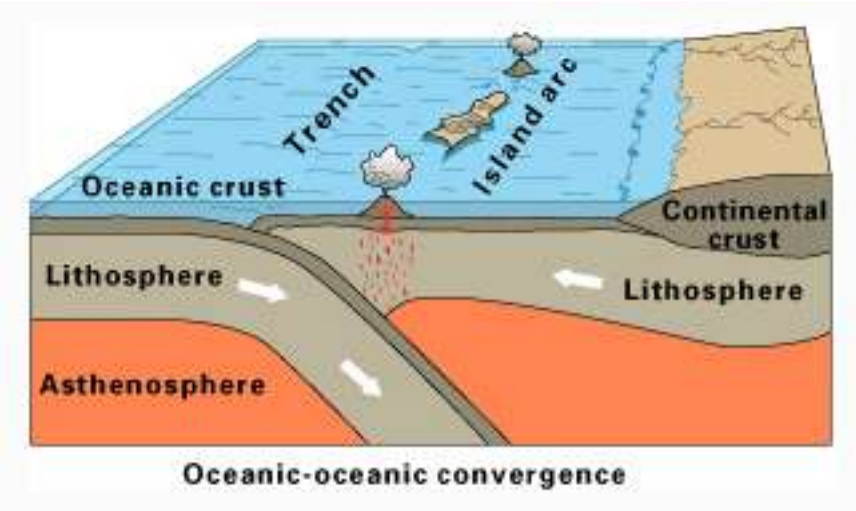
6,2 – 6,9 / 100
damage to many buildings

The continents moved for 250 millions years to reach the recent position



The collision of two tectonic plates caused by rising magma > volcanic arcs

Collision of 2 oceanic plates



Collision of an oceanic plate with a continental plate

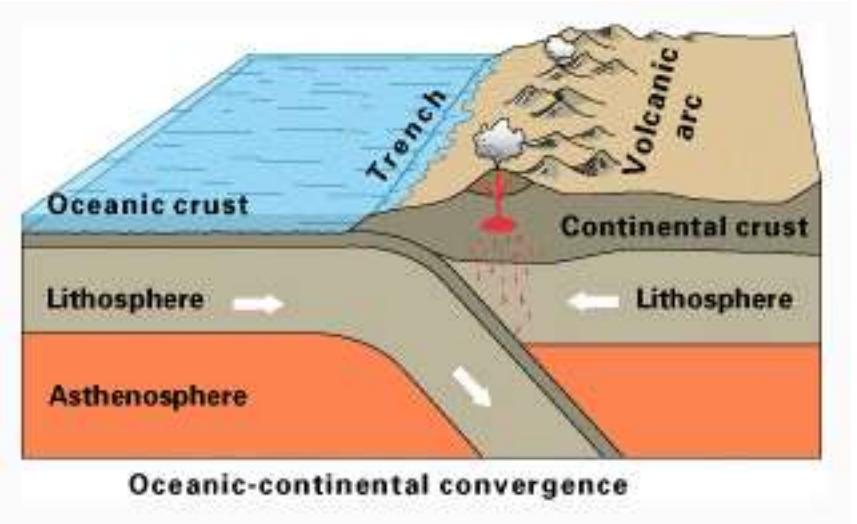
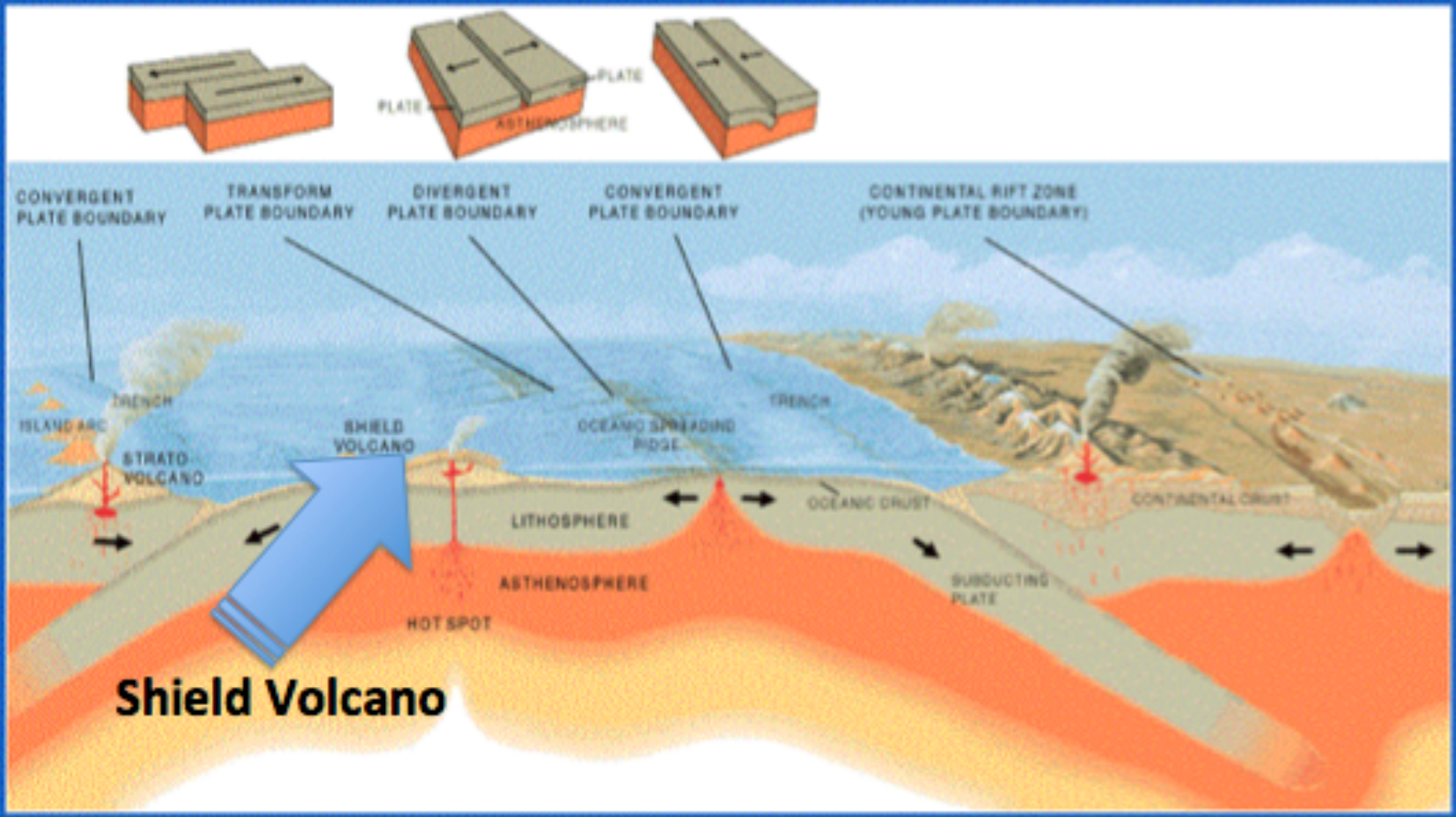


Plate Boundaries

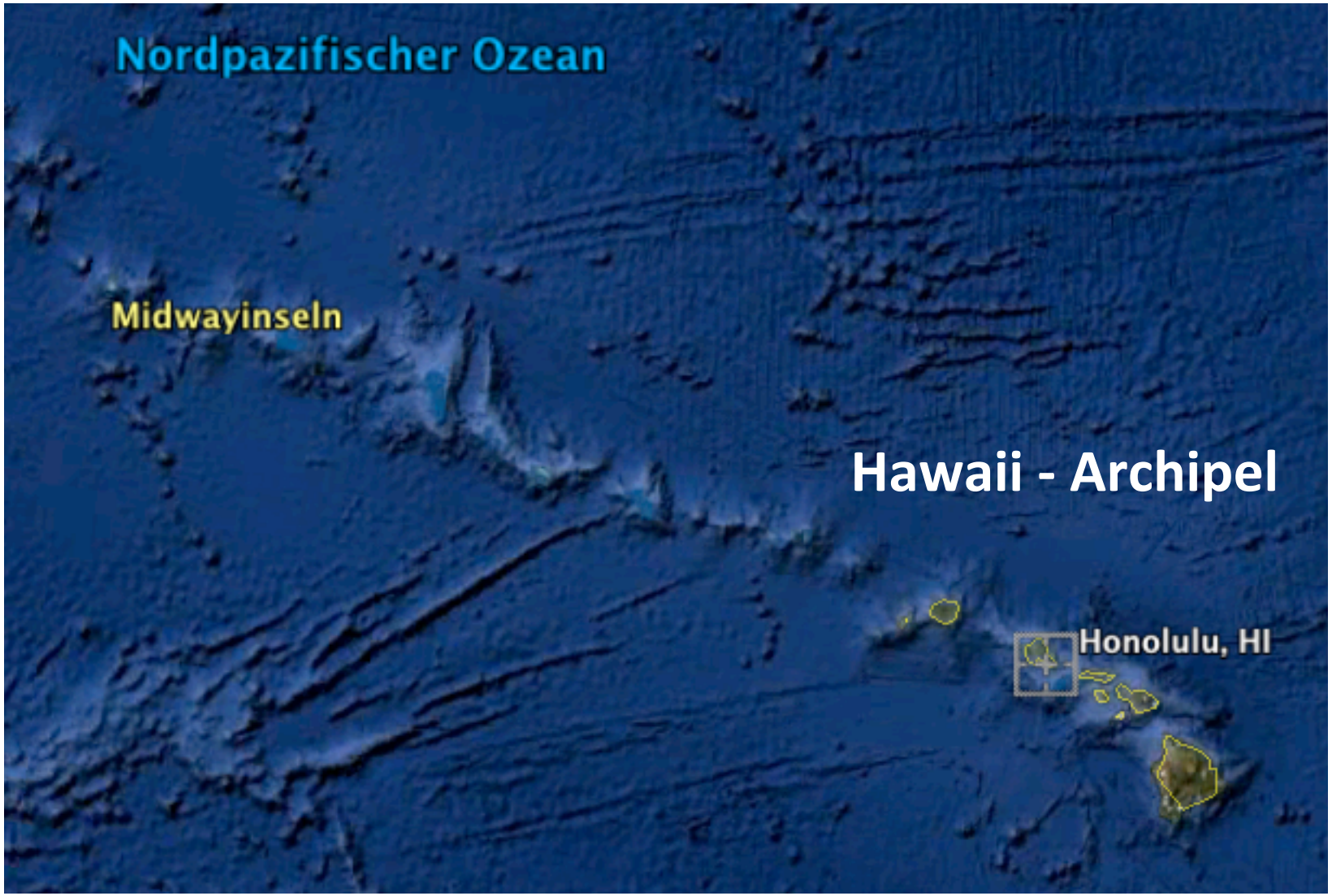


Module 2:
The Hawaiian hotspot

All the Hawaiian volcanoes, were created as the **Pacific tectonic plate** moved over the **Hawaiian hotspot** in the Earth's underlying mantle.

The Hawaii island volcanoes are the most recent evidence of this process that, over 70 million years, has created the 6,000 km - long Hawaiian–Emperor seamount chain.

en.wikipedia.org/wiki/Mauna_Loa

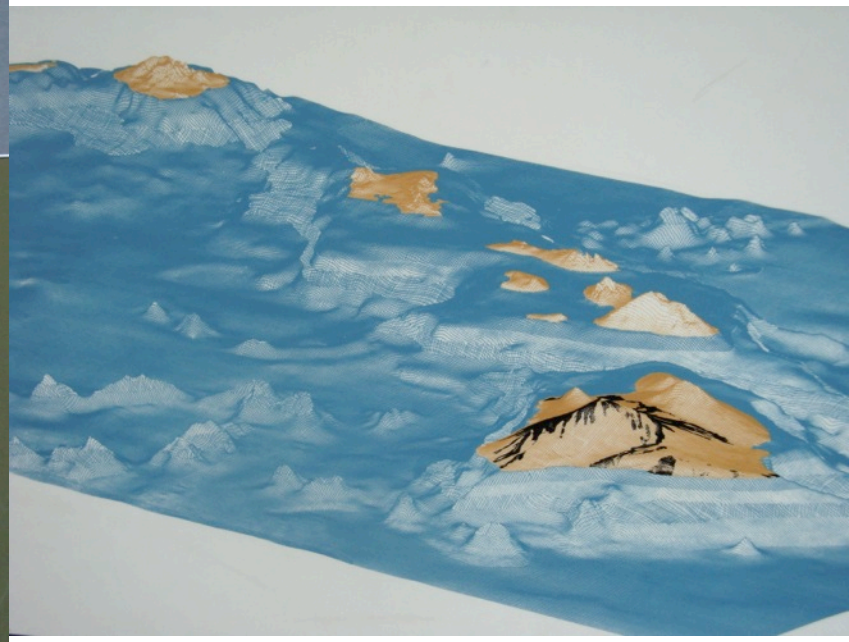


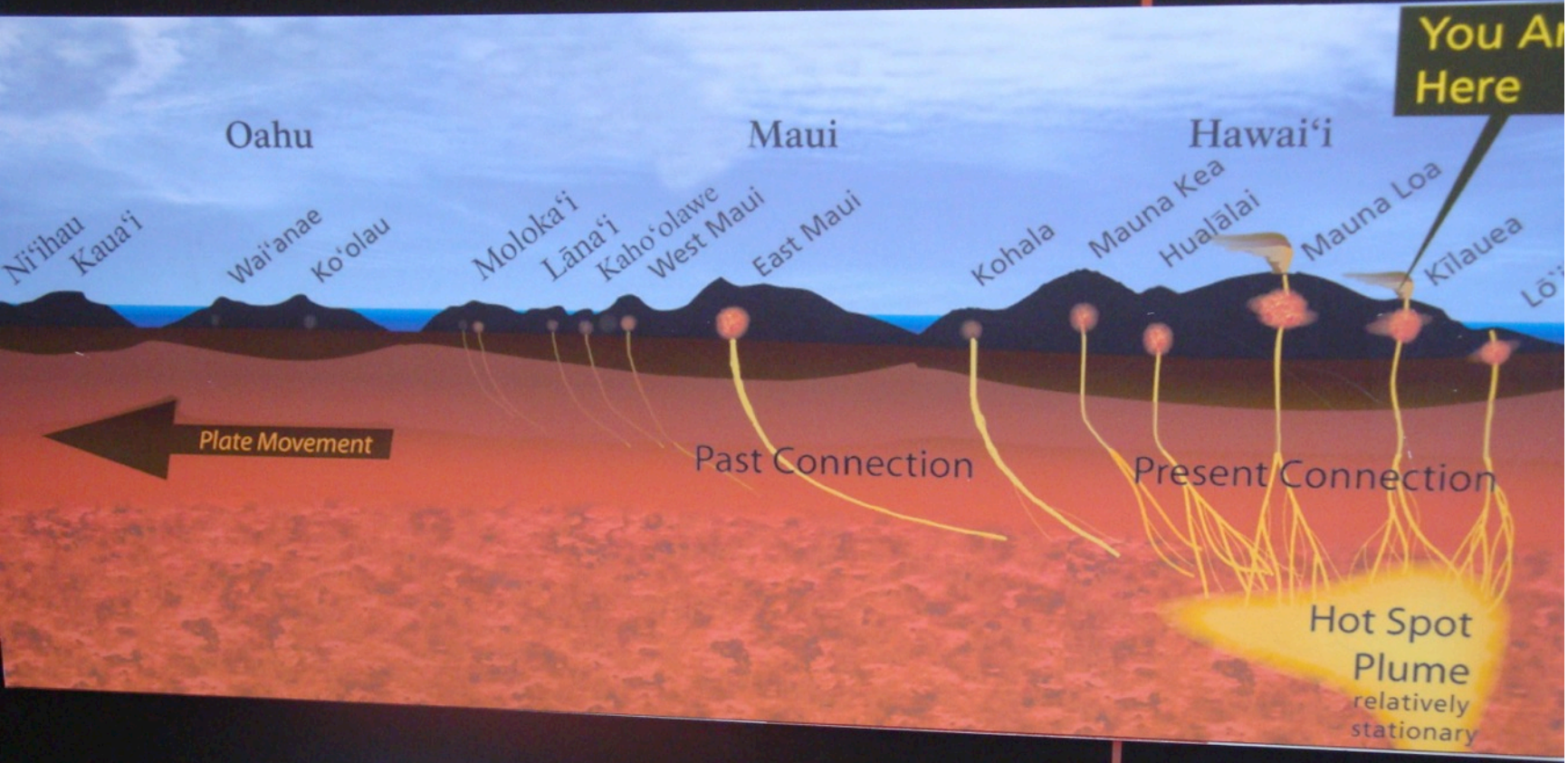
Seismo at School

Hawaii Grows

The island of Hawai'i is made up of five relatively young volcanoes. The oldest volcano is Kohala. It last erupted about 60,000 years ago. Mauna Kea (white mountain) last erupted approximately 4,600 years ago.

The three remaining volcanoes; Hualālai, Mauna Loa and Kīlauea, have all erupted in the last 250 years—Hualālai in 1801, Mauna Loa (long mountain) on March 24, 1984, and Kīlauea on January 3, 1983.





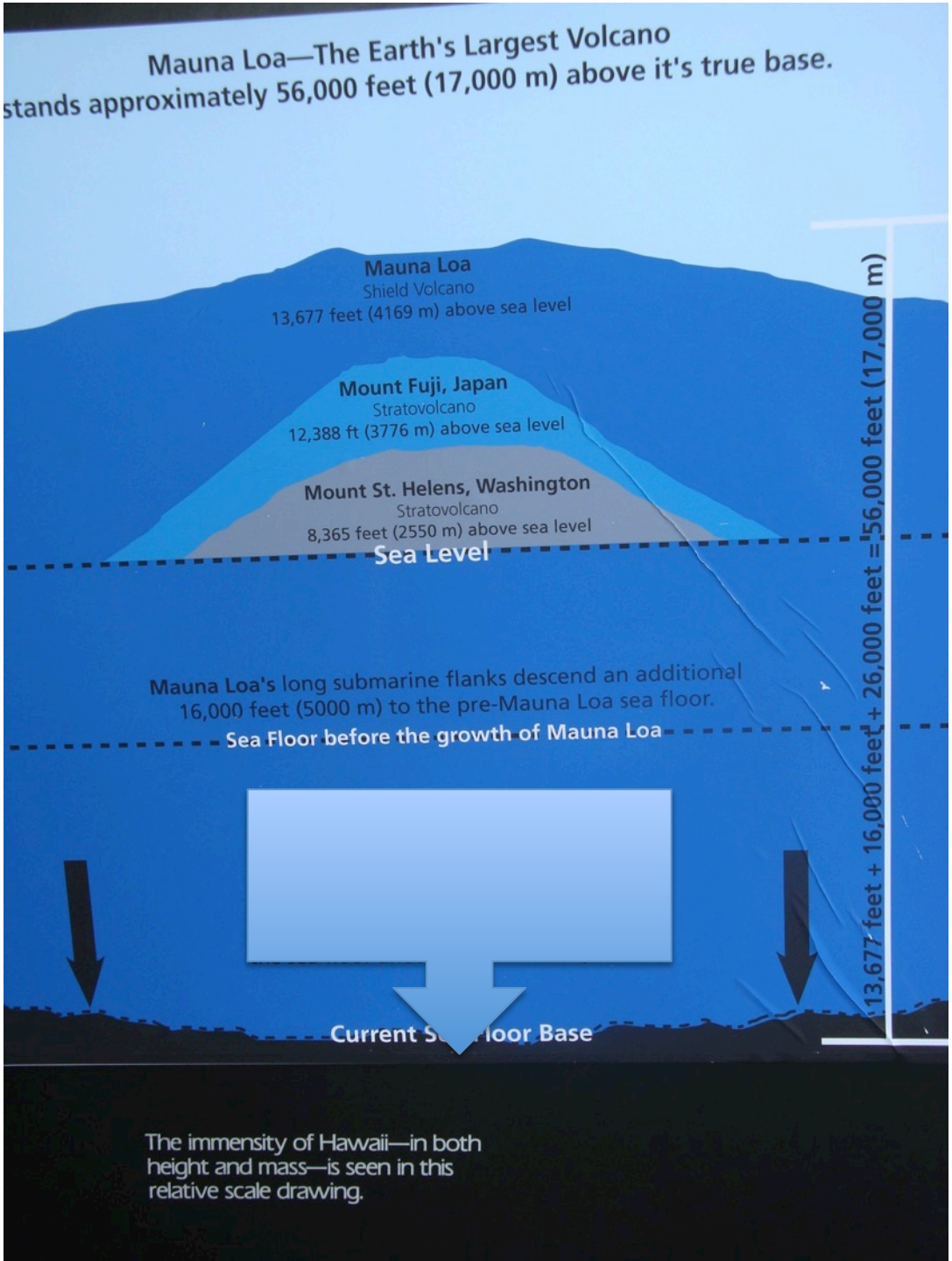
The Islands Show Their Age

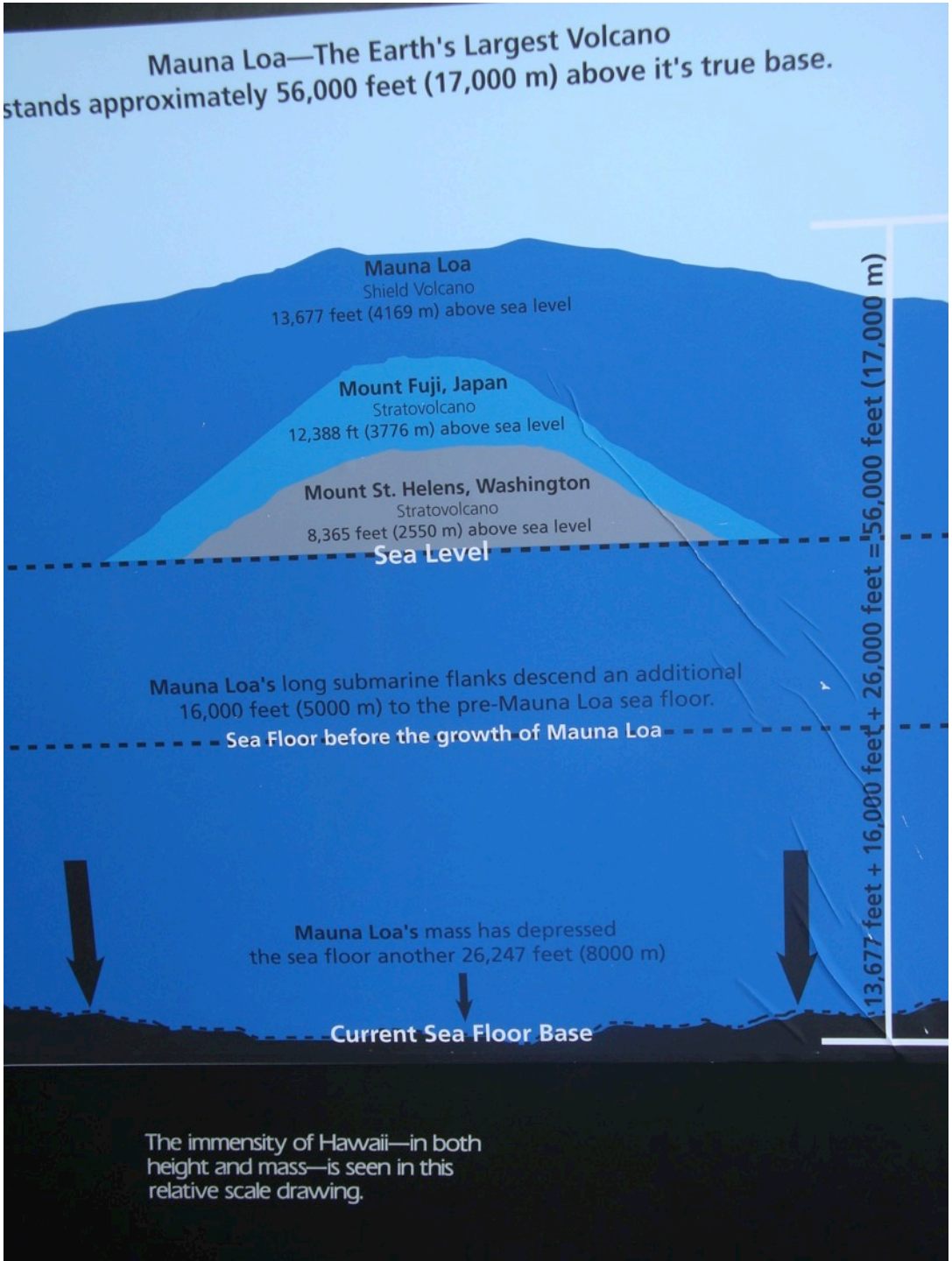
As Hawaiian shield volcanoes grow old, they become less active and finally become extinct. This process, from growth to decay, occurs over hundreds of millions of years. Of the eight main Hawaiian islands, Ni'ihau is the oldest, while Hawai'i is the youngest. The oldest rocks on Ni'ihau are at least 4.5 million years old and those on Hawai'i are younger than 500,000 years.

North of Ni'ihau is Nihoa Island (pictured at left), whose oldest rocks are at least 7.2 million years

The Pacific floor moves slow
northward over a stationar
spot. Magma forces its way
a weak spot in the crust to f
island.

The island is gradually move
and a new island is formed
source of magma


Mauna Loa—The Earth's Largest Volcano
stands approximately 56,000 feet (17,000 m) above it's true base.
Mauna Loa
Shield Volcano
13,677 feet (4169 m) above sea level
Mount Fuji, Japan
Stratovolcano
12,388 ft (3776 m) above sea level
Mount St. Helens, Washington
Stratovolcano
8,365 feet (2550 m) above sea level
Sea Level
Mauna Loa's long submarine flanks descend an additional
16,000 feet (5000 m) to the pre-Mauna Loa sea floor.
Sea Floor before the growth of Mauna Loa
13,677 feet + 16,000 feet + 26,000 feet =56,000 feet (17,000 m)
The immensity of Hawaii—in both
height and mass—is seen in this
relative scale drawing.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Sea Level
Mauna Loa's long submarine flanks descend an additional
16,000 feet (5000 m) to the pre-Mauna Loa sea floor.
Sea Floor before the growth of Mauna Loa
Mauna Loa's mass has depressed
the sea floor another 26,247 feet (8000 m)
Current Sea Floor Base
13,677 feet + 16,000 feet + 26,000 feet = 56,000 feet (17,000 m)
The immensity of Hawaii—in both
height and mass—is seen in this
relative scale drawing.

Position of Mauna Loa on Hawai'i island

Landsat mosaic; recent lava flows appear in black

Mauna Loa has historically been considered the largest volcano on Earth both mass and volume, and. It is an active shield volcano.

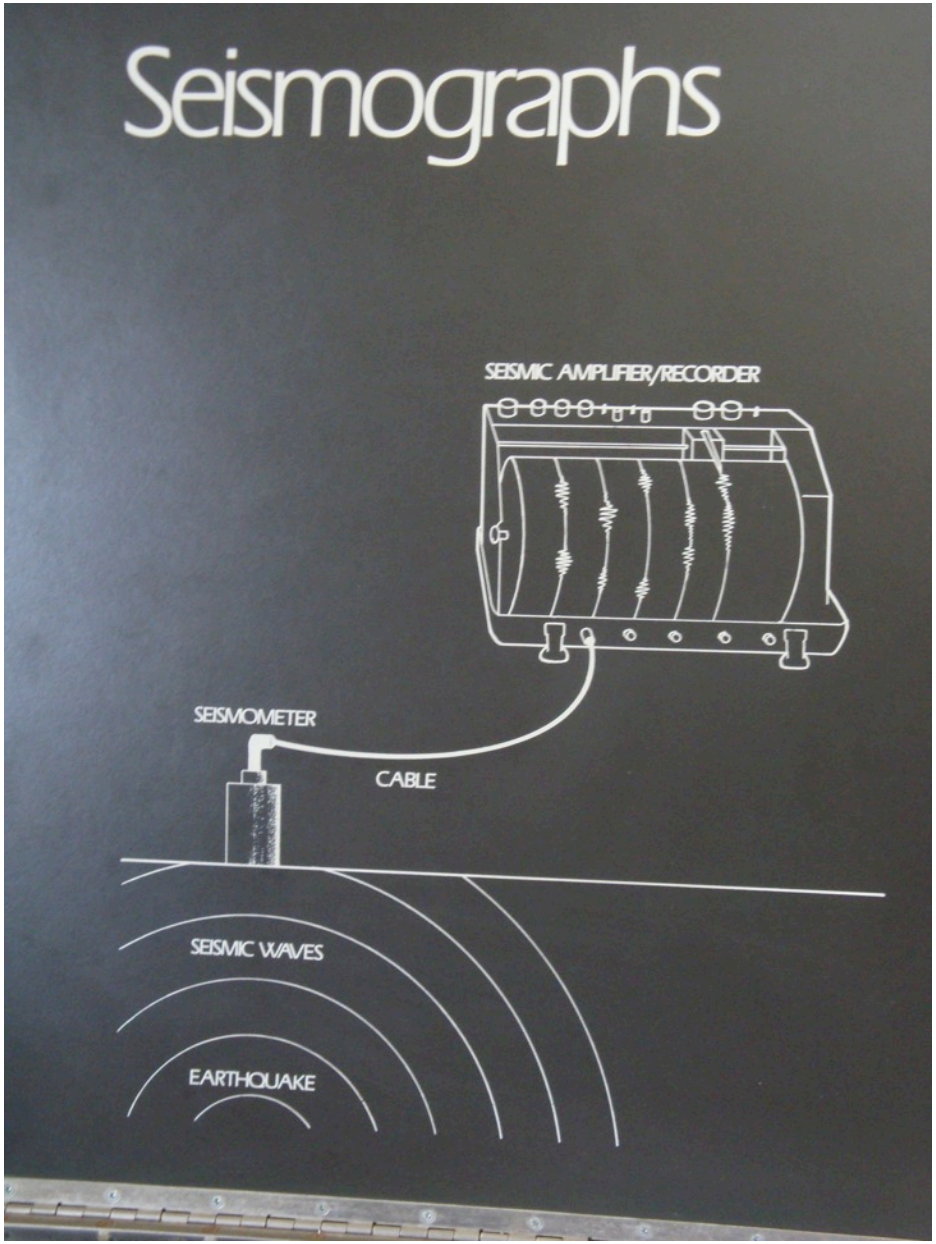
Seismo at School

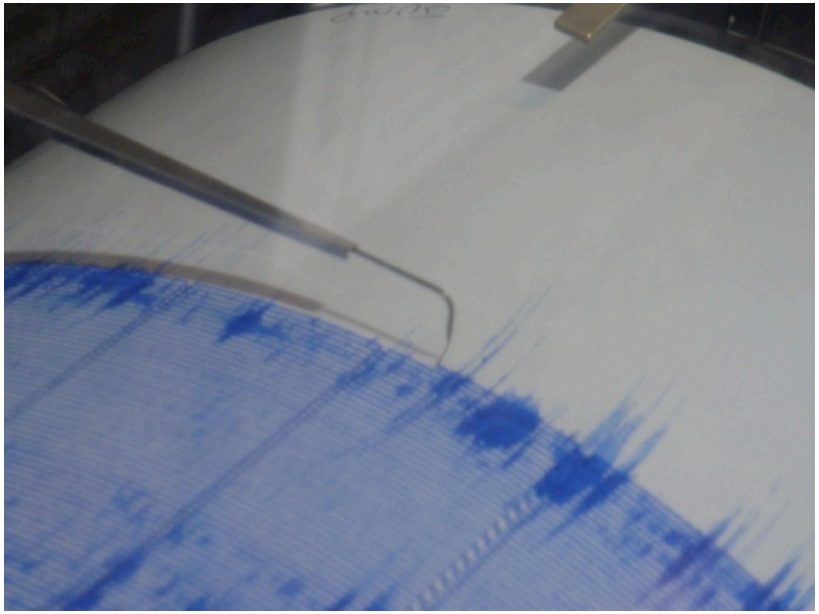
On Kilauea at Hawai‘i = Big Island

Seismo at School

Seismographs at the *Jaggar Museum* on Hawai‘i = Big Island

Seismo at School


Seismographs
SEISMIC AMPLIFIER/RECORDER
SEISMOMETER
CABLE
SEISMIC WAVES
EARTHQUAKE



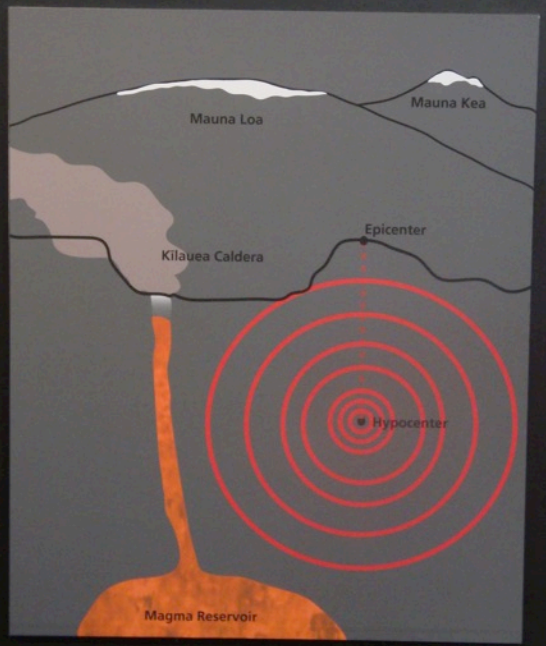
Pre-eruption Indicators

Tilt of ground surface indicates inflation or deflation of the area due to magma activity below. When this happens, signals from tilt sensors are transmitted to observatory tilt meters that produce records such as the one shown here.

Inflation-related swarm of short-period earthquakes at the summit of Kilauea.

Magma in
earthquak
preceding

Finding the Earthquake

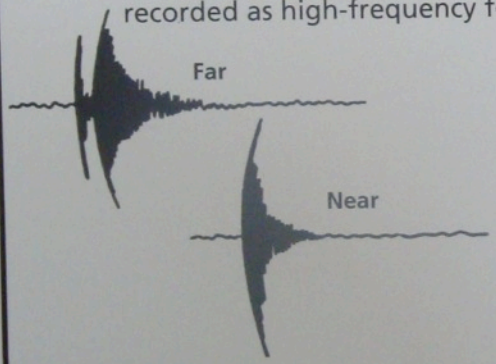


What Shows on the Recorder?

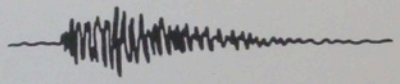
Ordinary Seismicity

A. Local Earthquakes

a. Short-period (SP) earthquake:
Tectonic related earthquakes that are recorded as high-frequency features.

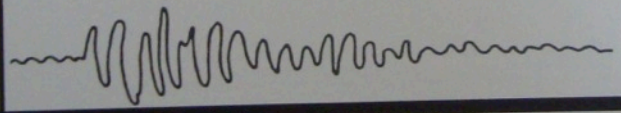


b. Long-period (LP) earthquake:
Volcanic related earthquakes that are recorded as low-frequency features.

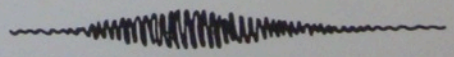


B. Teleseism: Earthquake that occurred a great distance away

a. P (Primary) wave: A compressional seismic wave that has traveled through the earth.



b. T-phase: A seismic wave that has traveled through the ocean



Natural	Man-Induced
	G. Shallow Explosions

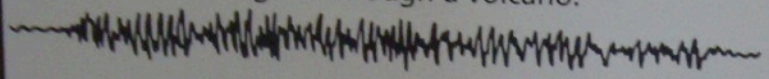
Seismo at School

Other types of Seismicity

Natural

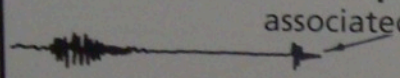
C. Volcanic Tremor:

Continuous rhythmic signal often associated with the movement of magma through a volcano.



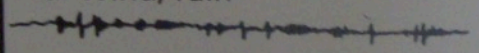
D. Rockfall

E. Volcanic "Gas" Explosions

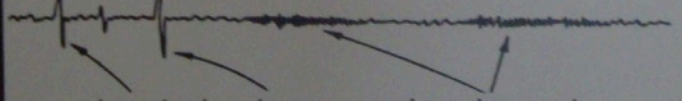


F. Weather Disturbances

a. Wind, rain



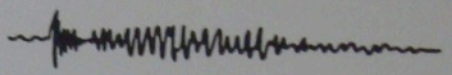
b. Electrical storm



Man-Induced

G. Shallow Explosions

quarry or construction blast



H. Sonic Bursts

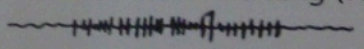
artillery fire

I. Helicopter and Light Aircraft

J. Ground Traffic

a. Automobile

b. Person walking (footsteps)



The observatory has a worldwide reputation as a leader in the study of active volcanism.

Update time = Mon Mar 22 18:00:02 HST 2010
Here are the earthquakes appearing on this map, most recent at top ...

MAG	DATE y/m/d	LOCAL-TIME h:m:s	LAT deg	LON deg	DEPTH km	LOCATION
2.1	2010/03/20	22:30:26	19.390N	155.497W	8.3	15 km (9 mi) SE of Mauna Loa Summit
1.9	2010/03/20	19:33:28	19.327N	155.194W	5.5	8 km (5 mi) NW of Ka`ena Point
2.0	2010/03/20	10:40:36	19.336N	155.190W	6.0	9 km (5 mi) NW of Ka`ena Point
2.3	2010/03/16	12:24:12	19.384N	155.492W	8.7	16 km (10 mi) SE of Mauna Loa Summit
2.3	2010/03/16	11:35:01	19.422N	155.310W	3.8	4 km (2 mi) W of Kilauea Summit
2.0	2010/03/15	21:56:20	19.321N	155.225W	30.9	11 km (7 mi) WNW of Ka`ena Point
2.3	2010/03/15	19:25:44	19.418N	155.312W	5.2	4 km (2 mi) W of Kilauea Summit
1.9	2010/03/13	22:35:14	19.365N	155.220W	3.2	8 km (5 mi) SSE of Volcano
1.8	2010/03/13	10:19:20	19.490N	155.388W	6.0	14 km (9 mi) NW of Kilauea Summit
2.0	2010/03/12	15:44:57	19.363N	155.214W	3.3	8 km (5 mi) SSE of Volcano
2.7	2010/03/12	06:04:00	19.417N	155.311W	5.6	4 km (2 mi) W of Kilauea Summit
2.2	2010/03/11	12:07:58	19.329N	155.109W	6.6	6 km (4 mi) NNE of Ka`ena Point
2.2	2010/03/10	18:53:06	19.313N	155.221W	5.4	10 km (6 mi) WNW of Ka`ena Point
1.8	2010/03/10	09:01:13	19.251N	155.442W	2.8	6 km (4 mi) NE of Pahala
2.5	2010/03/10	00:57:39	19.456N	155.259W	2.8	4 km (2 mi) NW of Volcano

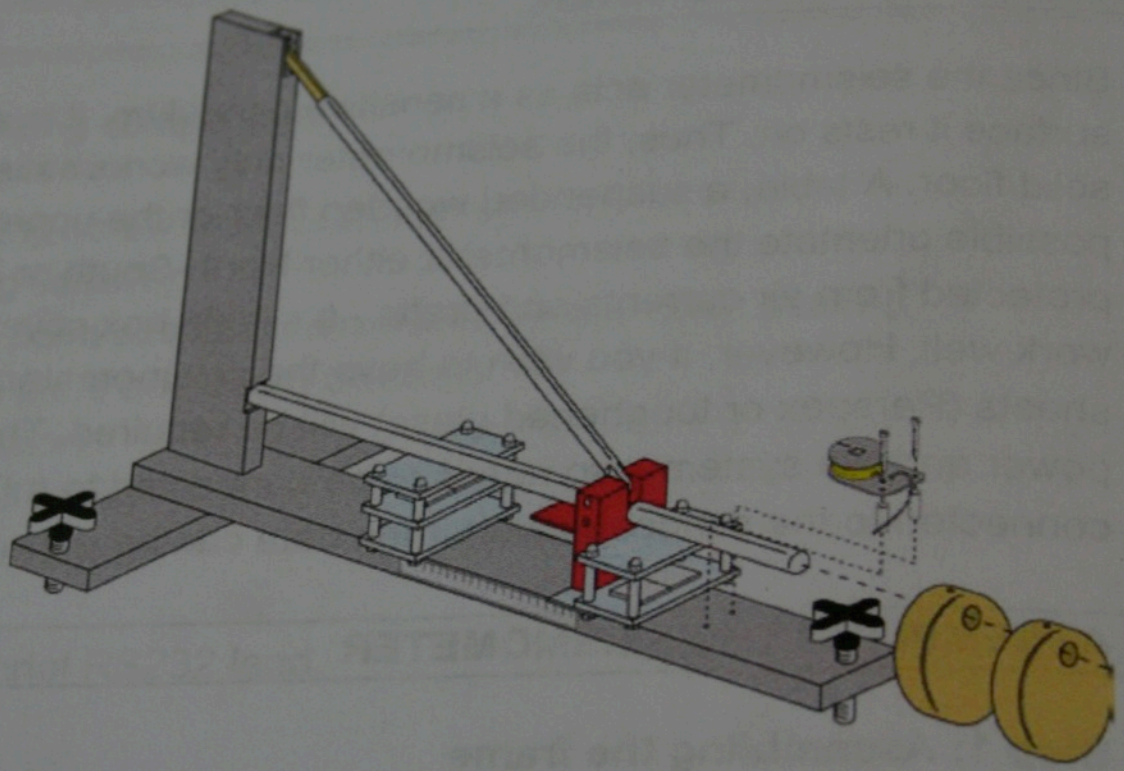
The GLOBE student research group

Module 3: **Unpacking & Installing**

unpack the seismometer, you
that the sensor magnet
nt is already attached to the

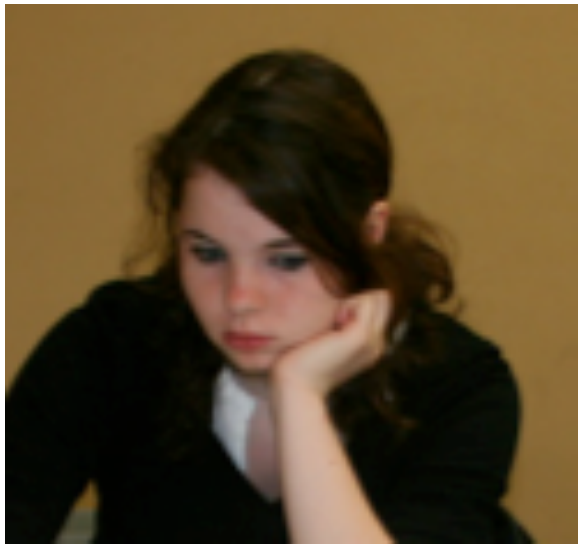
d to attach the sensor coil
meter frame - *but this*
AFTER the boom arm is
rass masses are
f all.

notographs show the
ons.



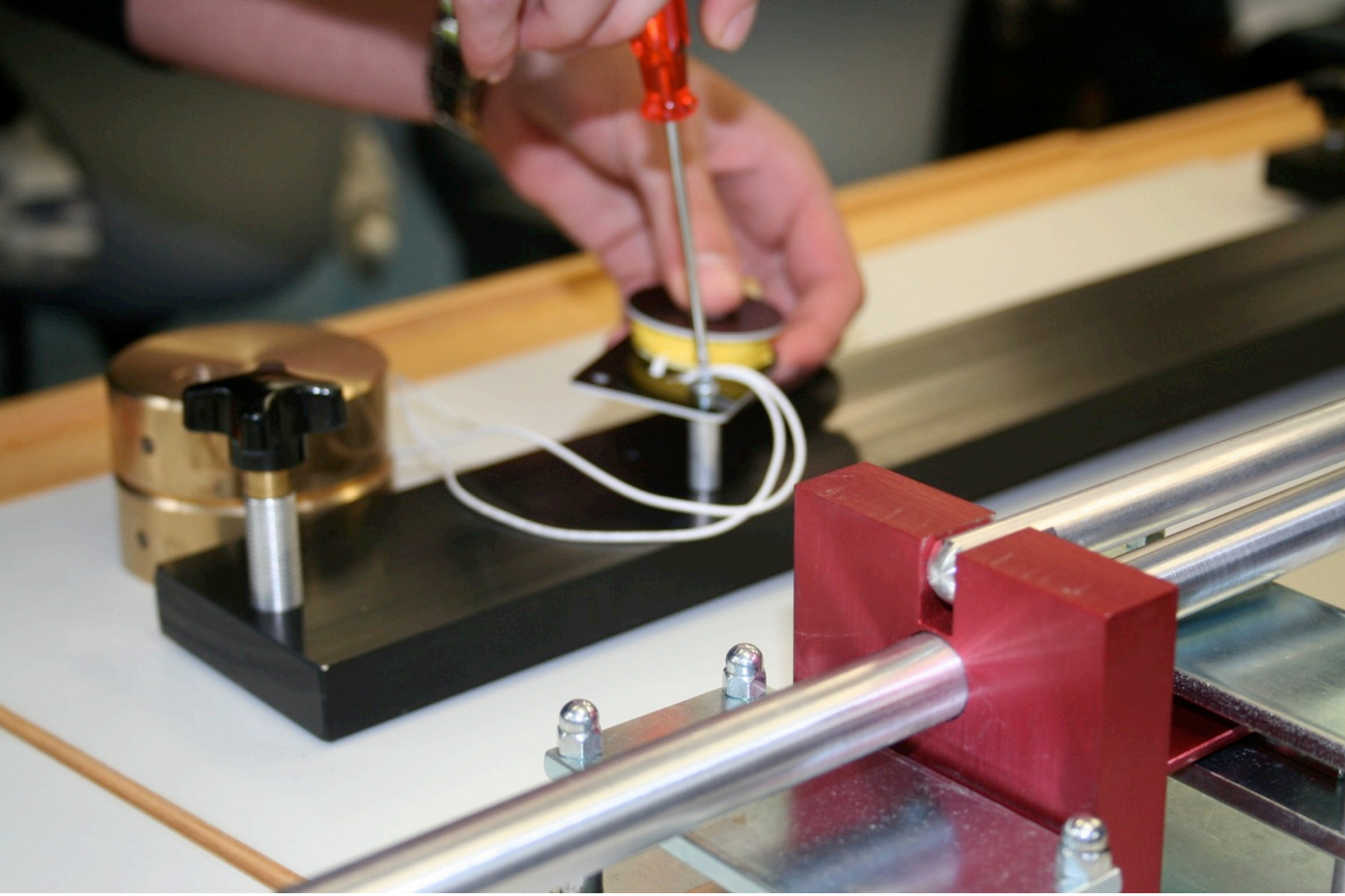
meter on the floor where you plan on operating it. Put the steel cage with the
on the baseplate near the upright. Gently hook the top pivot point into place, and
arm on the bottom pivot point. The length of the boom arm is factory set and
justing.

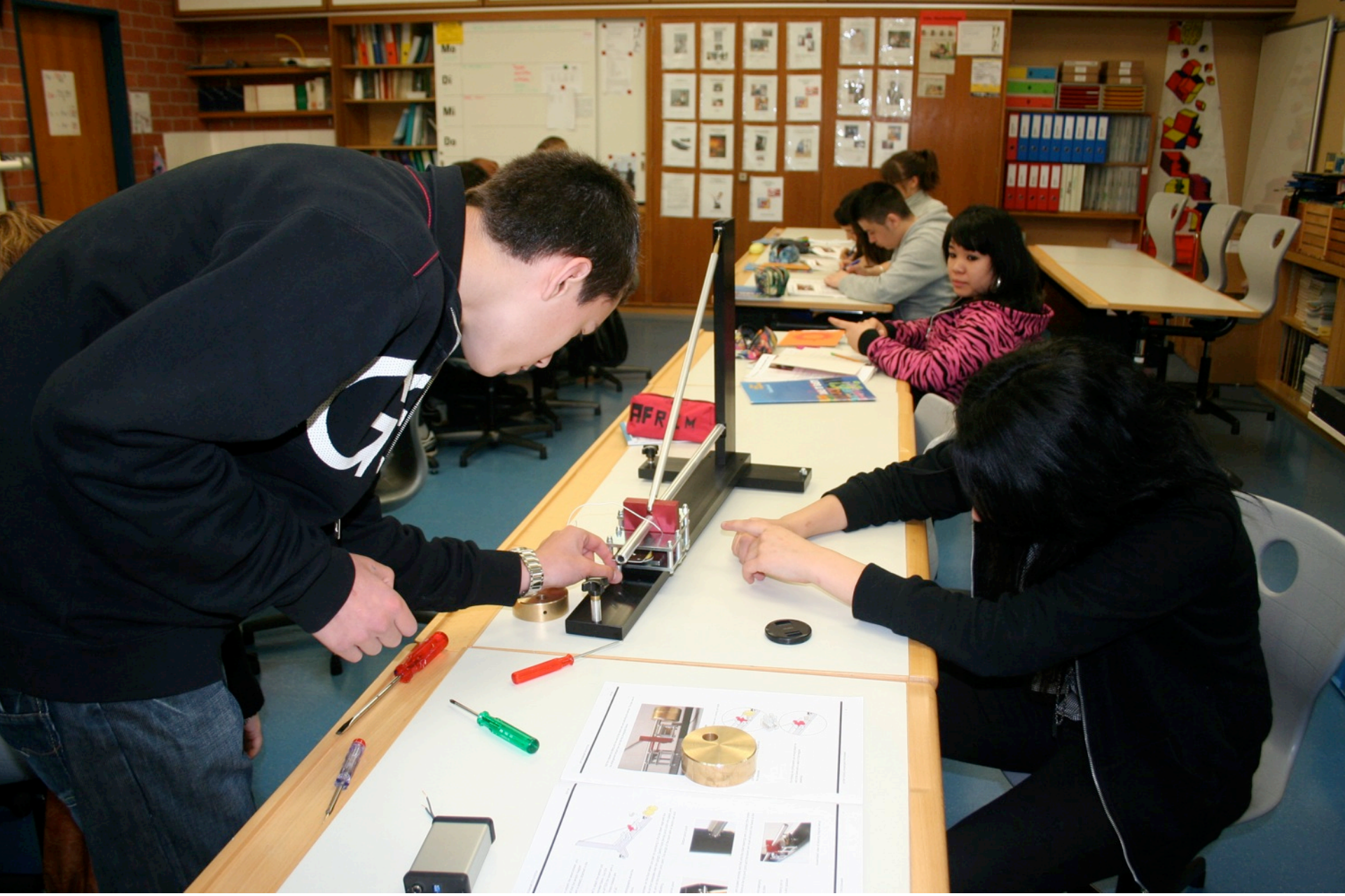
Is our English good enough?

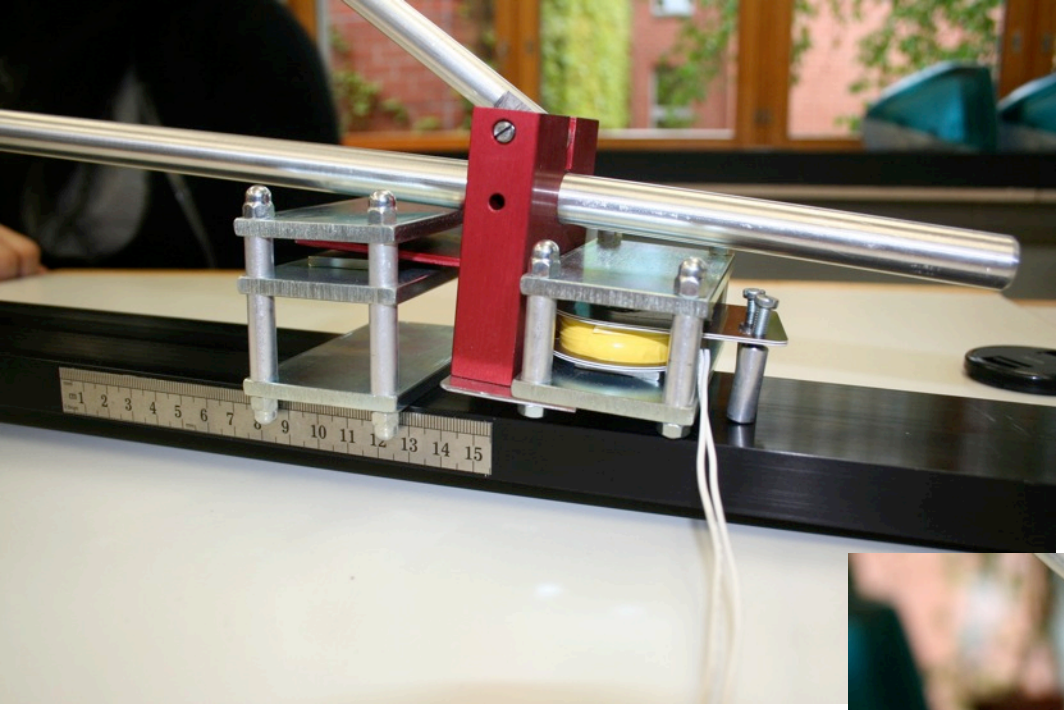


Lost ?

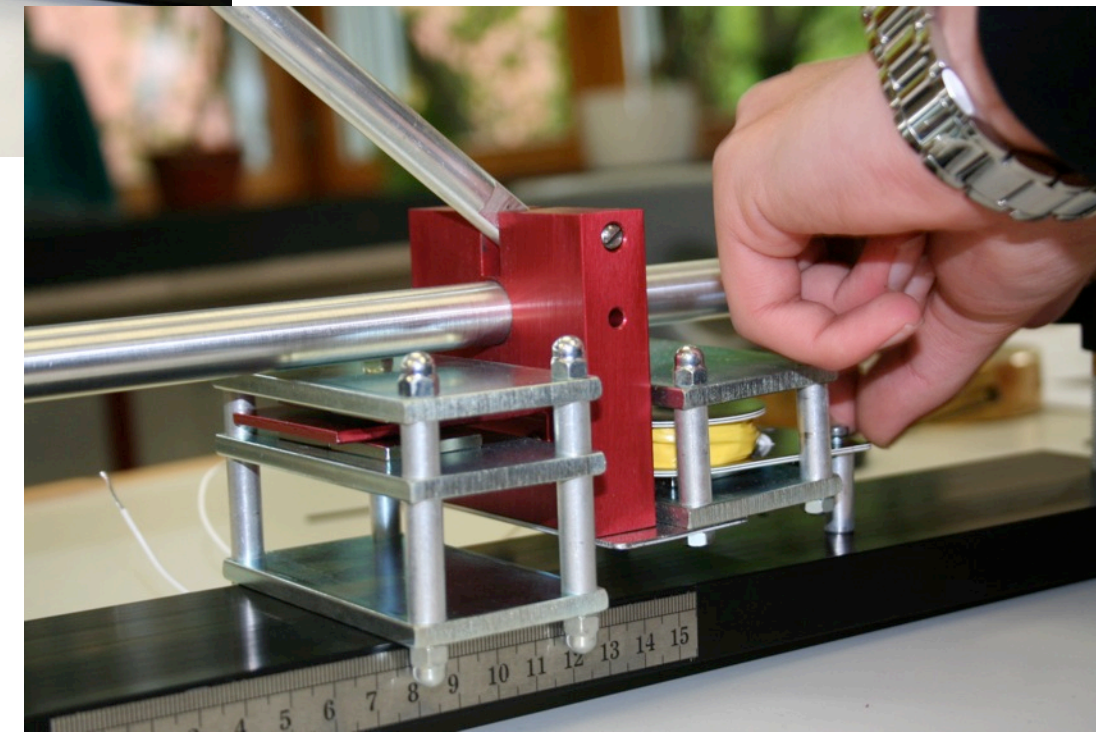
http://www.youtube.com/watch?v=zogw8dI3fUQ



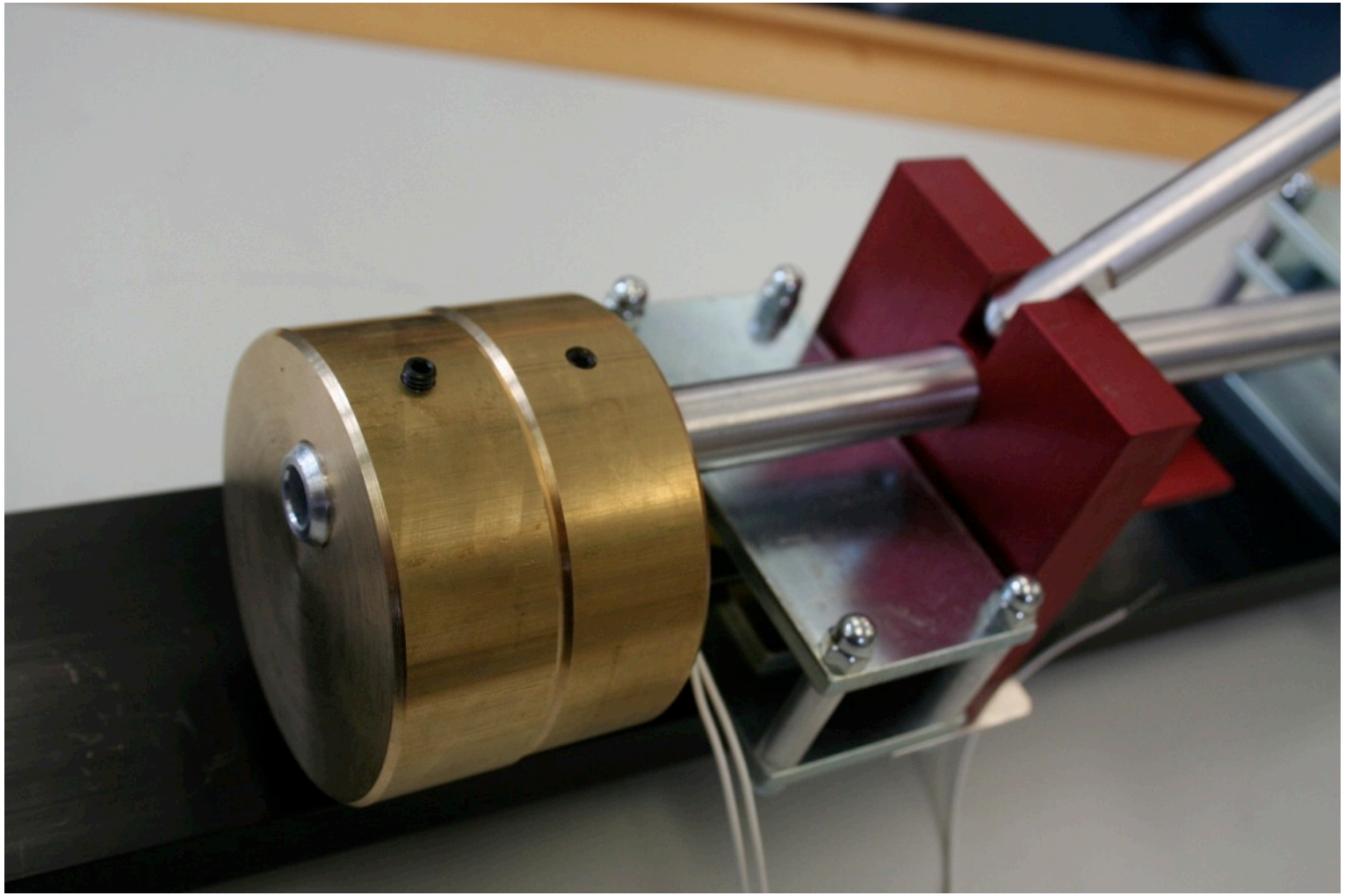


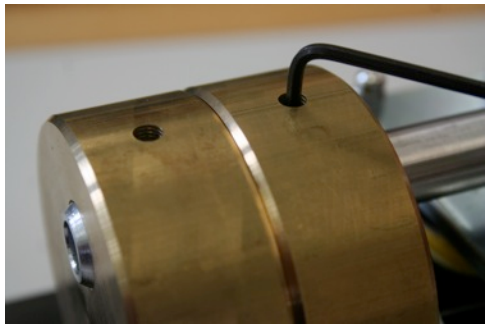


Sensing magnets and coil...

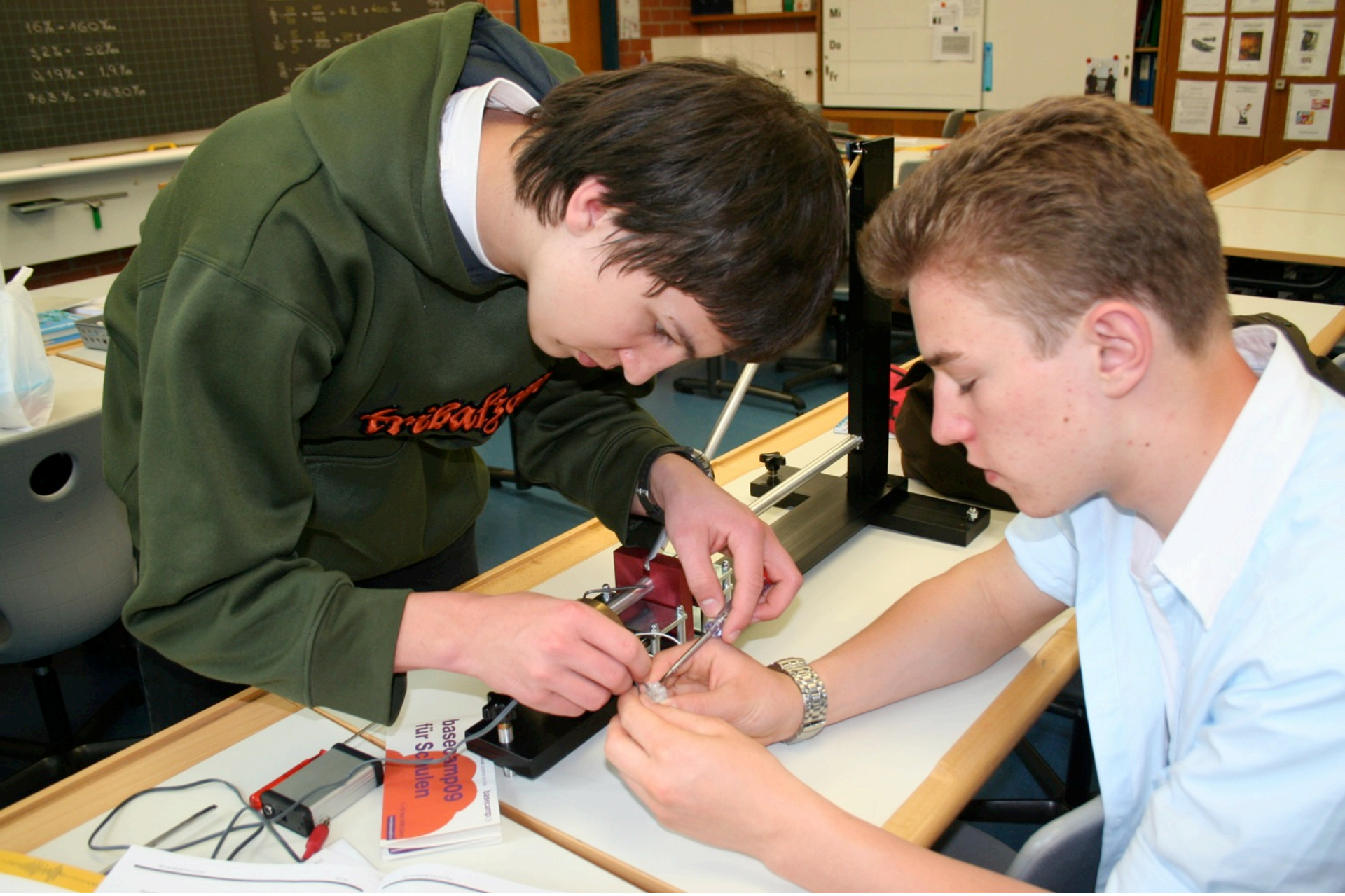


...damping magnets





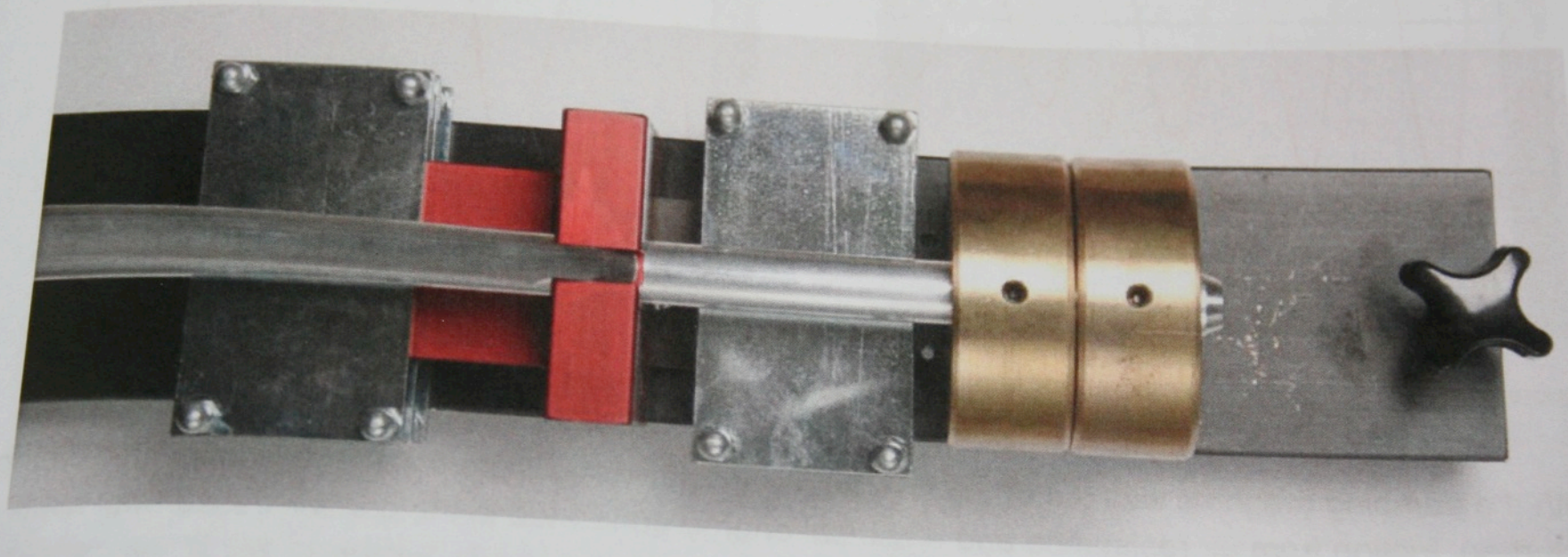
Brass masses with locknut



Fitting the electronic parts

The screw on the long base frame (by the mass) is used to adjust the period of the seismometer by changing offset between the top and bottom hinges.

Adjust the levelling screws on the short frame base until boom is swinging freely. Make fine adjustments of the levelling feet on the short frame base until the boom arm and brass mass are stable along the centreline of the long frame base.



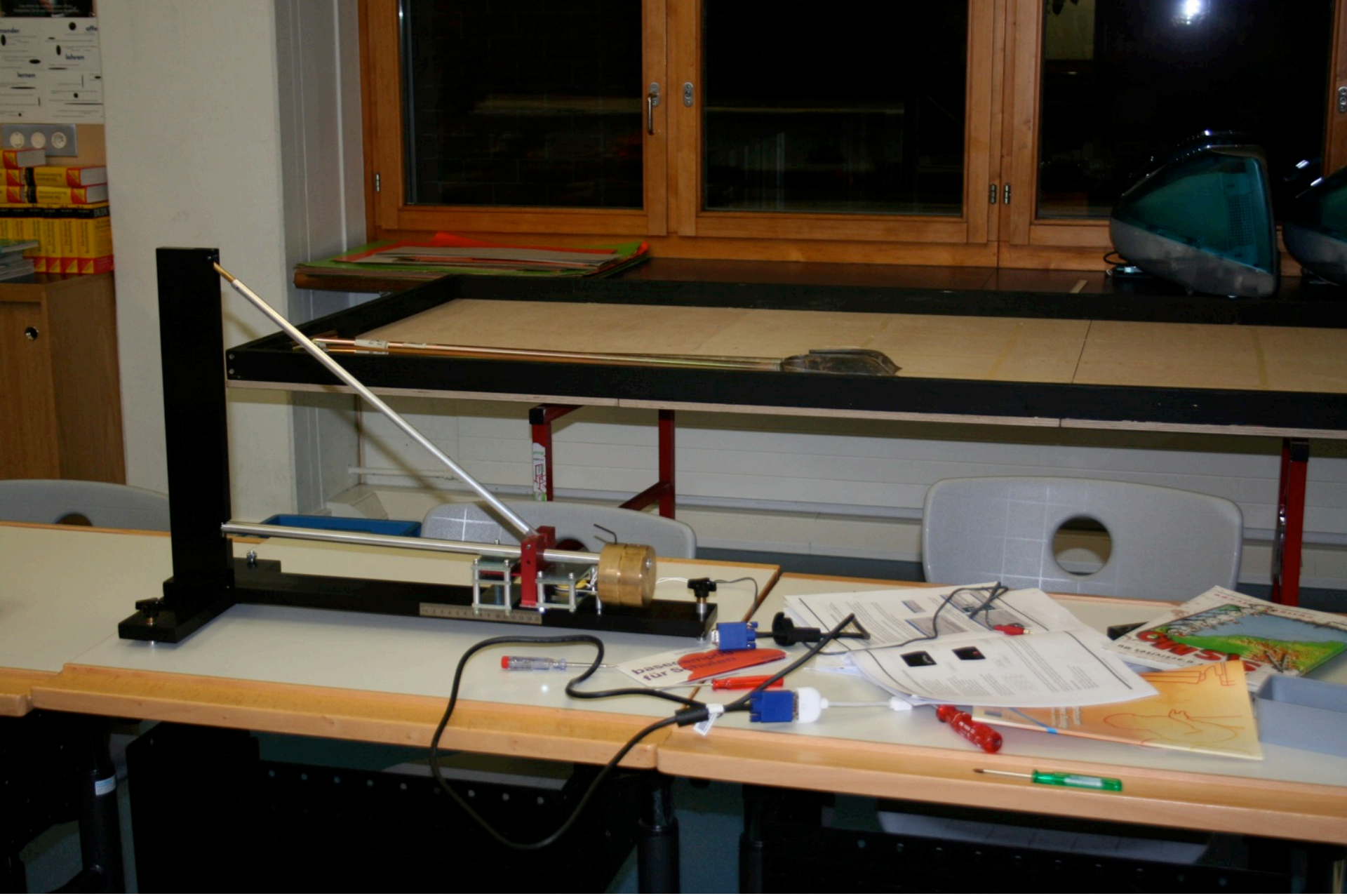
Step 4: Adjusting the natural period

The natural period of the seismometer depends on the angle of the line joining the top suspension point and the roller bearing point to the vertical. The closer this angle is to vertical the longer will be the natural period of the seismometer. The period

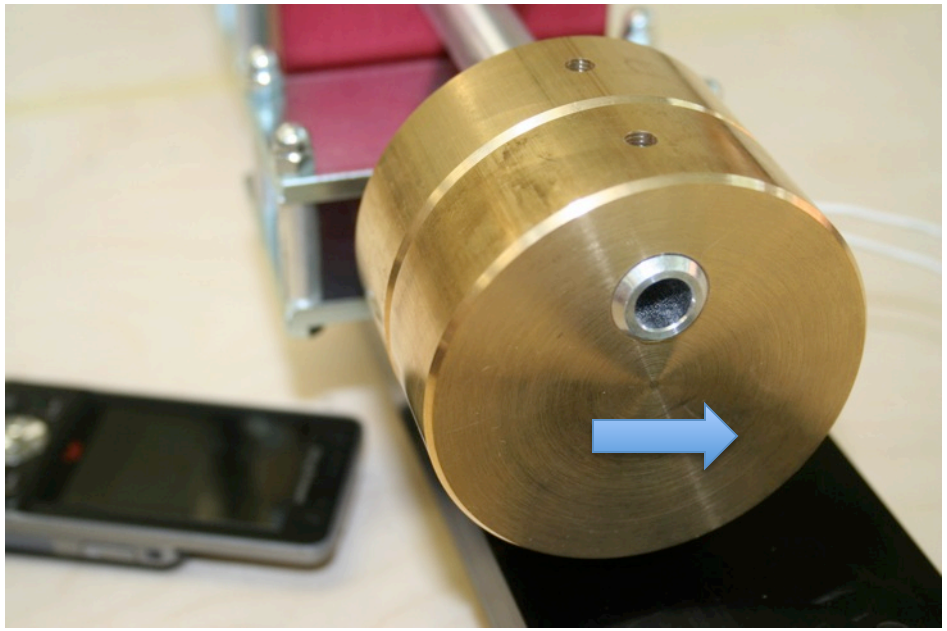
School- or Technical-English?

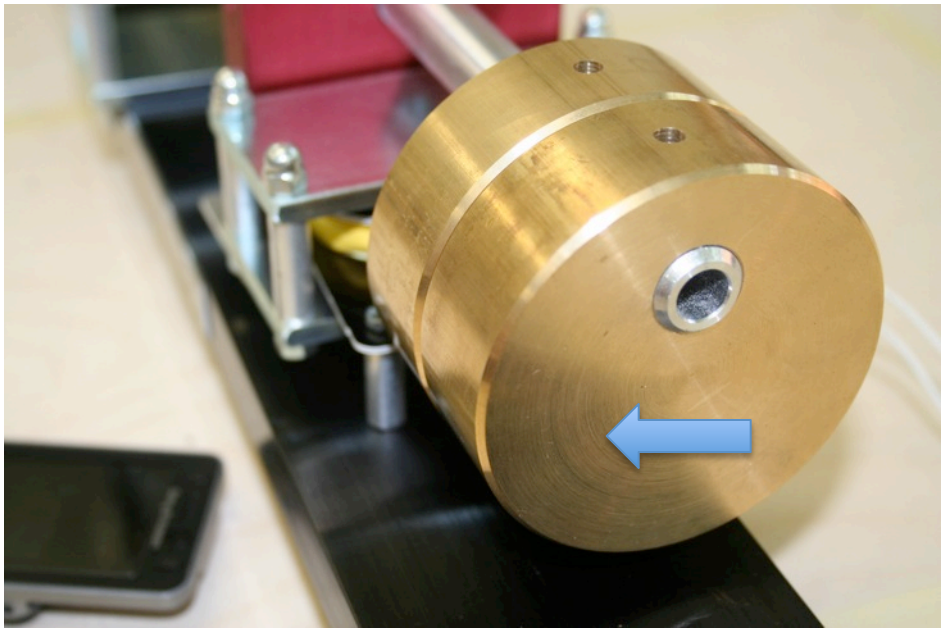
The electronic box contains an amplifier, a filter circuit and a digitiser circuit...

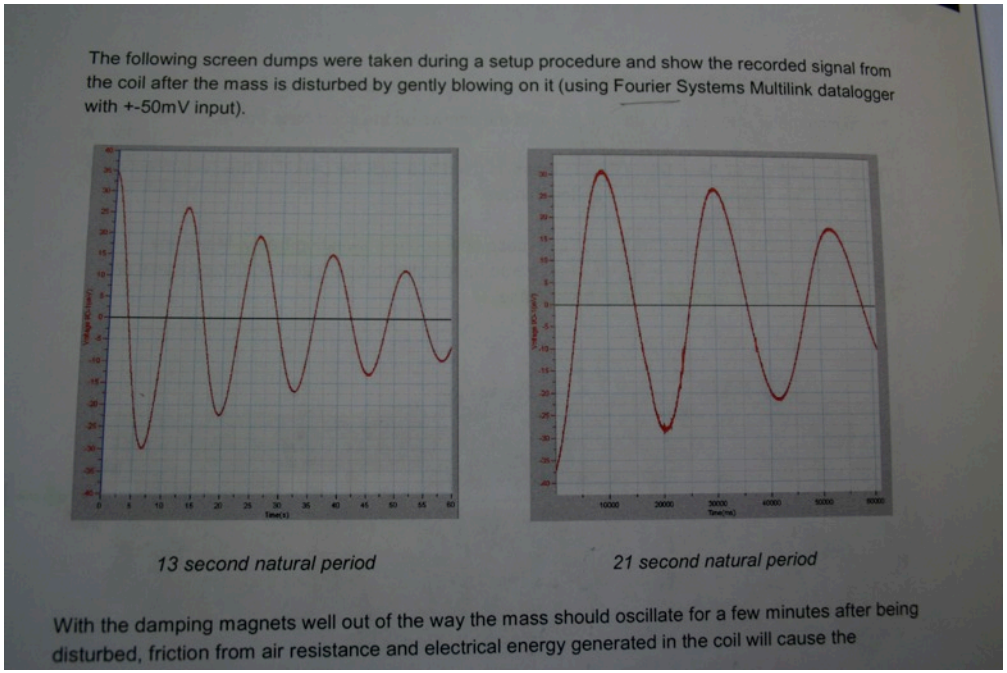
...that converts the changing voltage into digital data - readable by the AmaSeis program (Windows only).



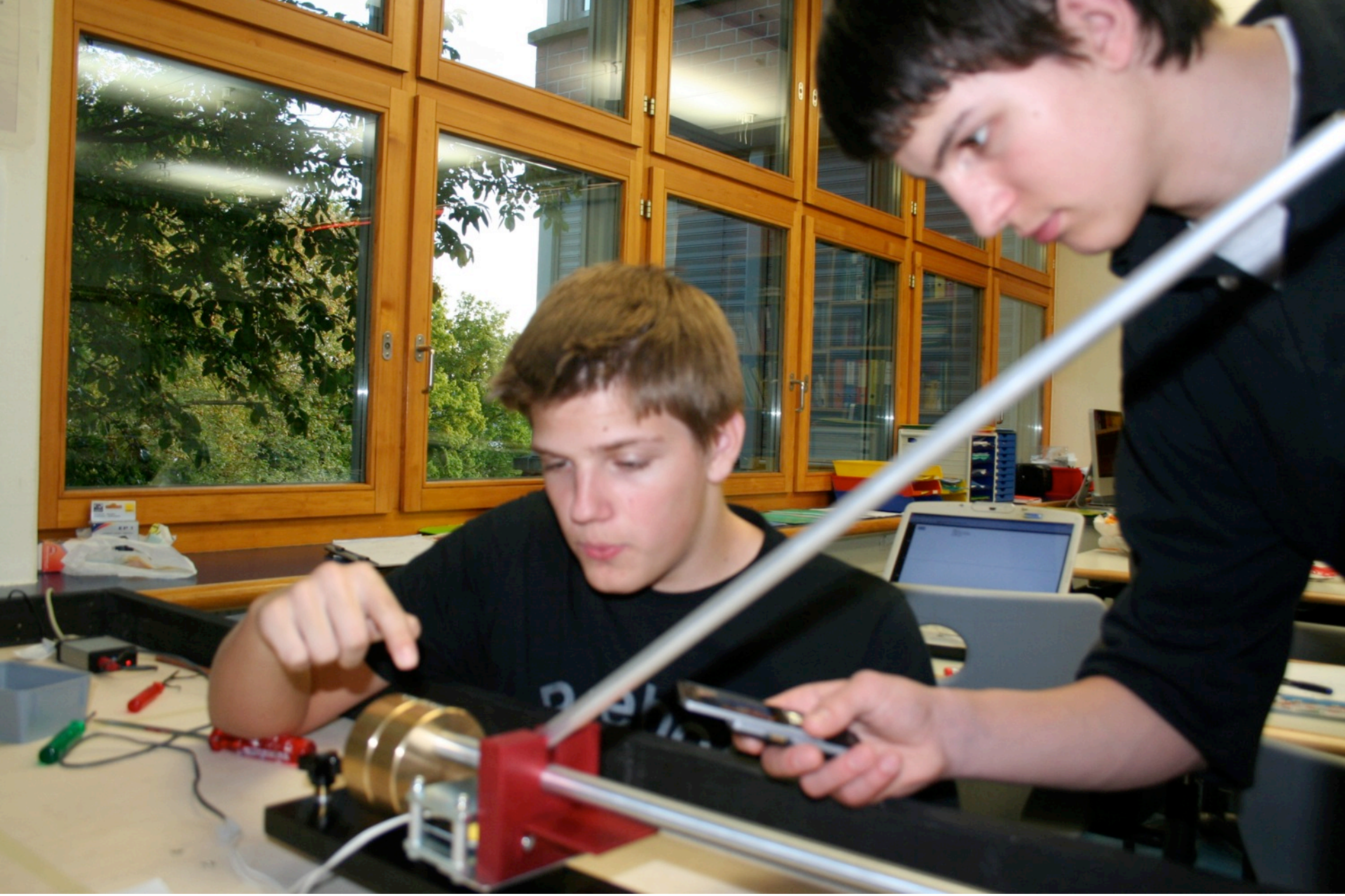
The completed SEP Seismometer



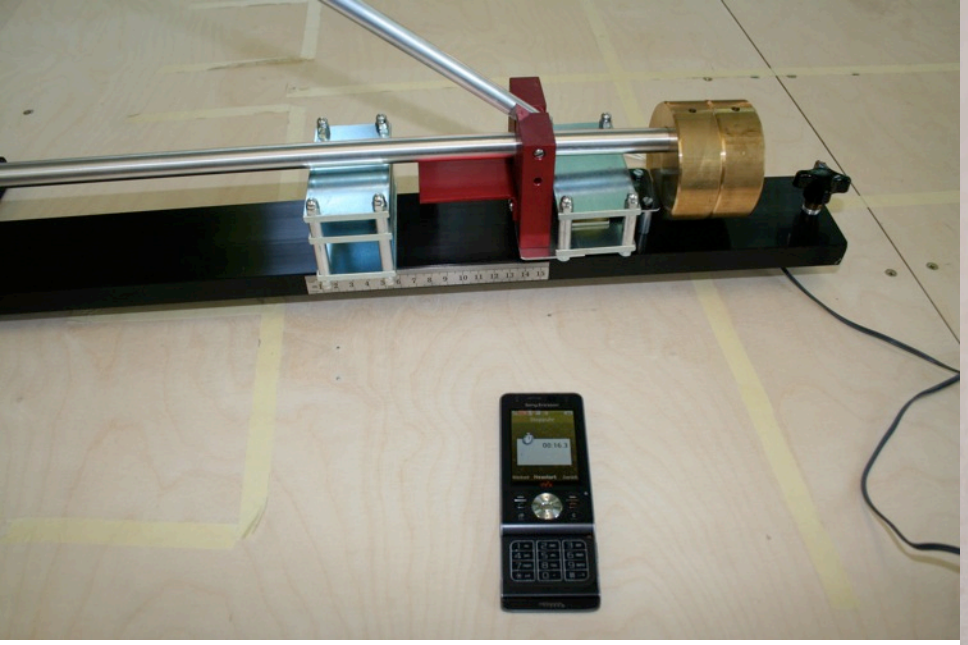




Observe one periode-movement (⟺) of the brass masses !



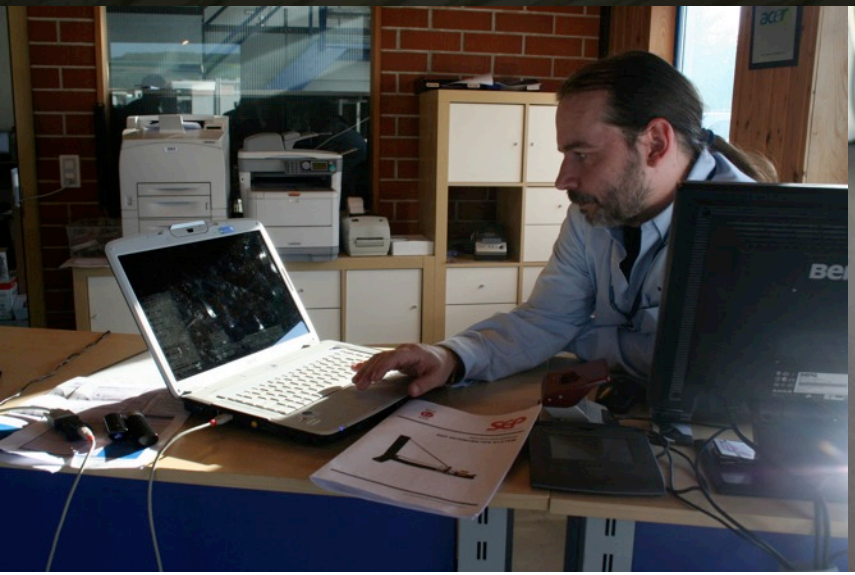
Testing and Calibration

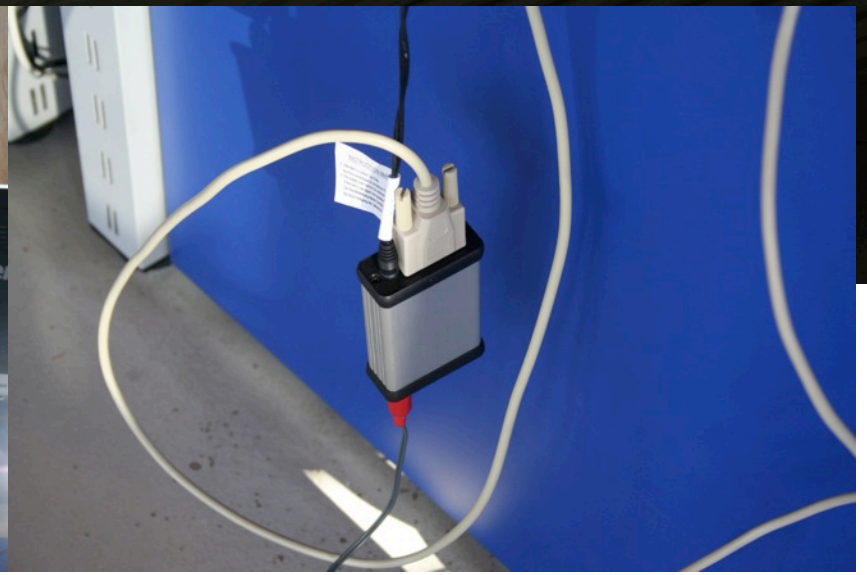


Calibration of the movement of the Suspension Arm with the two brass masses:

1 Periode = 15 – 20 seconds (use cellphone stop-watch)

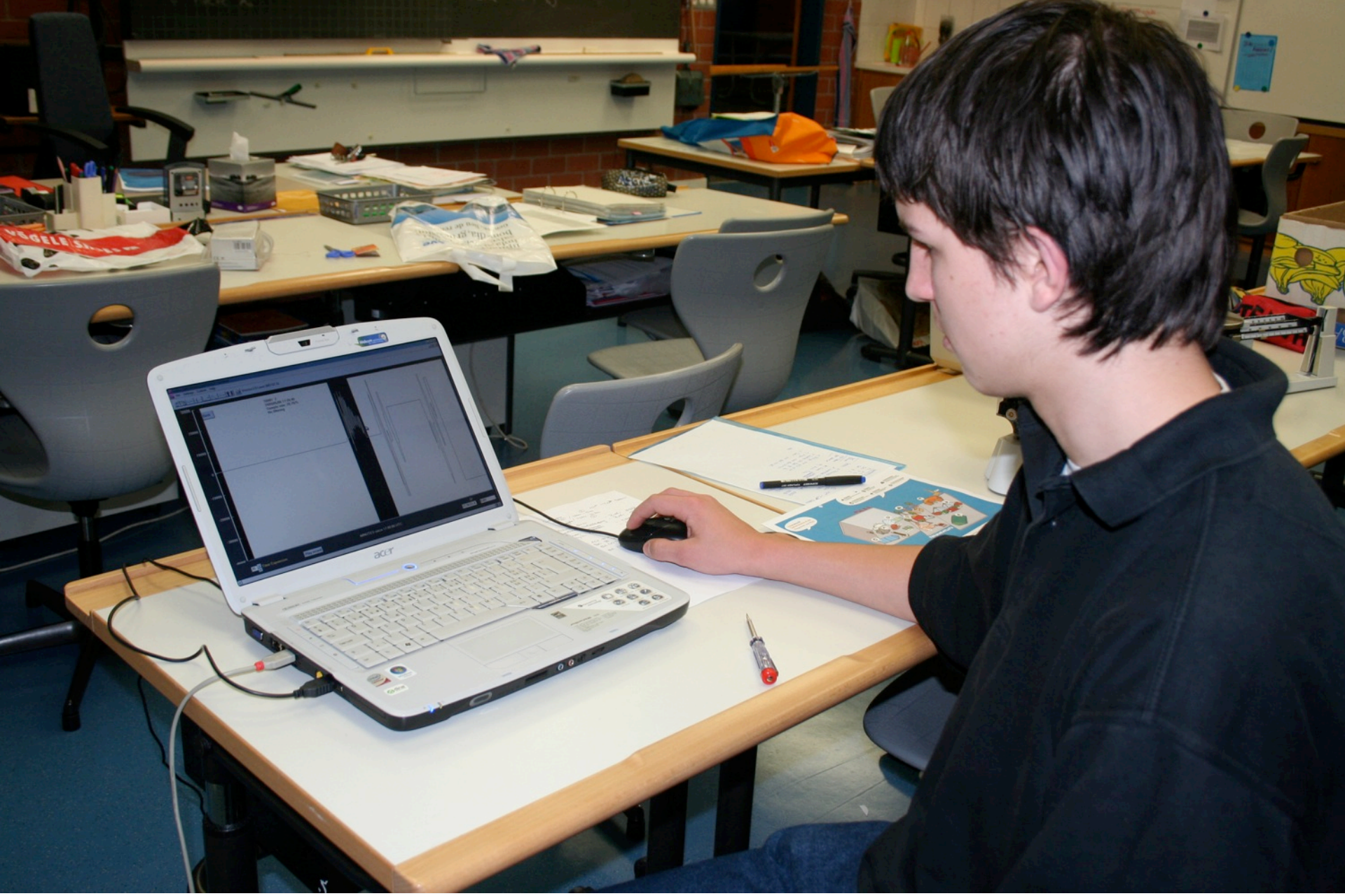
Last minute update of Hardware with the IT-specialist





Module 4:
Evening Training

Experiment for Wave Propagation
> one drop only!



Getting to know the software *AmaSeis*

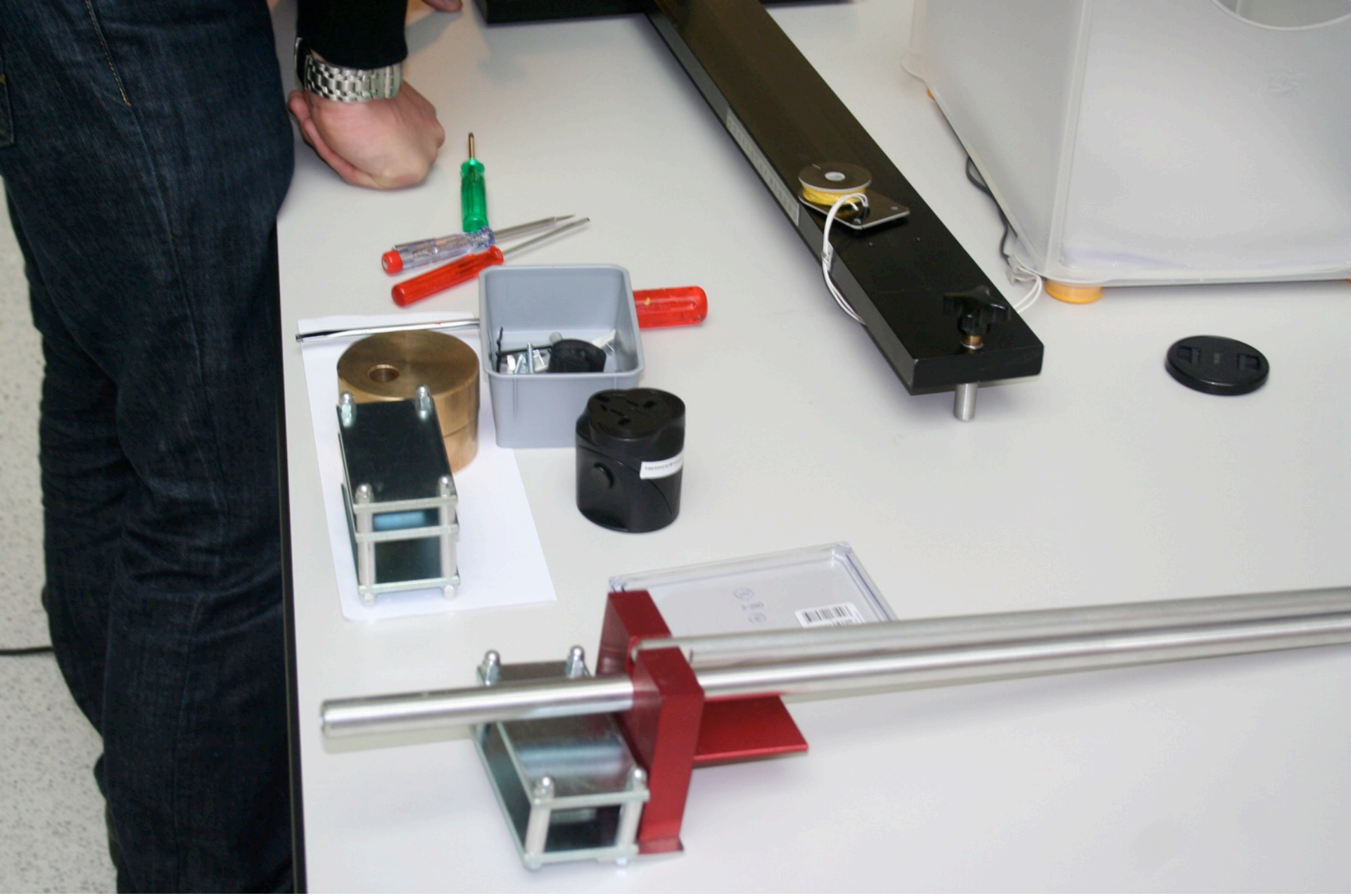
Studies of earthquake-Web information

Module 5: **Ready for University**

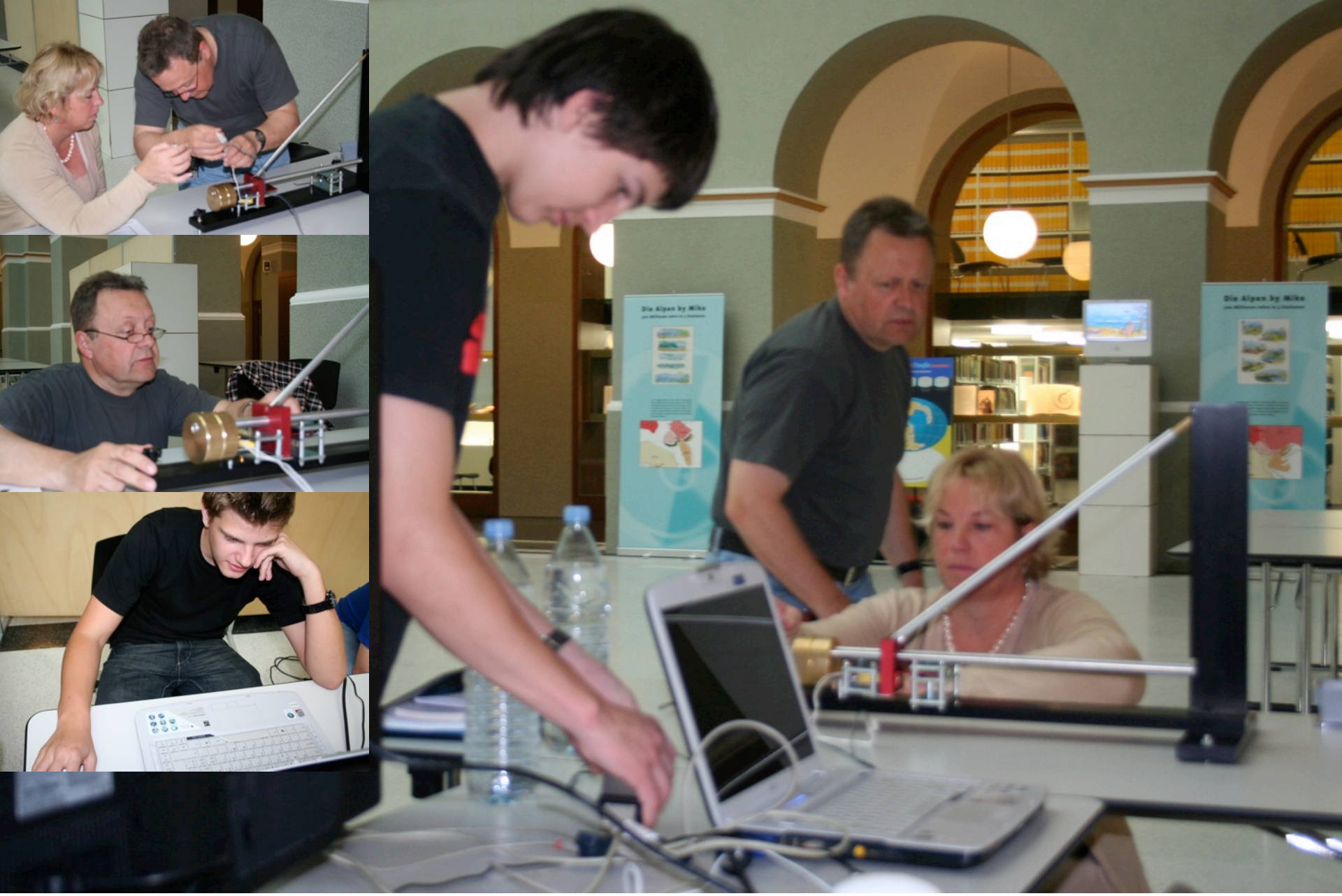
The exhibition ***focusTerra*** at ETH Zurich


HOTEL
CONVERSE
ALL STAR

Institute of Geophysics, exhibit ***focus*Terra**



Re-assembly of the seismometer



Final calibrations

Setting on of the side-workshops

Adjusting Displays for public viewing


USGS


Ready for the public to visit our exhibition

Thank you for your attention!