Instrumentation, Recording systems

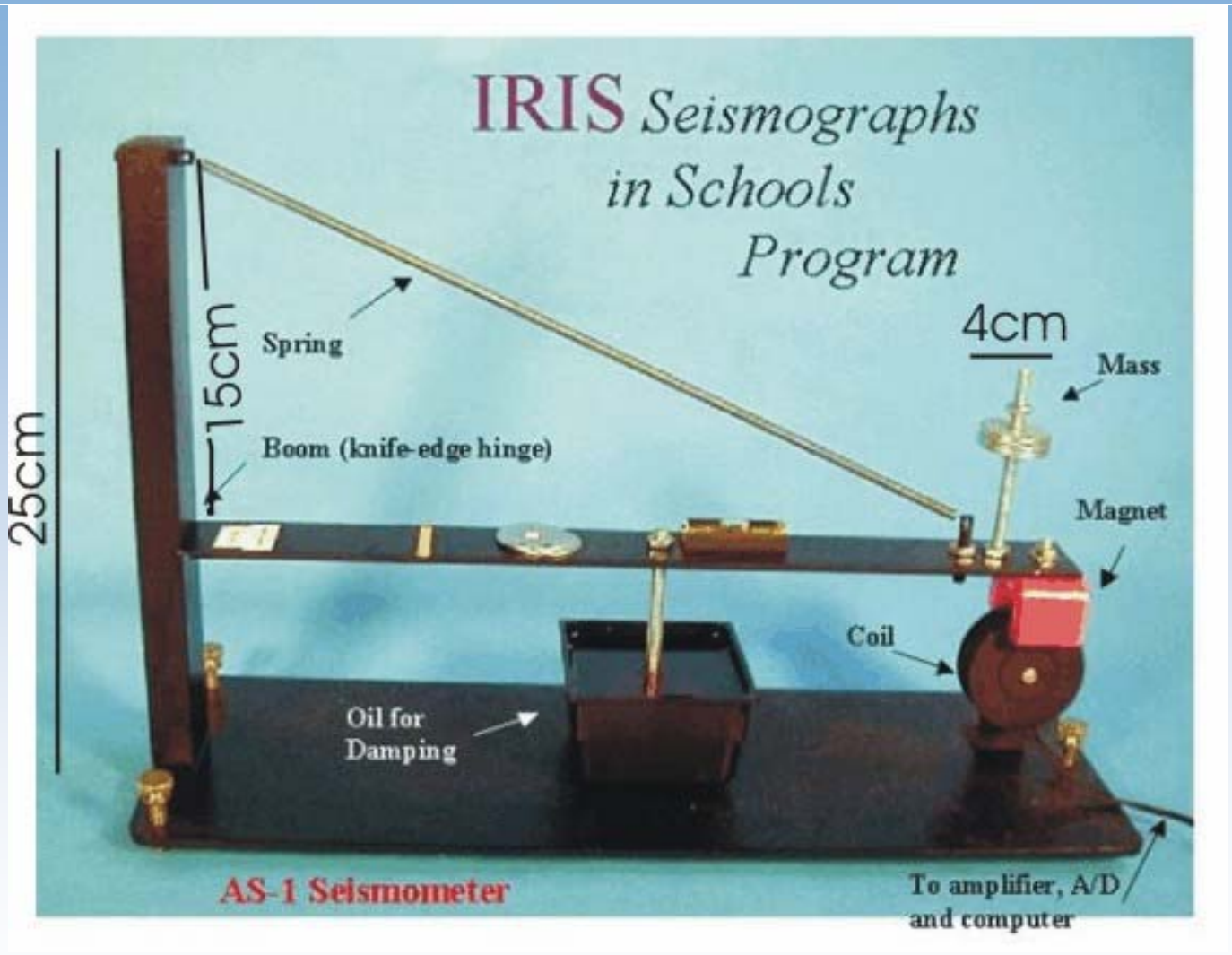
Data transmission & Archiving

Topics covered:

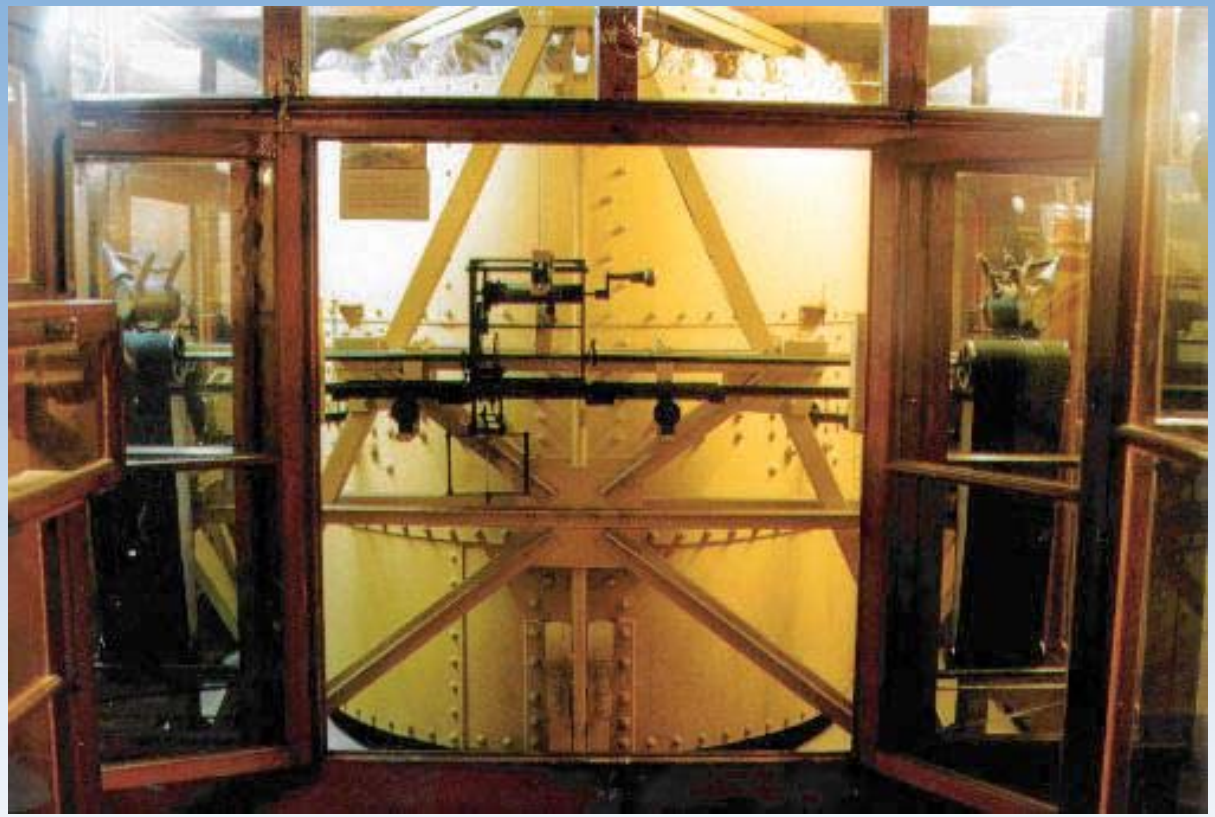
- Types of seismic instruments
- Other equipment needed
- How sensors are installed
- Data transmission (telemetry)
- Data archiving (storage)

Seismometer:

- An instrument to record seismic waves (vibrations caused by earthquakes or explosions)



A simple seismometer



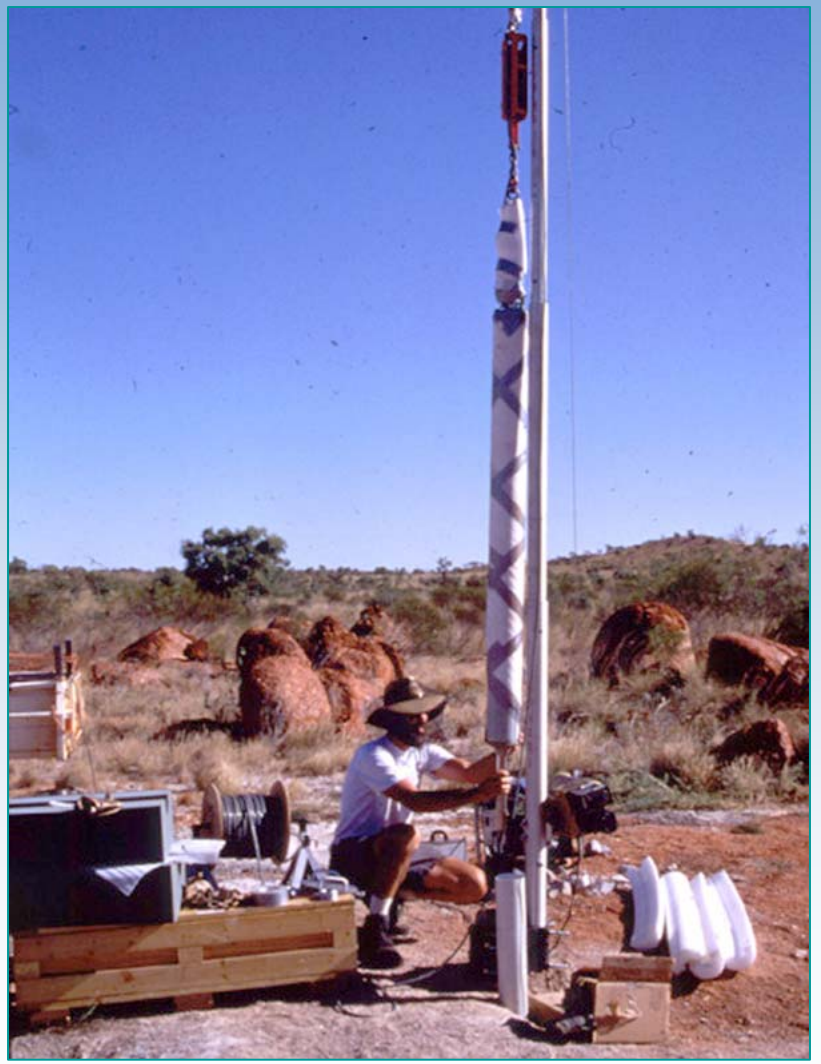
A large seismometer – 1200kg, 2m

Today's seismometers use electromagnetic feedback to hold the mass still. This allows seismometers to be made more compact and sensitive.

An observatory-class seismometer

Streckeisen STS-1 Very Broadband Seismometer

A seismometer placed in a borehole.



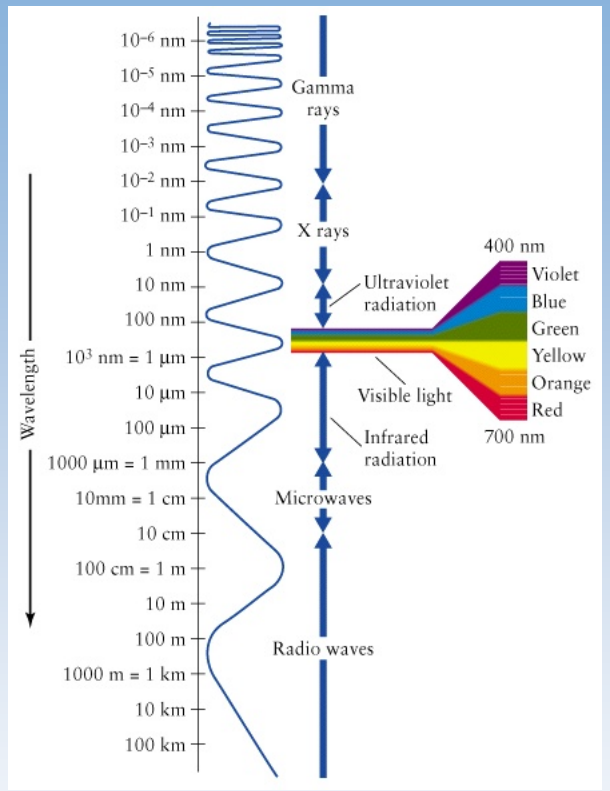
Teledyne KS-54000-I Borehole Seismometer

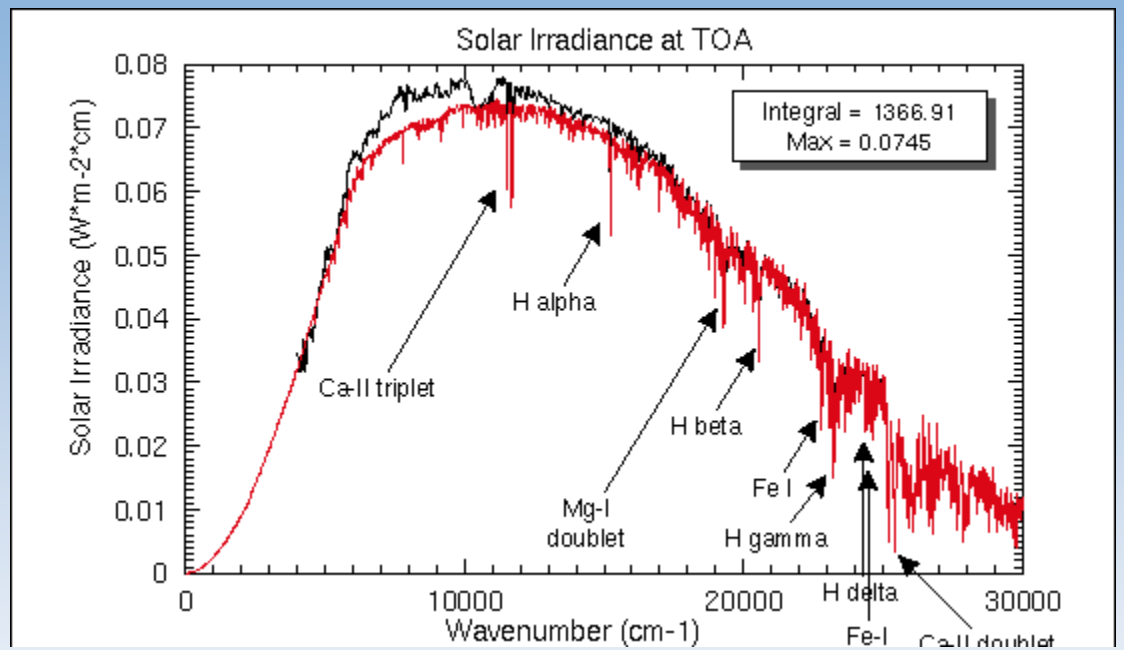
High frequency seismometers

Guralp CMG-3T

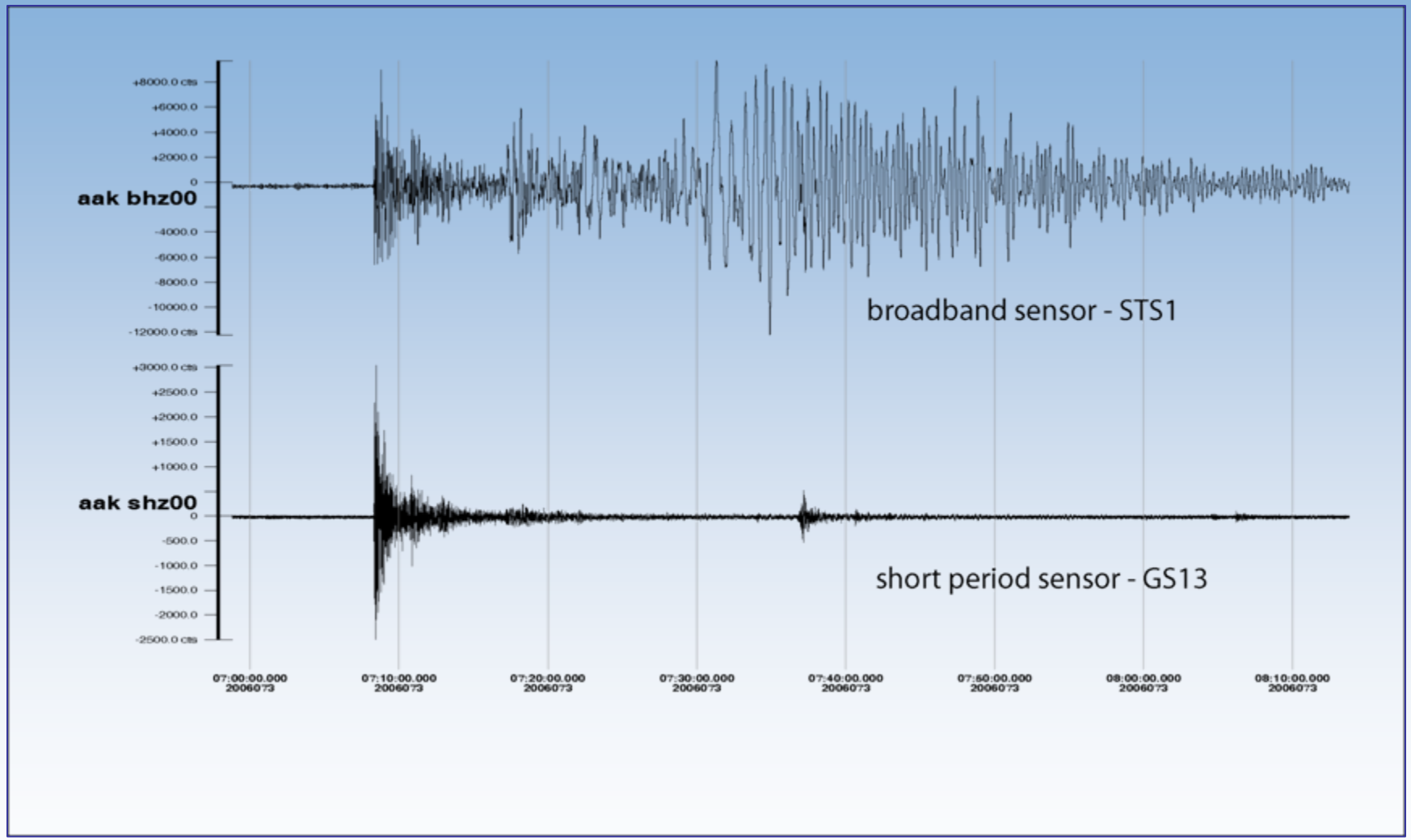
Streckeisen STS-2

Teledyne GS-13





Our eyes see only part of the light from the Sun.

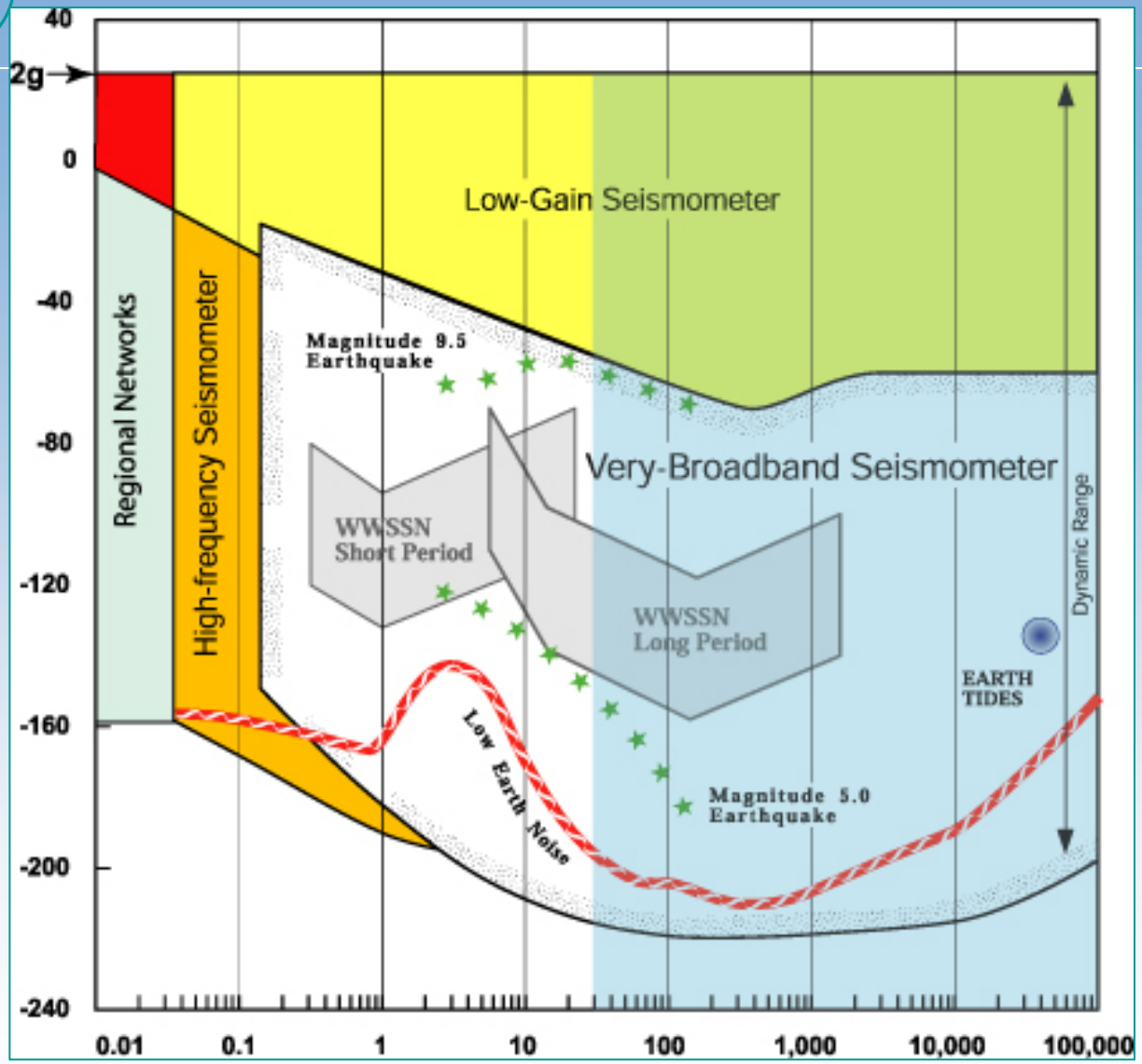


Short period sensors do not record long period signals

Kinemetrics FBA-23

An “insensitive” (strong motion) seismometer: good for recording violent shaking

IRIS GSN SYSTEM



Why more than one kind of seismometer is used

Other equipment needed:

- Clock to time the data

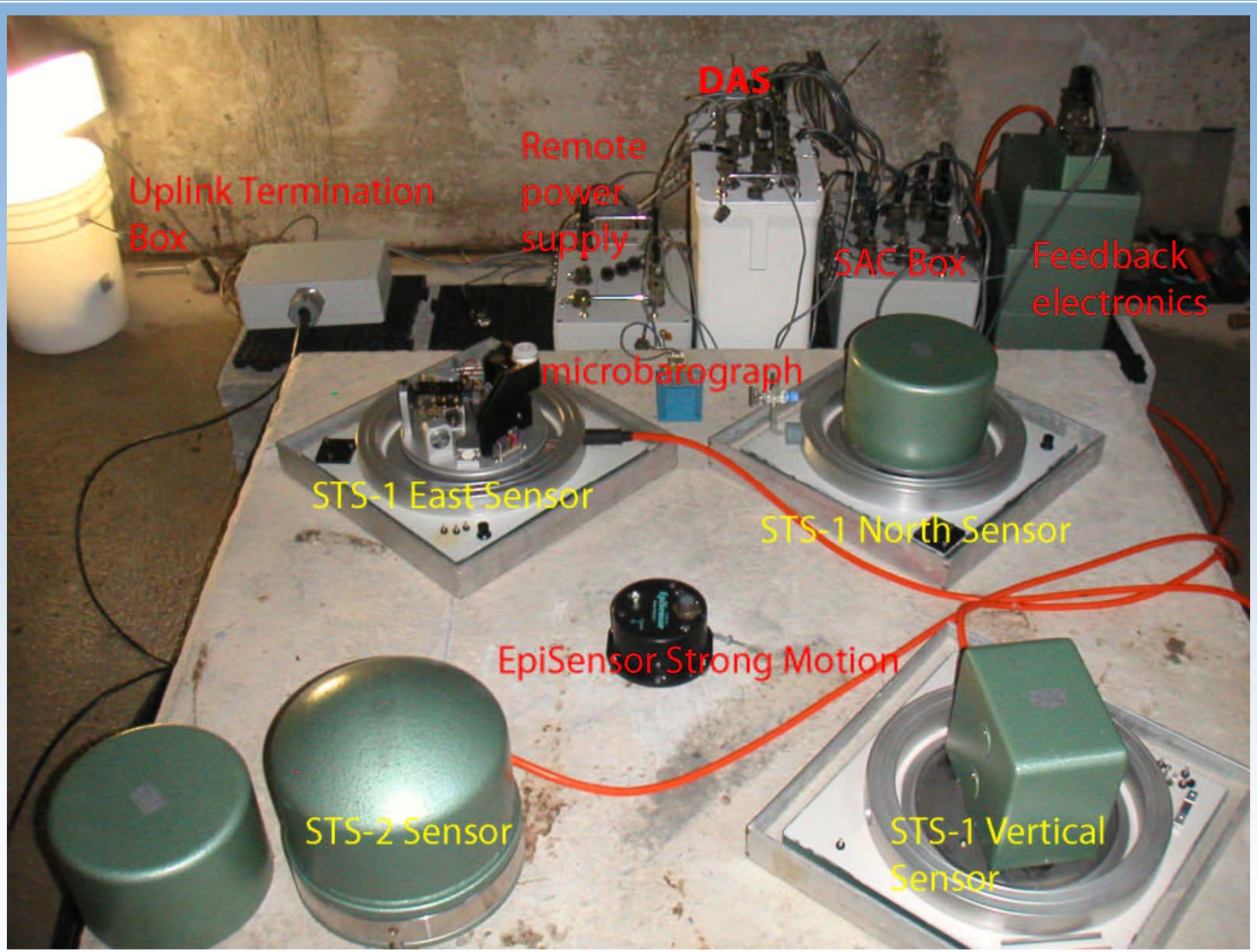
Other equipment needed:

- Clock to time the data
- “DAS” to convert electric current to numbers for a computer to process

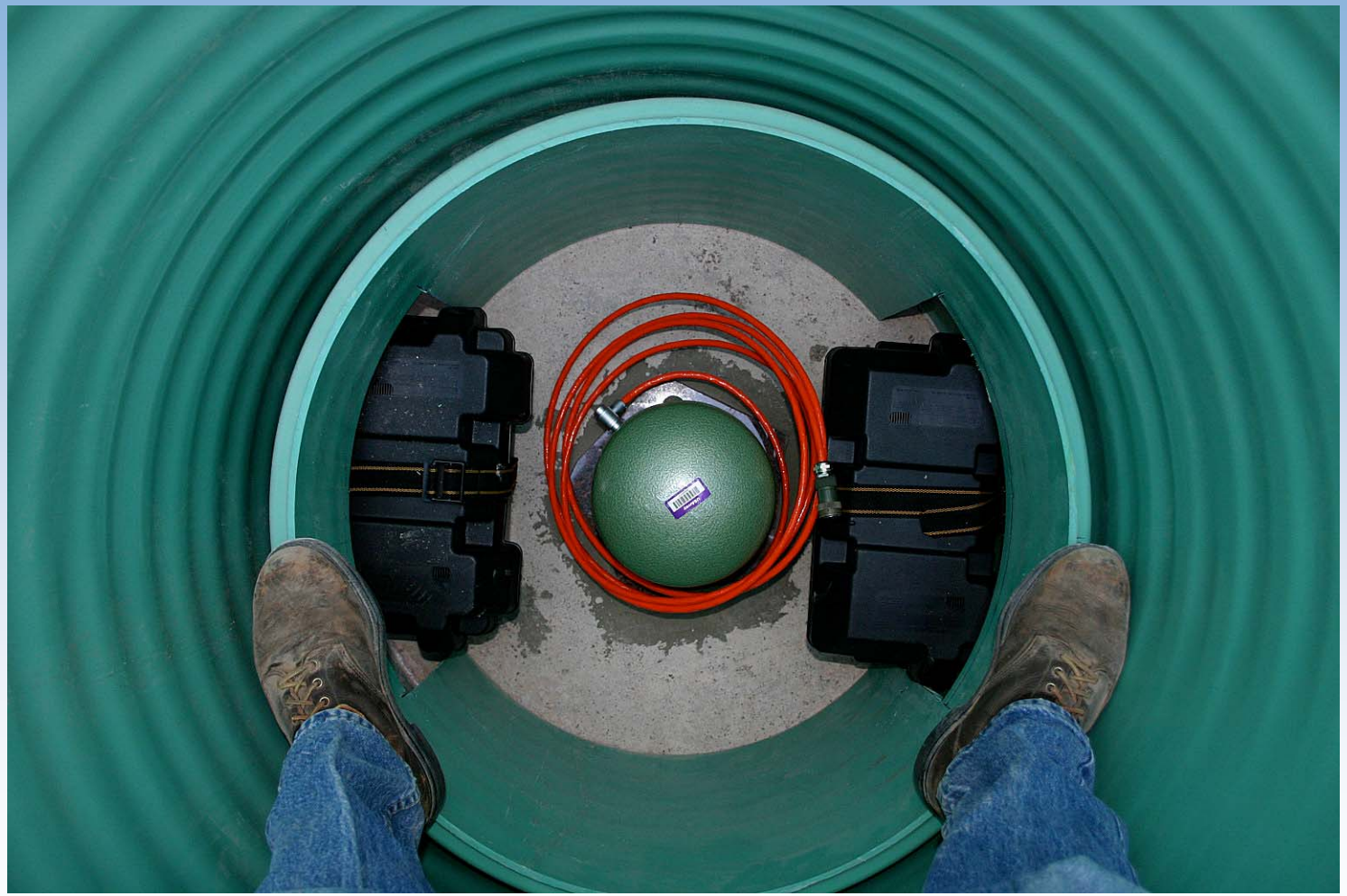
IDA MK8 DAS

Another popular model

Vault of an observatory



Vault of a regional seismic station



Other kinds of equipment needed:

- Clock to time the data
- “DAS” to convert electric current to numbers for a computer to process
- A source of electric power

Power for an observatory:

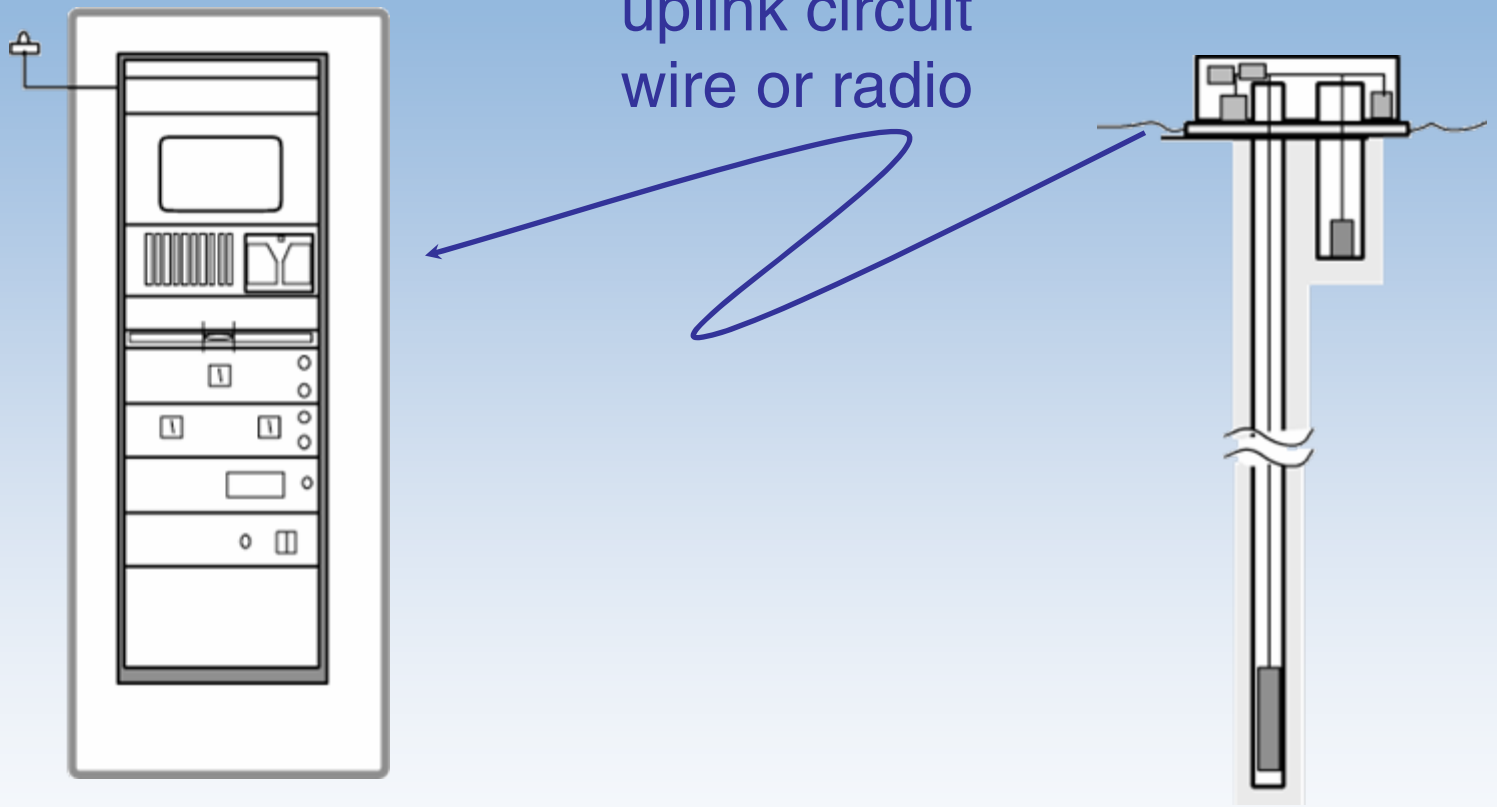
Solar power

Thermoelectricity

A regional station:

Where is a good place to put a seismometer?

- Far from human-generated noise (roads and machinery)
- Far from the ocean
- On solid (competent) rock
- In a temperature-stable environment

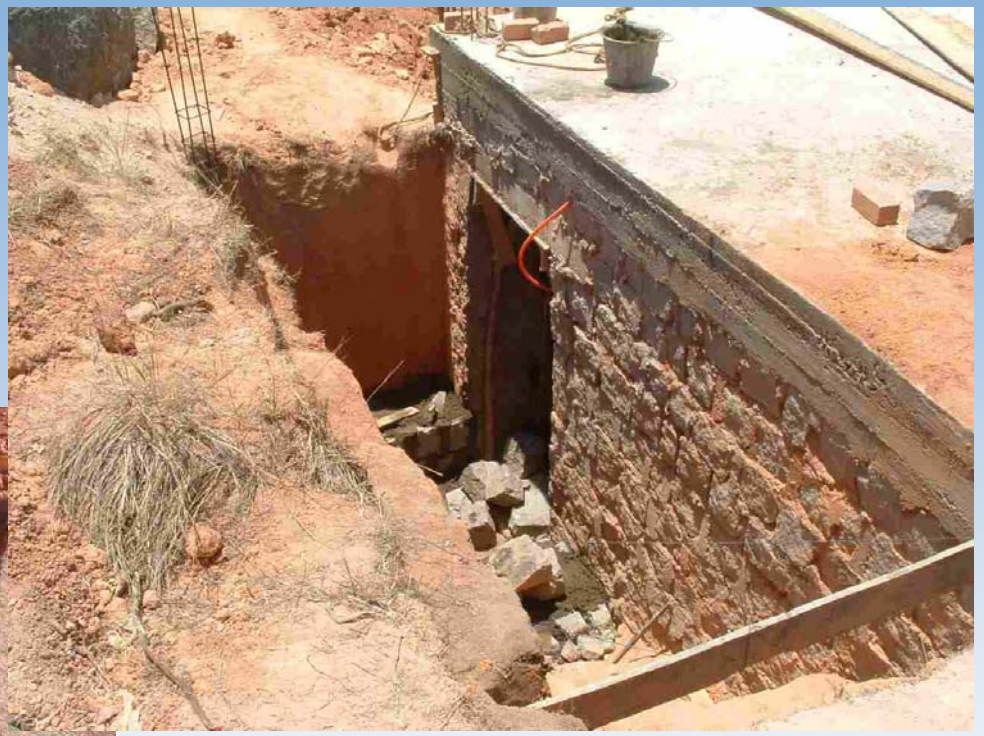


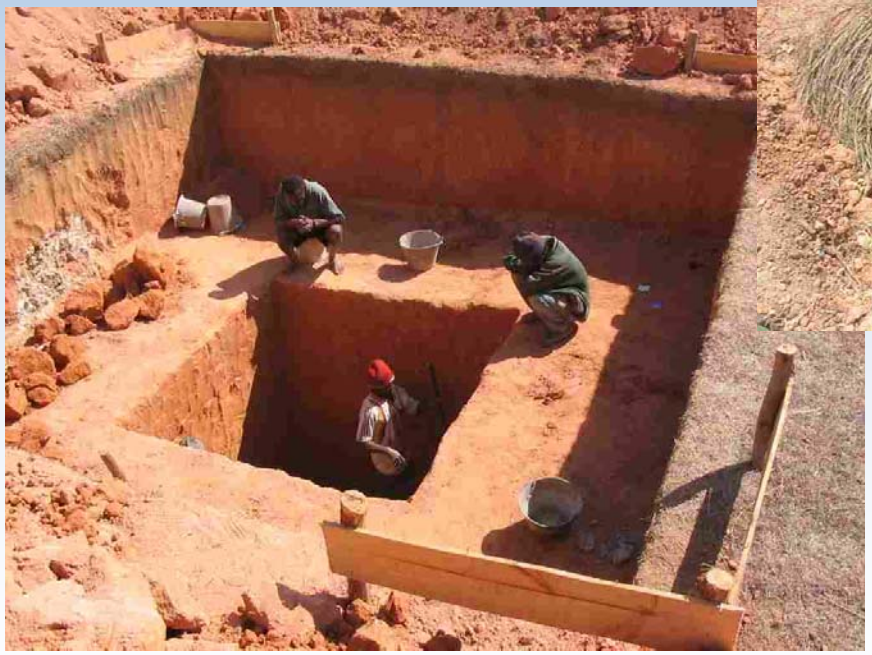
Recording Room

Seismometer Borehole

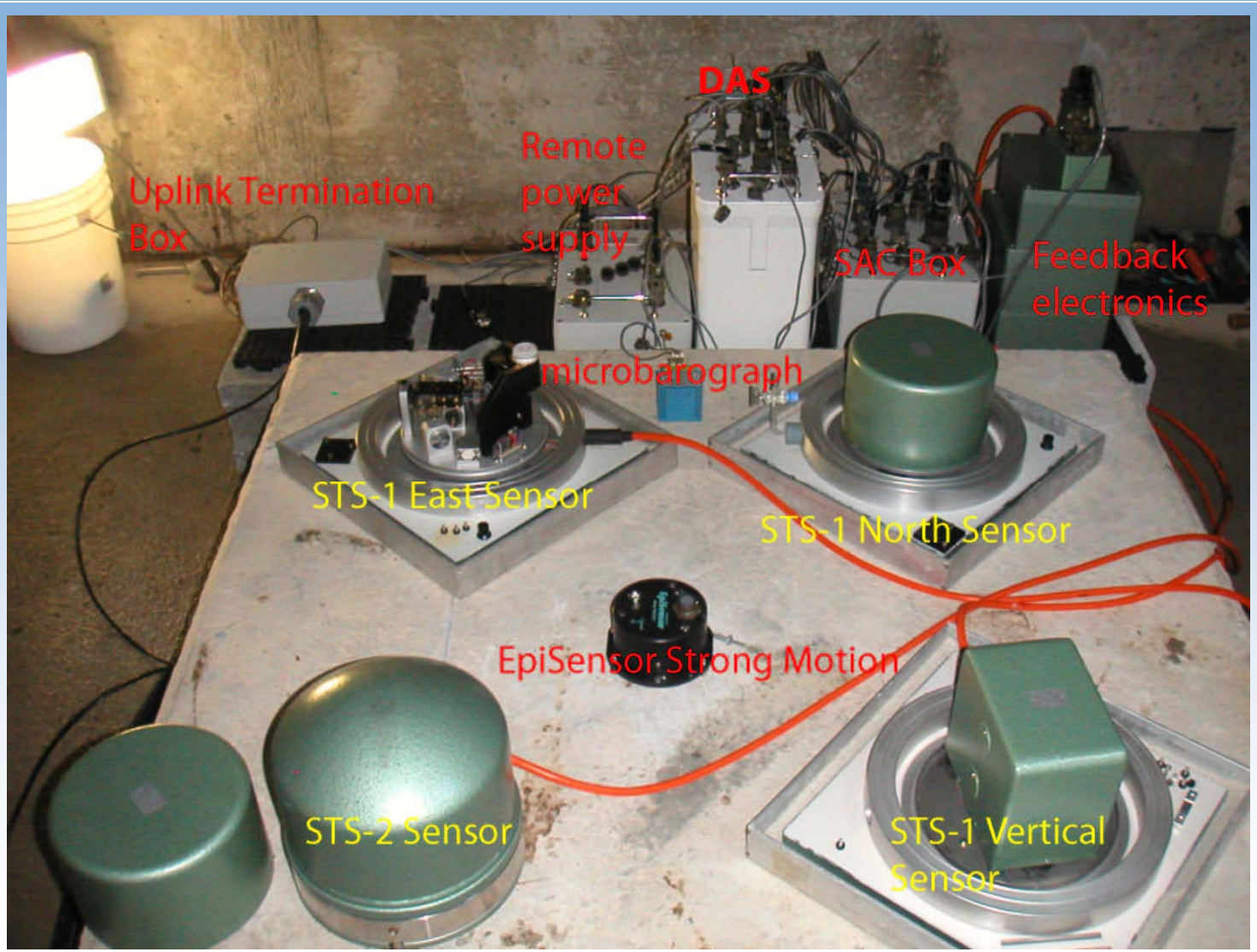
Recording room:

Seismic vault under construction in Madagascar:





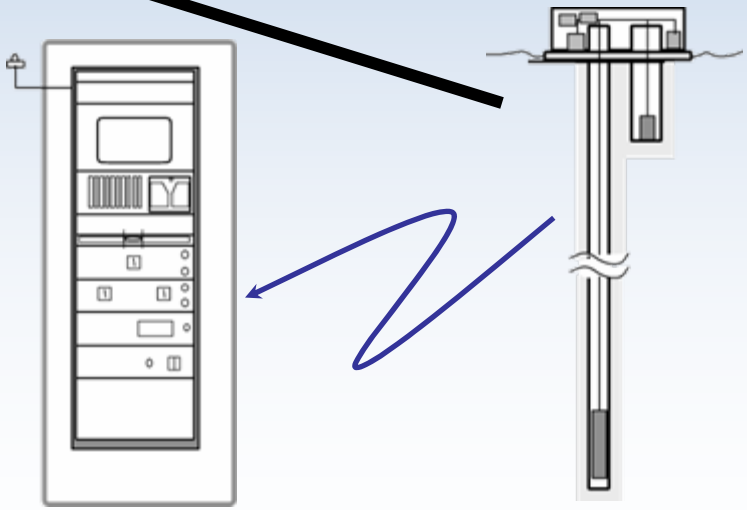
Seismic vault under construction in Madagascar:



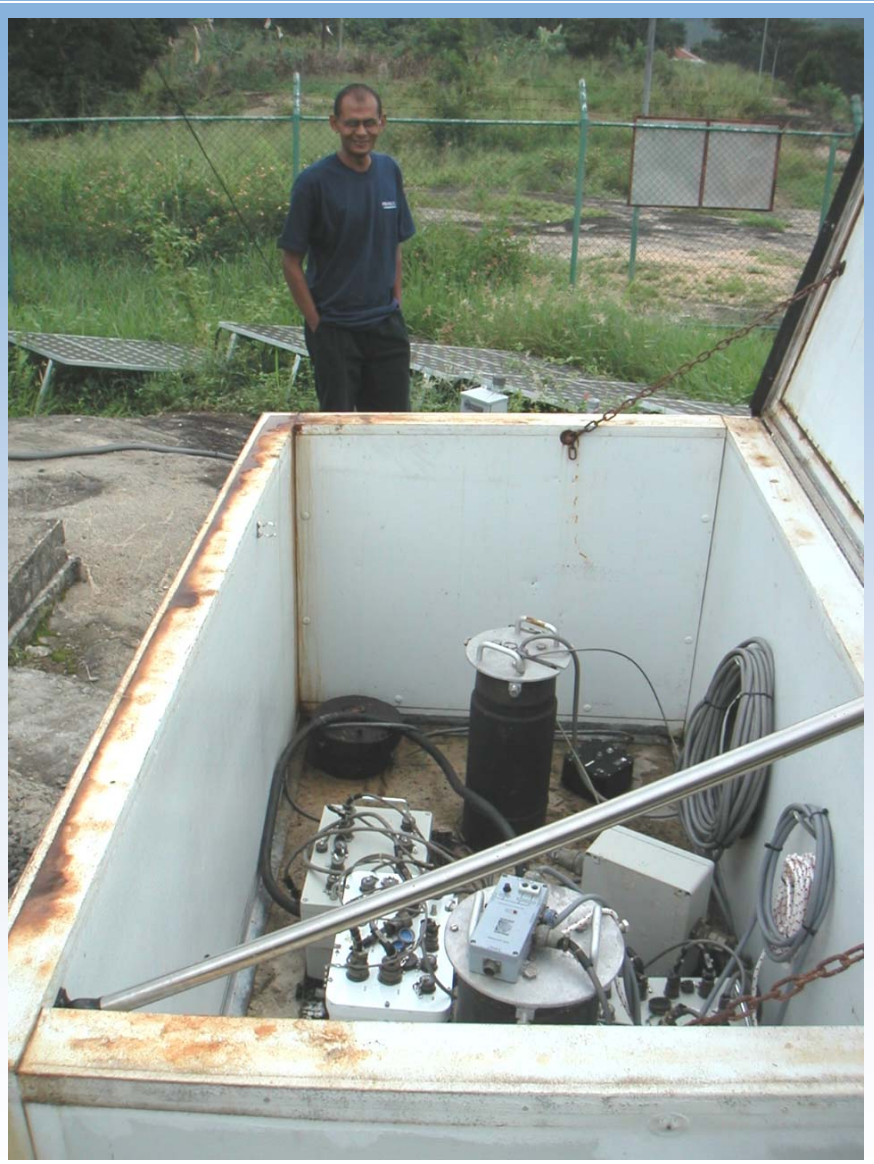
Vault of an observatory

When a vault or tunnel is not available, a seismometer can be placed in a borehole to reduce noise.

Pallekele, Sri Lanka



At PALK, the wellhead and recording room are very close.



The wellhead cover protects the electronics against damage.

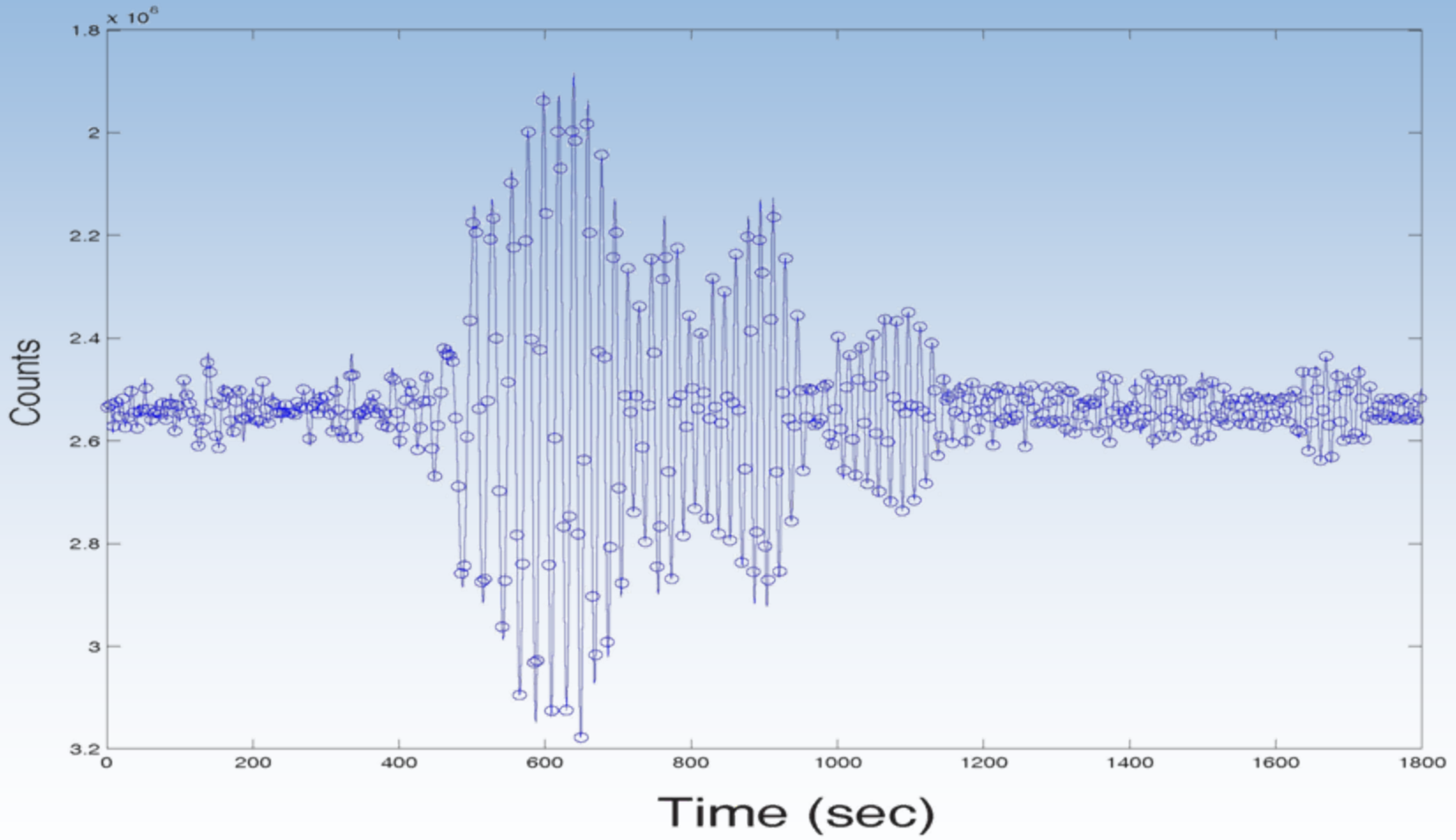
Another important subject…

the DAS

The DAS converts electrical current from the seismometer into numbers to be processed by the computer.

The electrical current from the seismometer is continuous, but the DAS produces numbers only at set intervals of time, the *digitization rate*. The DAS bundles these numbers into a packet called a *data record*.

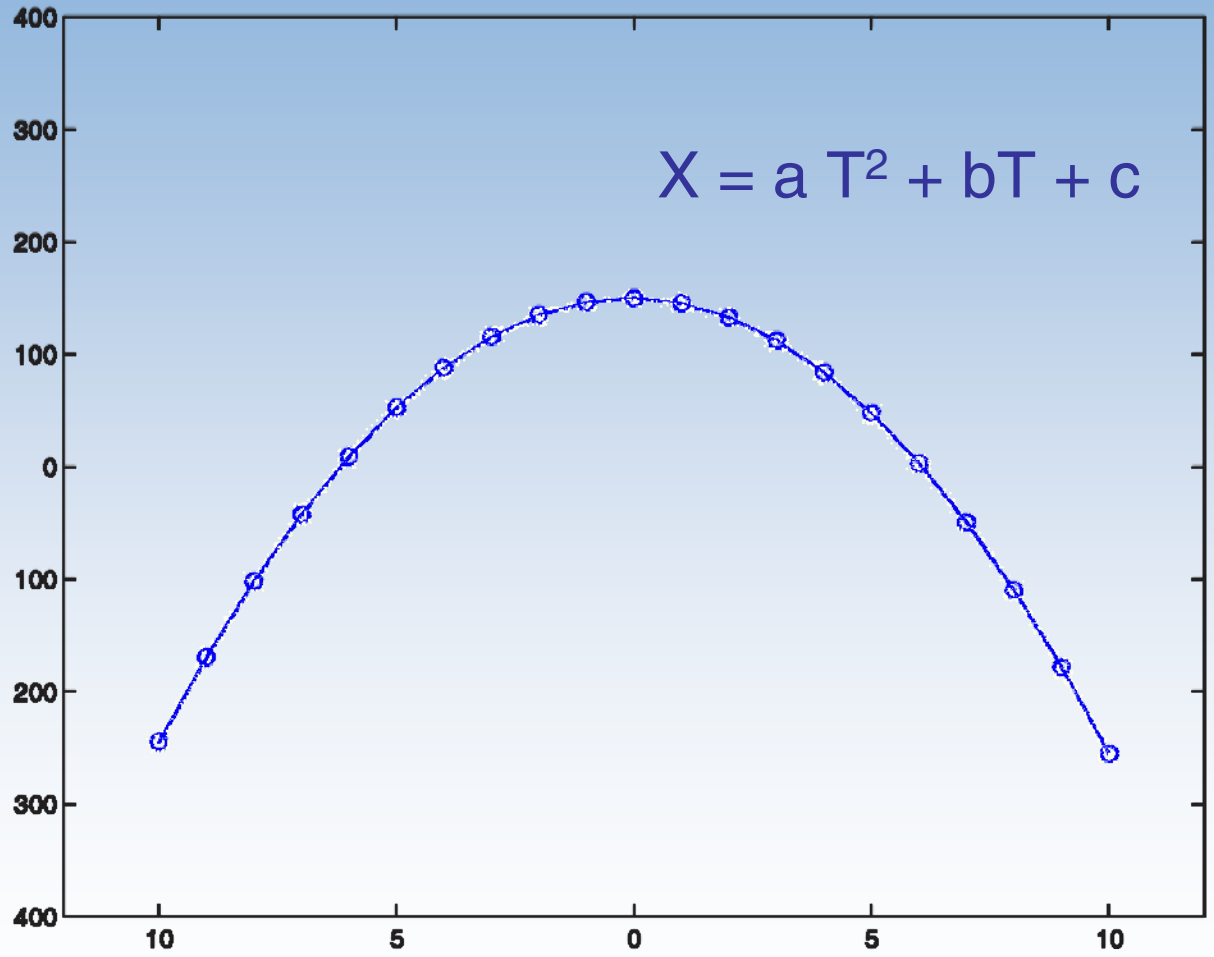
The DAS converts electrical current into numbers.



How the DAS bundles the data depends upon the computer programs running inside the DAS. Some DASs produce a record containing data for a fixed ***period of time***. Other DASs produce a record of a fixed ***size***. In this case, the period of time contained varies from record to record because the data are *compressed*.

compression

This “seismogram” is very simple:



We “compress” 20 numbers into 3 (a, b, c):

Data Telemetry

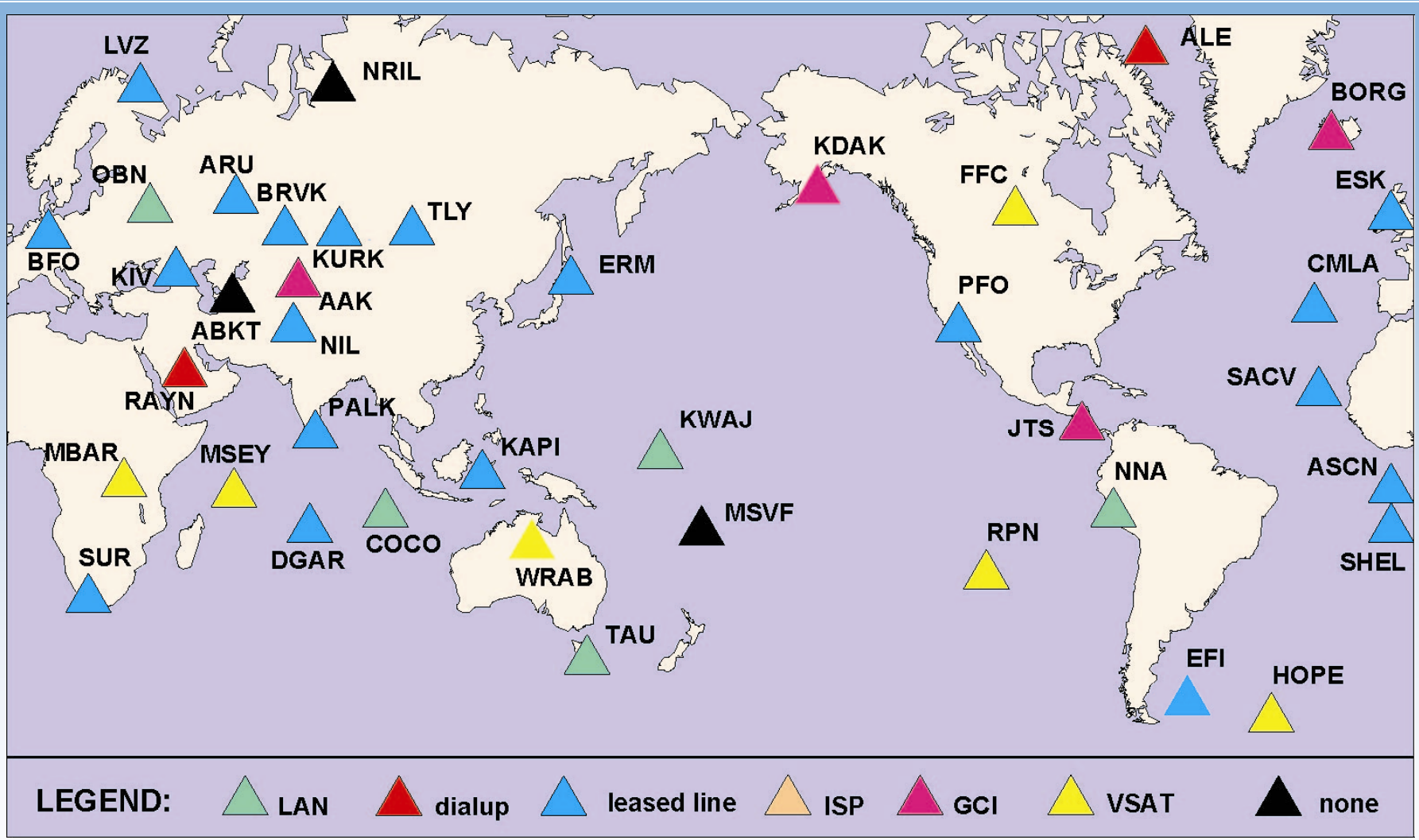
To transmit data, the following must be considered:

- Type of circuit to carry the data
- Format of the data
- The computer application(s) to manage the data transmission

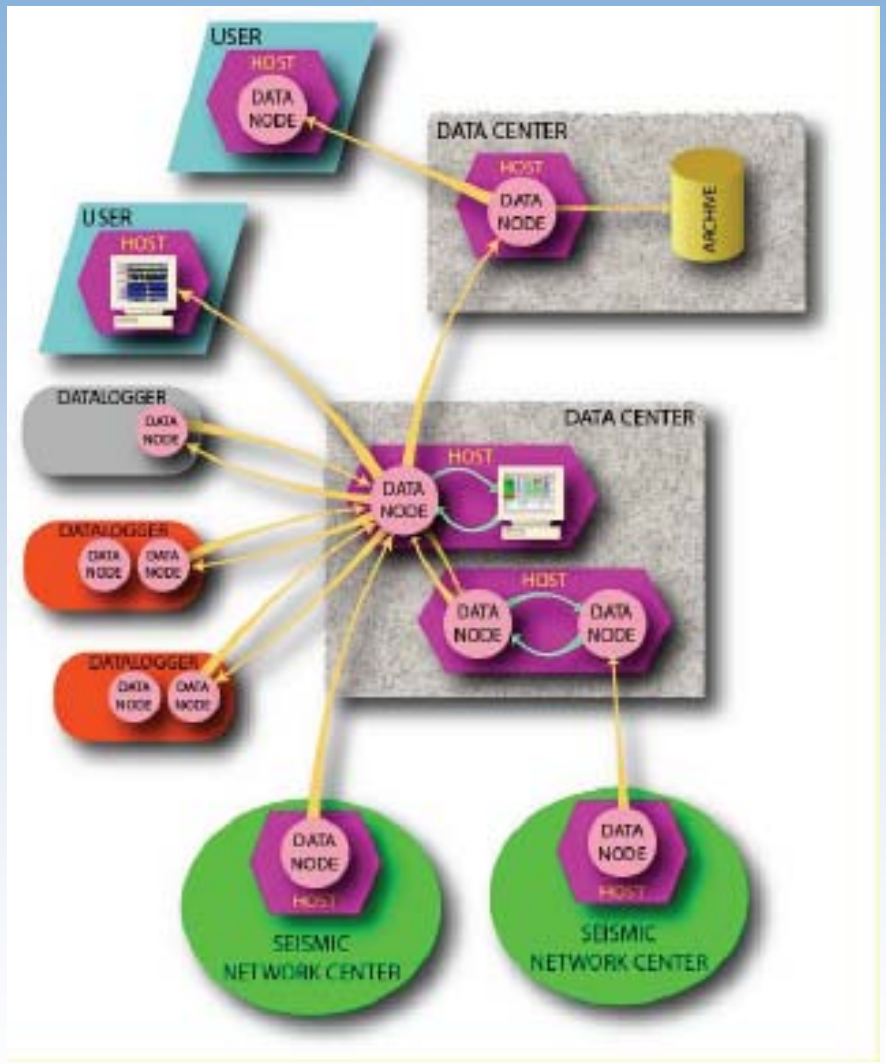
Types of circuits

- local area network (LAN)
- leased telephone lines
- VSATs
- local Internet service provider (ISP)

Mbarara, Uganda

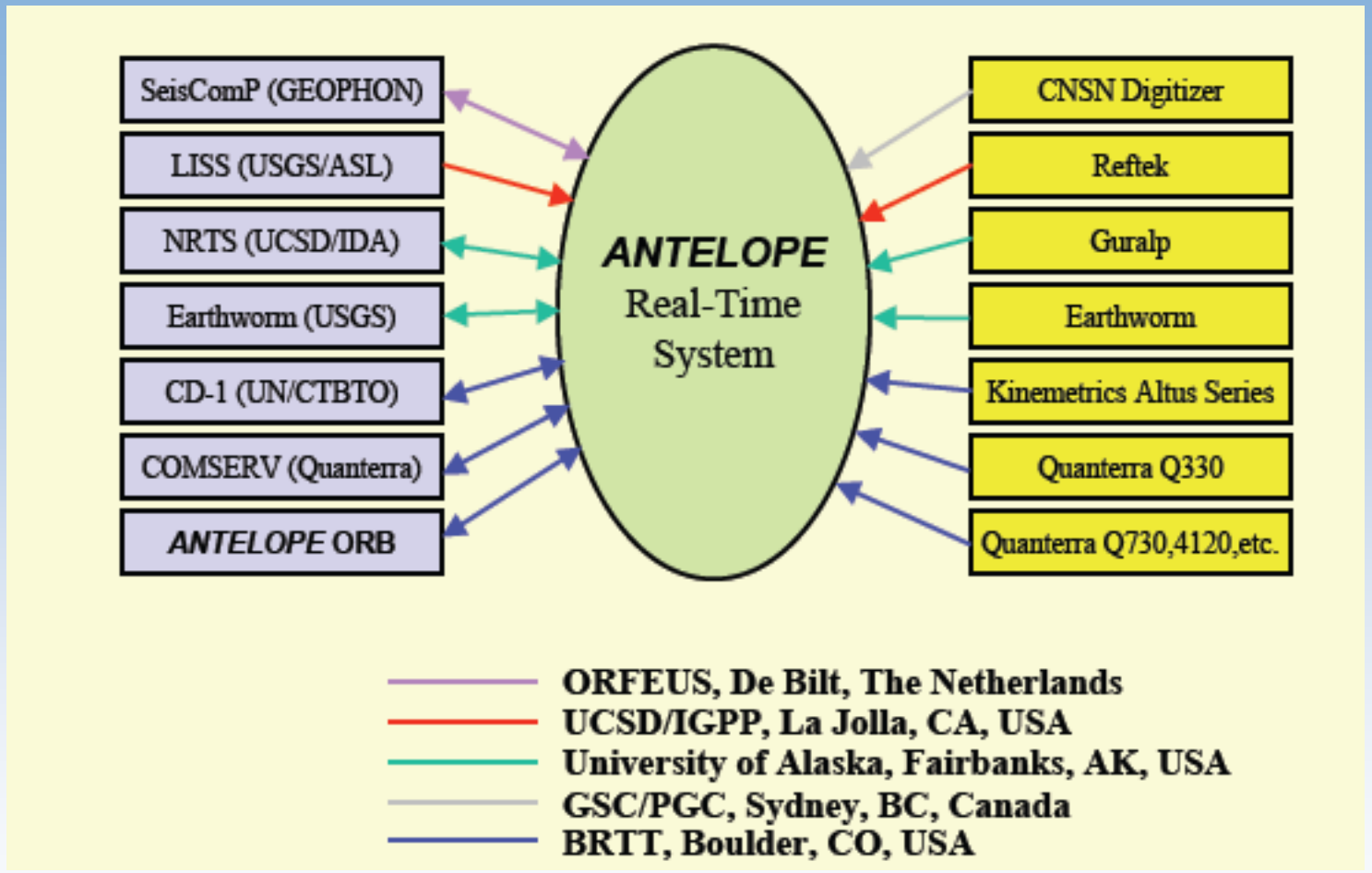


IRIS/IDA Telemetry Topology

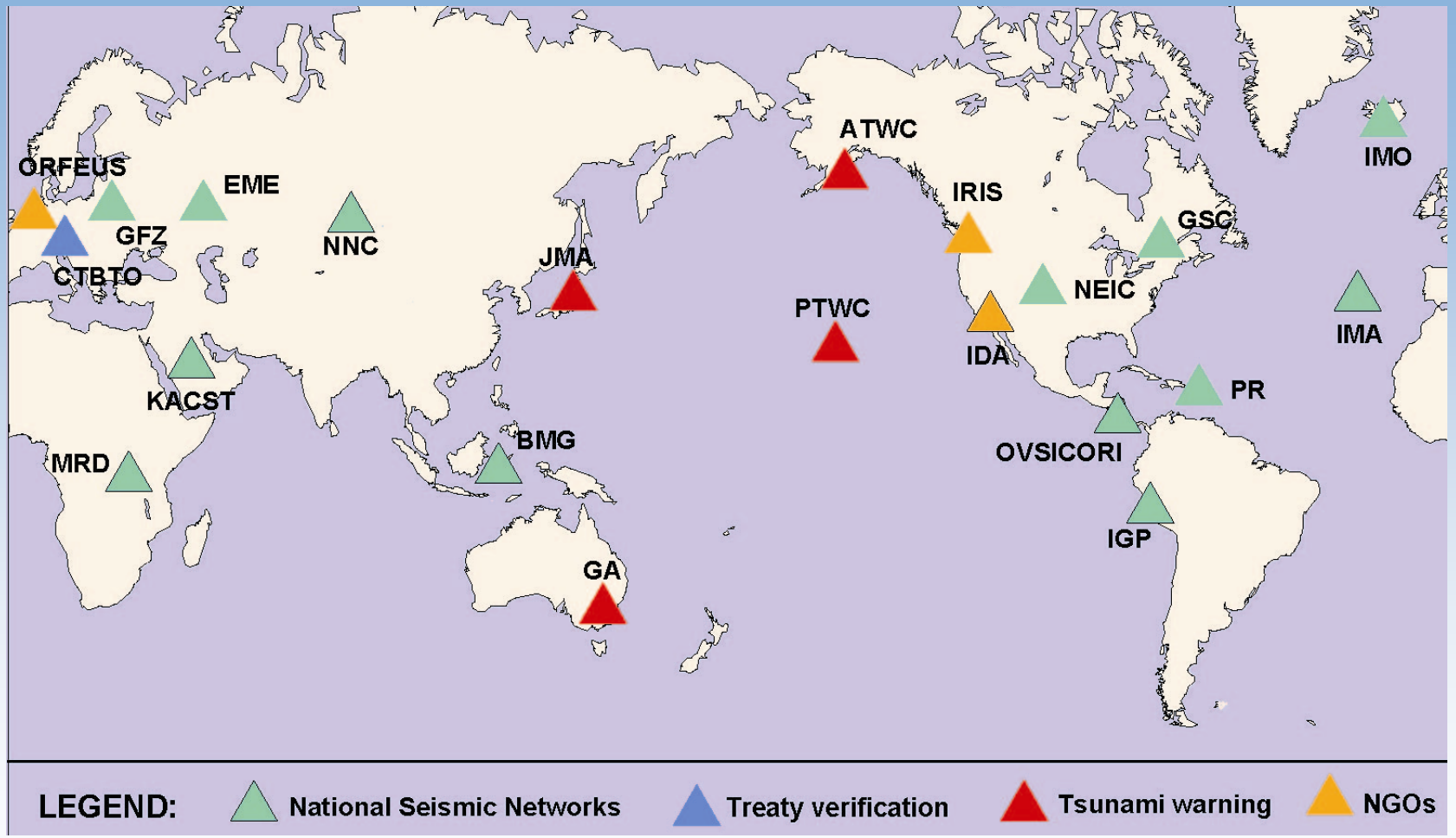


Data formats:

Data records are passed from computer to computer using data telemetry methods. Data centers may pass data to computers from other organizations. By sharing data, both organizations obtain more information.



Data center software is quite complex. Several packages exist, including this commercial one.

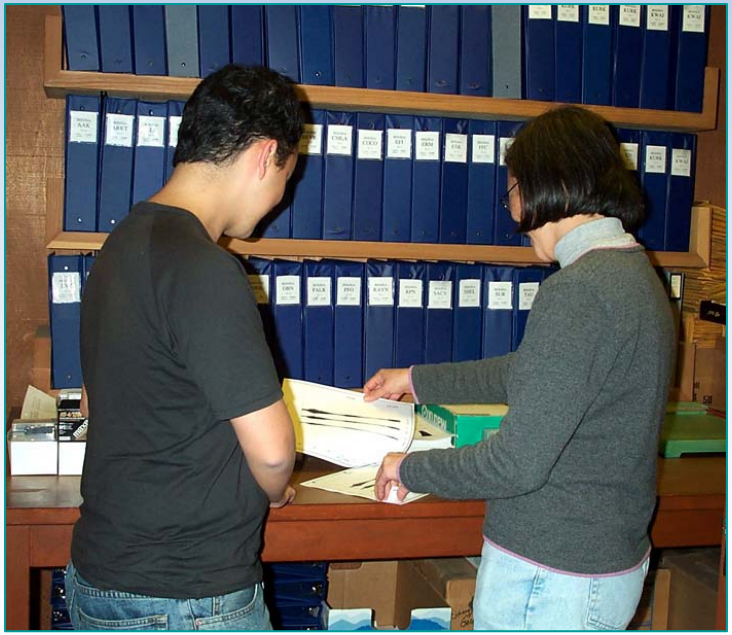


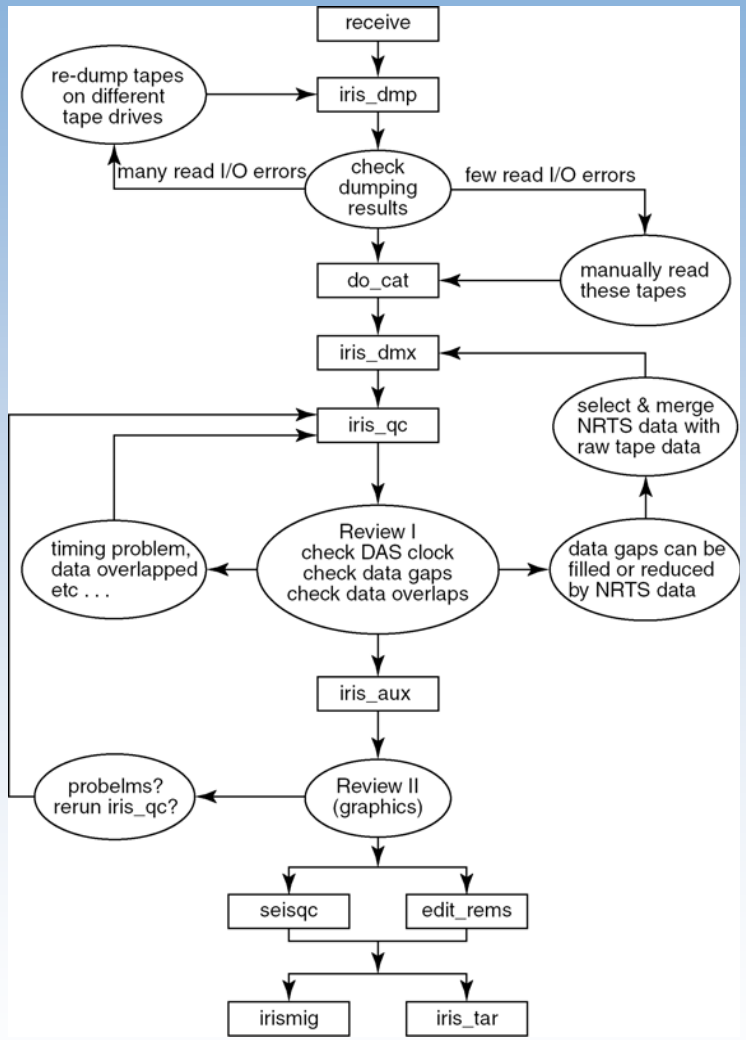
Networks integrating IRIS/IDA Data

Data archiving:
On-site recording media

- DAT tape
- CD-R

In San Diego, comprehensive data analysis





Data are then sent to the IRIS Data Management Center in Seattle, USA where they are available to anyone who requests copies. For more information, see http://www.iris.edu.