Lecture 6: Starting Scientific Projects, Map bases, Safety

Project design
Base maps and where to get them
Communication
Stratigraphic columns
Maps at various scales
Remote sensing
Literature search on Georef and Web of Science
Health and safety considerations
Readiness to undertake field work
Today in the field: Contact and marker bed mapping
A new design for an intuitive mapping protractor

Outline:
- Identification of the problem: objectives and scope
- Background information and literature search
- Planning and strategy
- Field orientation, formation names, rock types
- Implementation
- Completion

The problem: What needs to be known? Why? Is the question important and interesting? What would you do with the answer if you had it in hand? Is the problem tractable and worthy of the time and the cost?

Background information falls into five principal categories:

1. Maps (topographic and geological), 2. Visual remote sensing (air photos, satellite images and side-looking radar-SLR), 3. Geophysical surveys (airborne and land-based magnetics, radiometrics (U, Th and K) and gravity), 4. Scientific reports (the literature) and 5. Scientists currently working in an area.

One accesses these types of information by different means and the information is provided on different media. For example, topographic maps are usually printed on paper while geophysical data is available now on CDROM.

Recently digital terrain data has become available. Computers are heavily used in earth sciences. To effectively locate the critical sources of information, computer-assisted search techniques are vital and these are very user friendly. If you have never been exposed to them, they will change your life.

Current thesis research is often published by state geological surveys to promote interaction. Get to know other workers in the area and cooperate with them rather than compete. Build up a group of professional colleagues and share talents and resources.

Topographic maps by US Geological Survey: excellent quality and several scales available: 1:12 minutes of longitude,
The California Division of Mines and Geology also carries maps. Their head office is in Sacramento.

Selected topographic maps can be purchased at Recreational Equipment Inc (REI) at 1338 San Pablo Avenue, Berkeley. They also carry a fairly complete supply of US Dept. of Agriculture Forest Service maps of national forests. These are excellent road maps and show park boundaries as well as property divisions including Indian lands, Bureau of Land Management, State land and private ownership.

UC Berkeley Campus: (1) the Map Room of the ES has maps and air photos for many parts of the world. The Earth Sciences library map room is good or using master quadrangle location maps to find the specific areas you may need.

Foreign geological surveys and Ministries of Mines in each country.

Geological maps: Geological quadrangles

Road atlases: De Lorme Southern California Atlas and Gazetteer
De Lorme Northern California Atlas and Gazetteer

Convenient and well-organized books composed of topographic maps of all of California and Oregon. Good for locating sample and planning field trips, finding campsites, but quality of the topo maps is not high.

Purchasing air photographs from:

U.S. Department of Agriculture
Sales Department
Aerial Photography Field Office
2222 West 2300 South
Salt Lake City, Utah
84115
Telephone: (801) 233-3503

Specifying location: Quadrangle name and position within the quadrangle by Township, Range and Section are used which are coordinates based upon early public land surveys if the US. The grid extends across the entire US.

Aerial surveys can be arranged commercially. Airplanes can be chartered at quite a reasonable expense to simply provide you with an aerial perspective of your field site or more considerably more money, take new air photos and carry out geophysical surveys.

Satellite images - Landsat and other satellites, eg. French provide photographs and spectral imaging at different wave lengths, eg. infra red which shows water content and THEMATIC MAPS which shows minerals eg. iron and potassium.

Stratigraphic Correlation: When starting field work in a new area, you can immediately find out the main formations. They are already known. In the US the American Association of Petroleum Geologists (AAPG) have compiled stratigraphic sections across the entire North American continent. It is called (Correlation of Stratigraphic Units of North America (CORINA)). CORINA stratigraphic cross sections contain a wealth of stratigraphy and geochemistry.
Figure 3.9: Designating locations of parcels of land is usually done by specifying (a) fraction of a section, (b) section, and (c) township (by township and range). Examples A through D follow below.

A: NW 1/4, Sec. 32, T2N, R4E
B: SW 1/4, NE 1/4, Sec. 32, T2N, R4E
C: W 1/2, SW 1/4, Sec. 32, T2N, R4E
D: S 1/2, SE 1/4, Sec. 32, T2N, R4E

Note that the order of fractions of a section is as though the words were read between fractions. A point, rather than a parcel, can be described as the (c) of some fraction of a section.

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Contact
AAPG
Bookstore
for CD ROM

http://bookstore.aapg.org/source/orders/index.cfm
Medium scale maps
Geological Maps

Scale 1: 5,000,000 (1 inch = 40 miles) 1974 Geological Map of the United States, United States Geological Survey, located by Room 391 ESR. Good for recognizing continent-scale structures and units, eg. Cordillera, sedimentary basins such as the Belt, and really big features.

Scale 1: 2,500,000 (1 inch = 20 miles) Geologic Base map used for locating most of the Geology 100B rocks in California. (reduced to fit on 8.5x11 inch sheet). Very generalized, but useful for broad lithological divisions.

Scale 1: 750,000 (1 inch = 12 miles) 1977 Geological Map of California, California Division of Mines and Geology, located next to Room 398 ESR. Good for synthesis.

Scale 1: 250,000 (1 inch = 4 miles) Geological Map of California. California Division of Mines and Geology, 2 degree (Latitude) sheets which all together make up the entire state, located opposite Room 399 ESR. Turn on light with pull chain. Excellent maps for reconnaissance work.

Scale 1: 62,5000 (1 inch = 1 mile). Geological 15 minute quadrangle maps. Most widely published scale for geological mapping.

Small Scale maps (1 inch = 20 to 100 feet). Used for many purposes when detailed mapping is required, eg. intrusive relations, metamorphic facies, mine workings, engineering and environmental geology.
Detailed mapping

Rainbow Tungsten Mine Sierra Nevada Mts.

Small scale maps

Map scale depends on the needs of the project:
What question are you trying to answer
Digital Base maps and ortho-images:

Start with USGS

http://ngmdb.usgs.gov/
Accessing maps in digital format on the web:

Hyperspectral (visible and IR) Thematic Mapper Atacama desert, Chile

Dips due to energy absorbed by vibration of water molecule
What are the processes behind spectral features?

**Vibrational region**
- Caused by excited vibrational modes of certain molecules in structure
- Affected by:
  - Number of atoms in molecule & their masses
  - Bonding between atoms
  - Symmetry of the molecule

**Electrical region**
- (0.35-1.0 \( \mu \text{m} \))
- Caused by change in energy level of shared electron in unfilled shell in Transition elements (Fe, Ni, Co, Ti...)
- Affected by:
  - Valence of atom

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**Satellite-borne**
E.g., NASA's Landsat 6

- Target on ground is typically 1 Km²
- Acquisition time is in the order of fractions of seconds.
Landsat Thematic Mapper
Bands 2, 4 and 7 output on Red, Green and Blue

Hyperspectral (visible and IR) Thematic Mapper Atacama desert, Chile
Be ready And Equipped To do your field work

Please make sure it is assembled and you are writing in it each day
Mapping contacts and marker beds are used to find geological details, like faults.
Conducting the field project

Project planning

Safety first

Seek permission *in advance*

Maintain your contract for continued access

*eg EBMUD:*

Access only as a class under supervision,
On days with advance notification,
No smoking, don’t bother the cows
Inform locals where you will be and when you return
Health and Safety:
Personal First aid kit in your vest or back pack
Group first aid kits in (1) Instructors vest and Vehicle.
Have an emergency plan
Recommend: (1) a First-Aid class eg by American Red Cross
First aid, CPR and automatic de-fibrillation
(2) OSHA or MSHA safety training
Never climb over barbed wire fences, go under them or through gates
Do not have a lot of loose gear or rocks in back that can fly around
Driving: Seat belts work at all times in vehicles: Driver should check at start
Driver is held accountable by CHP
Never drive while fatigued
Designated driver
Caravanning at all time
Hiking: Be careful of your footing and your neighbors, rock falls or slipping, avoid poison oak, wash each night- at truck and h

Driving (road accidents are your major threat):
Drive with sufficient distance between you and the car ahead for whatever the road conditions are
Do not drive in a rush and respond to changing road conditions
Call Cal Trans for road conditions
Passengers assist driver, especially all people in front seat
Keep a hammer taped under a seat to break windows if trapped
Keep a cell phone charged to call
Avoid long drives late at night to avoid fatigue
Maintain oil level in engine
Geological reasoning

Position

Strategy: (1) transect or (2) contact or marker bed

Working hypotheses to select a work plan

Best use of available time and resources

Safety first at all times

Observation

Mapping

Check expectations and resolve differences eg fault off-set

Pattern recognition

Maintain focus- not not go “Walk about” except on your own time

Meet in Hass Club house parking lot

Right Hand Rule
Direction of View
Read North Arrow
Quiz 2