Damietta University
Faculty of Science
Geology Department

Magnetic Exploration Course

For

First Year Geophysics Program

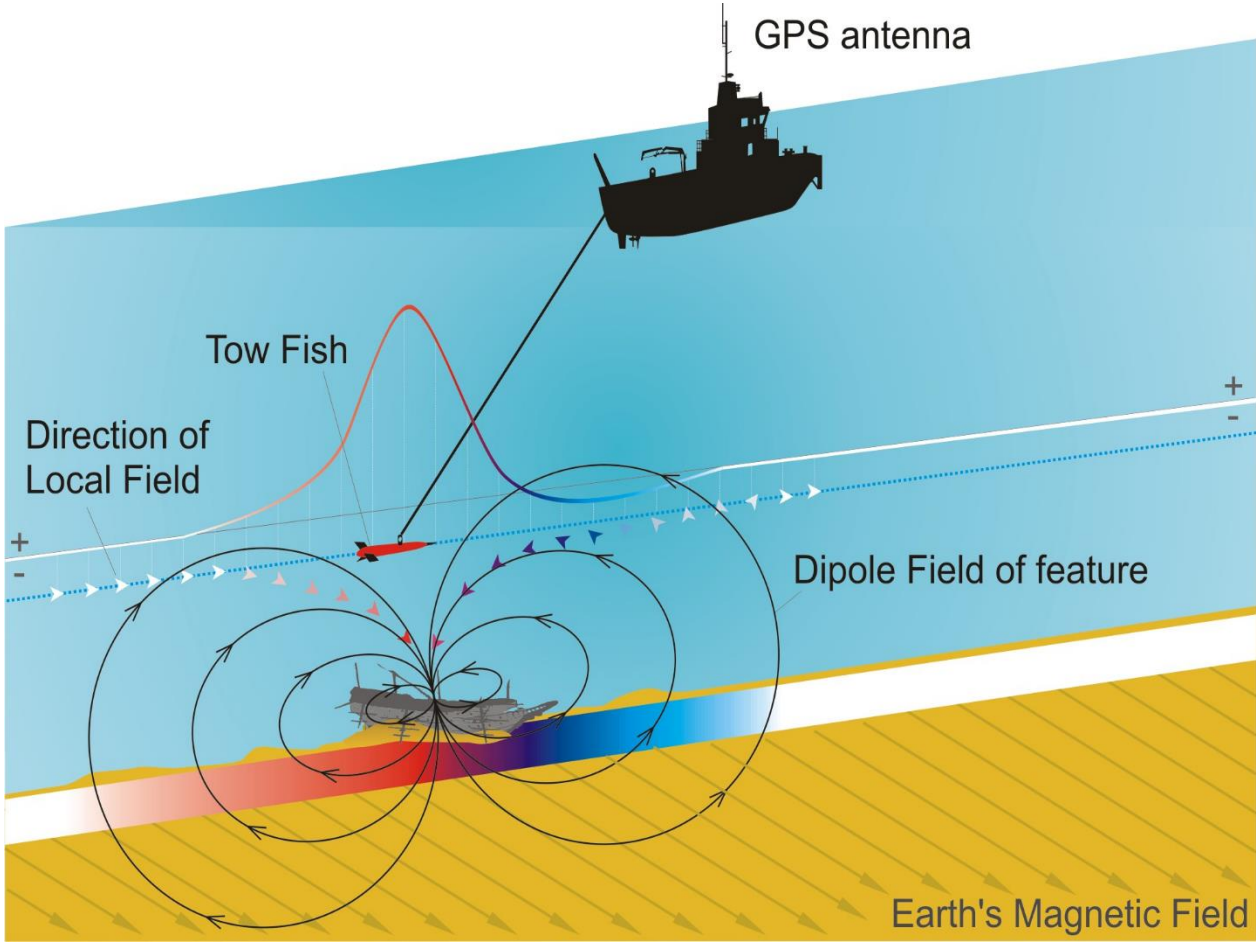
Code: 102 Geoph

Lecture 7: Data Aqustion Part 2

Dr. Hatem Aboelkhair

2020

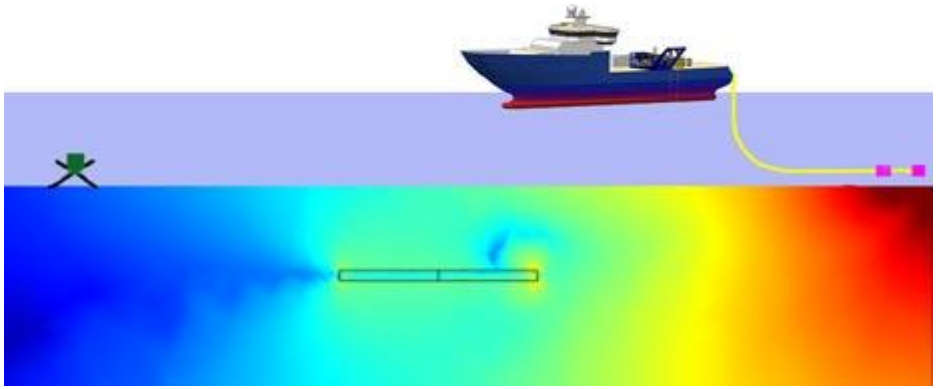
Shipborne magnetic survey



Shipborne magnetic survey

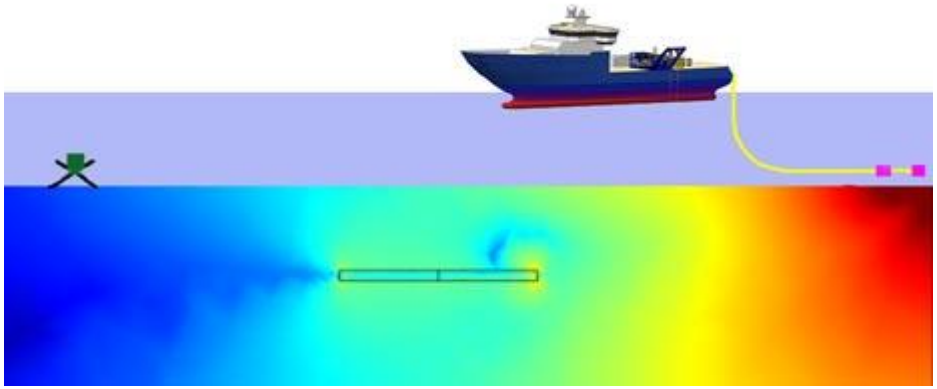
Application

- Marine magnetic surveys have produced much of the evidence for plate tectonics.
- Exploration of the seafloor for mineral resources, as well as archaeological, engineering, and military applications.



Shipborne magnetic survey

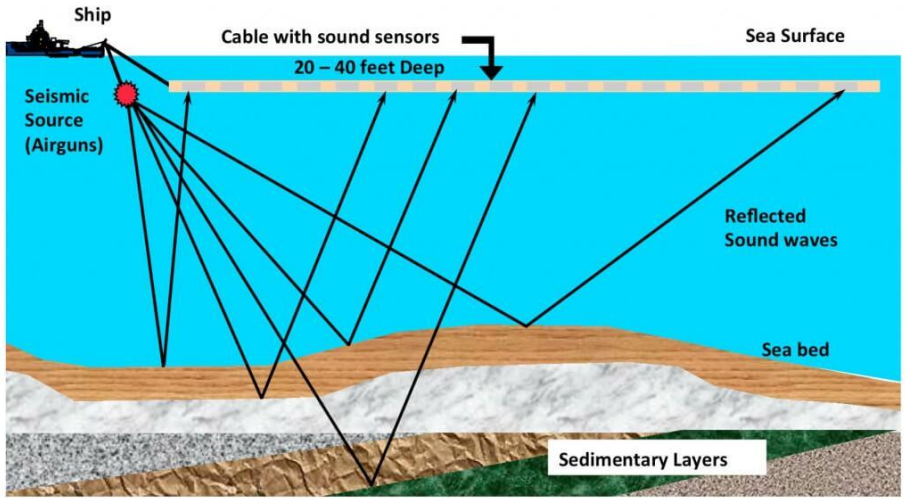
- Marine magnetic surveying is slower than airborne surveying.
- Magnetic surveys can be completed over water by towing a magnetometer behind a ship.



Shipborne magnetic survey

Acquired with other geophysical methods

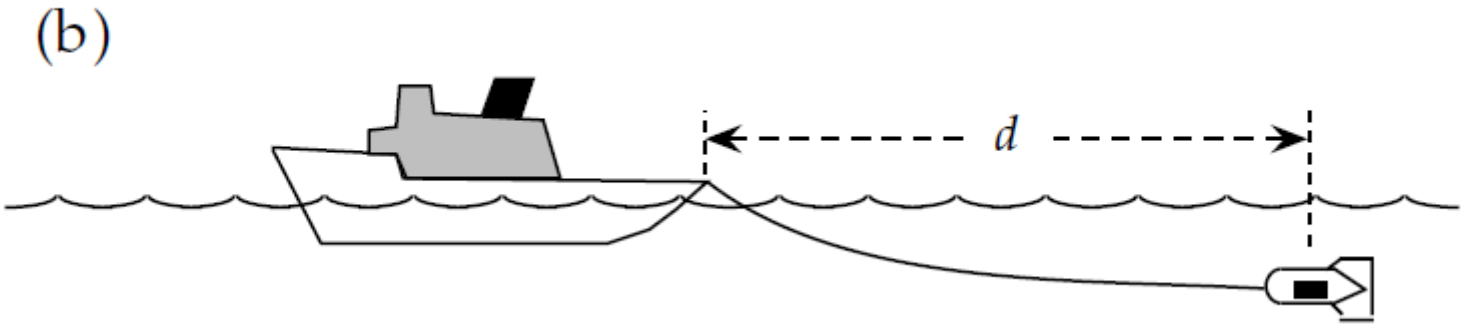
When other geophysical methods are being conducted by ship, however, it may make sense to acquire magnetic data simultaneously



Shipborne magnetic survey

Minimize disturbance

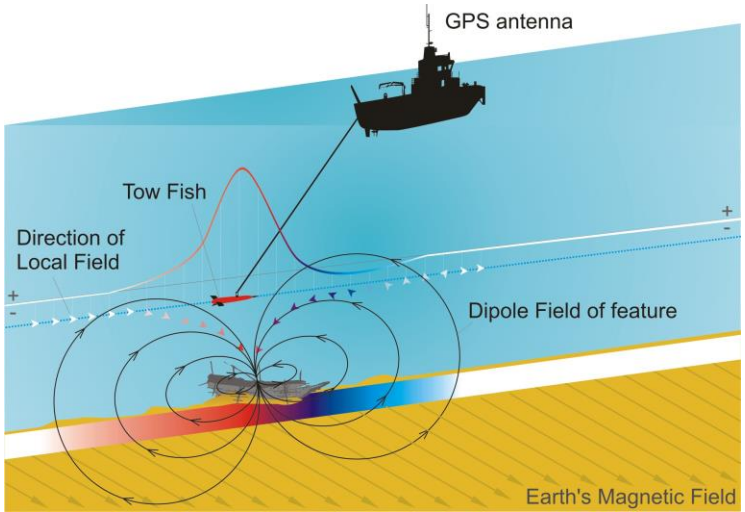
To minimize the disturbance of the ship the tow-cable must be about 100–300 m in length.



Shipborne magnetic survey

To improve the resolution of survey

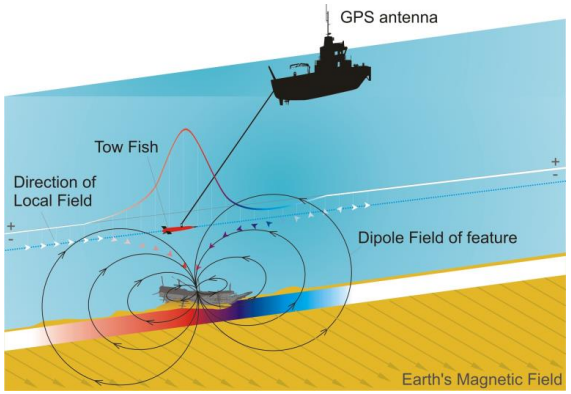
- Surveys may be made close to the ocean bottom to improve the resolution of the observations.
- The survey tracks are typically perpendicular to the magnetic or structural fabric of the seafloor.



Shipborne magnetic survey

Shipborne track spacing

- The track spacing is determined by the minimum magnetic source depth which is commonly taken as the water depth.
- Seafloor depths typically range over 2–6 km so that track spacings of 2–10 km are normally sufficient for most oceanic geology applications



Shipborne magnetic survey

Monitoring of temporal variations

- Temporal variations in the geomagnetic field may be checked from the records of nearby geomagnetic observatories or base stations anchored to the seafloor within the survey area.
- The need for magnetic base observations is eliminated when surveying with magnetic gradiometers.

Ground magnetic survey

Ground magnetic survey

Ground magnetic used for detailed follow-up

Ground magnetic surveys are often used for detailed follow-up in areas identified as interesting from reconnaissance.

Ground magnetic survey

In archaeological and environmental Exploration

In archaeological, and hazardous waste studies, station spacing can be close to 1m.

Ground magnetic survey

In petroleum exploration

In petroleum exploration, land magnetic and gravity surveys are often conducted in conjunction with land seismic survey.

Ground magnetic survey

- Measurements are made at specified locations using handheld instruments with the sensor located at the top of a staff of a half a meter or more above the ground surface.
- This is to minimize the effects from local variations in the magnetization of the soil and magnetic fields derived from currents induced in electrically conductive soils from fields originating within the magnetometer.

Ground magnetic survey

Define station location precisely

In either case, positioning of the stations can be performed precisely as desired from visually spotting stations on satellite image to surveying in each image using highly accurate GPS.

Ground magnetic survey

Be away from any magnetic interference

- Regardless of the objective, stations should be set at safe distances from all magnetic interference such as power lines, bridges, and other culture features.
- Typically, railroad tracks should be no closer than 120 m, cars 25m, wire fence 30m.

Ground magnetic survey

Operator should be free of magnetic materials

The magnetometer operator should be relatively free of magnetic materials.

Compasses, pocket knives and geological hammers are all detectable at distances below about a meter, and the use of high sensitivity magnetometers may require visits to the tailor for non-magnetic clothing.

Ground magnetic survey

Methods of survey

- Magnetic surveys are also commonly conducted on foot or with a vehicle.
- Ground-based surveys may be necessary when the target of interest requires more closely-spaced readings than are possible to acquire from the air.

Ground magnetic survey

Instrument reading

- All field readings should be taken twice and the two readings should differ by no more than 1 nT.
- Large differences between readings at adjacent stations call for infill at intermediate points. The operator must notices this, and infills immediately.

Ground magnetic survey

At each station the location, time and reading must be recorded, as well as any relevant topographic or geological information and details of any visible or suspected magnetic sources.

Unless the grid is already well mapped, the notebook should also contain enough information for the lines to be positioned on maps or satellite image.

Ground magnetic survey

- Wherever possible, conduct surveys perpendicular to strike.
- Establish base station to incorporate drift (should be in flat terrain, away from electromagnetic field sources, and easy to reoccupy).
- Position and elevation routinely recorded with GPS:
  - Continuous
  - Discrete station locations

Temporal Variations

An important consideration in the design of a magnetic survey is the procedure that will be used to monitor the temporal variations in the magnetic field.

Obviously, bases should be remote from possible sources of magnetic interference (especially temporary sources such as traffic)

Temporal Variations

- Unlike the gravitational field, the magnetic field can vary quite erratically with time.
- Magnetic readings taken at the same location at different times will not yield the same results.

Strategies for Temporal Variations

Using Two Magnetometers

One is used to monitor temporal variations of the magnetic field continuously at a chosen base station, at 3 to 5 minute intervals and the other is used to collect observations related to the survey proper.

Strategies for Temporal Variations

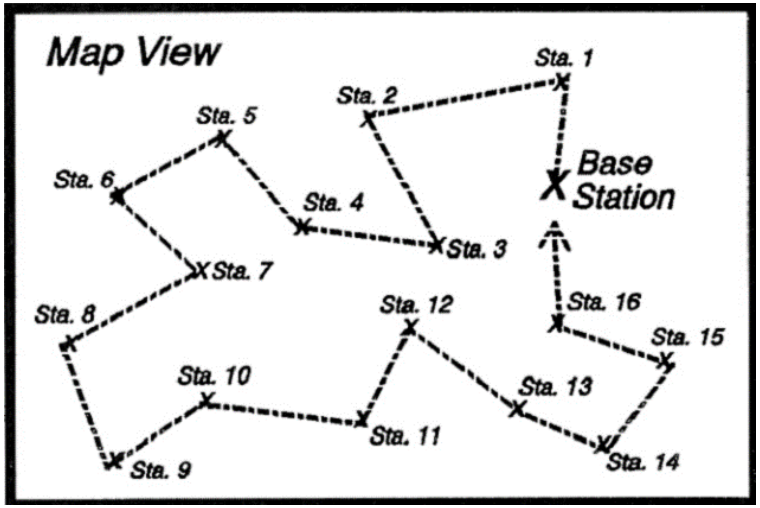
Using Two Magnetometers

By recording the times at which each magnetic station readings are made and subtracting the magnetic field strength at the base station recorded at that same time, temporal variations in the magnetic field can be eliminated.

Strategies for Temporal Variations

Using one Magnetometer

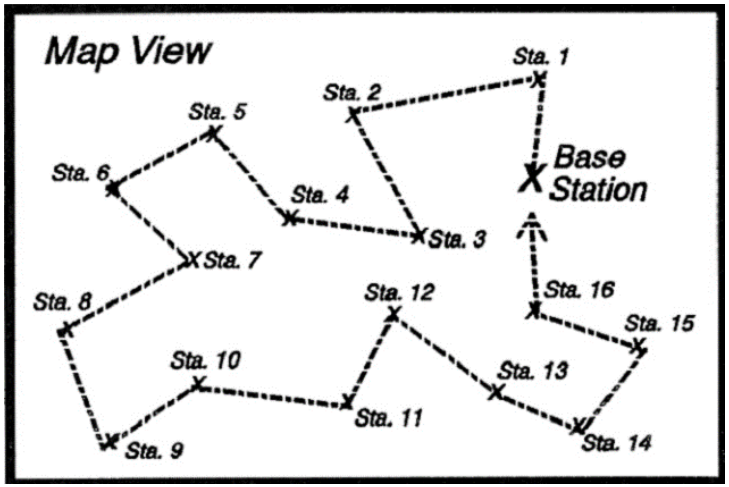
We accounted for this temporal variability by periodically reoccupying a base station at intervals of less than one hour. and using the variations in this reading to account for temporal variations of the field.



Strategies for Temporal Variations

Using one Magnetometer

If the stations are of the order of meter apart, it should be performed every 10 to 15 minute.



Strategies for Temporal Variations

Using one Magnetometer

Differences between the base reading are linearly interpolated for use in correction of field data.