ENHG
Emirates Natural History Group – Al Ain

and

INTERNATIONAL OASIS UNIVERSITY (I.O.U.)
Al Ain – Buraimi Oasis
UAE – Oman

President – Nick Saines
Bursar – Nick Saines
Chair of English – Michael Caine
Chair of Music – Steve Lawrence and Edie Gorme
Janitor – Nick Saines
Dean of Women – Nick Saines
Dean of Men – Who Cares?

present

A GEOLOGY WORKSHOP

I – Physiography of the Al Ain Region

II – Introduction to Rocks

III – Stratigraphy

IV – Generalized Regional Stratigraphy

- Break -

V – Sand Dunes

VI – Beach Processes (to be discussed in the field on the beach on Friday March 30, 1984)

VII – Structural Geology (test your ability to visualize in three dimensions)

VIII – Interpreting Geologic History from a Geologic Section

I – Physiography of the Al Ain Region

Physiographic Units

Mountains
Alluvial fans
Dune-covered desert
Wadi channels
Intermontane basins

What is a desert?

It is an arid or semi-arid (i.e. dry and parched with under 25 centimeters/10 inches of rainfall annually) region in which there is little or no vegetation. The term was always applied to hot tropical and subtropical deserts, but is equally applicable to areas within continents where there is low rainfall and perennial ice-cold deserts.

What is an oasis?

It is a place in a desert that has sufficient water to support vegetation. Deep wells may have to be dug to reach the water, or it may rise naturally at an artesian well, or the water table may be exposed in a deflation hollow.

Why is there an oasis here?

Because of the constriction of underground water flow between the bedrock ridges which forces the ground water closer to the surface. Judging by the archaeological evidence there has been human habitation in the Buraimi - Al Ain oasis since the local Stone Age (4000 BC). Water levels have dropped drastically in recent years because of over - pumping.

II – Introduction to Rocks

What is a rock?

It is an aggregate of minerals or organic matter, which can be divided into three types, based on the way they are formed: igneous, sedimentary and metamorphic.

Sedimentary Rocks

Sediment	Environment of Deposition	Rock-Forming Process	Rock	Sample Number
Clay	Deep sea	Compaction	Shale	-
Silt	Sea	Compaction + Cementation	Siltstone	1
Sand	Coastal	Cementation	-	-
Gravel	Continental	Cementation	Conglomerate	2
Limemud	Sea	Precipitation	Limestone	3,4,5
Fossils	-	Cementation + Precipitation	Fossiliferous limestones	6
Silica mud	Deep sea	Precipitation	Cherts	7

Igneous Rocks

	Basic Rock (dark)	Acidic Rock (light)	Sample Number
Fine-grained (extrusive	Basalt	Rhyolite	-
Coarse-grained (intrusive)	Gabbro Peridotite	Granite	- 8

(Ophiolites: ocean bottom crust including gabbros and peridotites.)

Metamorphic Rocks

Original Rock	Type of Metamorphism	Metamorphic Rock	Sample Number
Sandstone	Heat + pressure	Quartzite	-
Shale	Pressure	Slate	-
Slate	Heat + pressure	Schist	-
Limestone	Heat + pressure	Marble	-
Granite	Heat + pressure	Granite gneiss	-
Gabbro	Heat + pressure	Gabbroic gneiss	-

Some Common Secondary Minerals

Mineral	Composition	Hardness	Acid Test	Sample Number
Quartz	SiO_2	7	Negative	-
Calcite	$CaCO_3$	3	Positive	9
Gypsum	$CaSO_4$	2	Negative	10

Moh's Hardness Scale

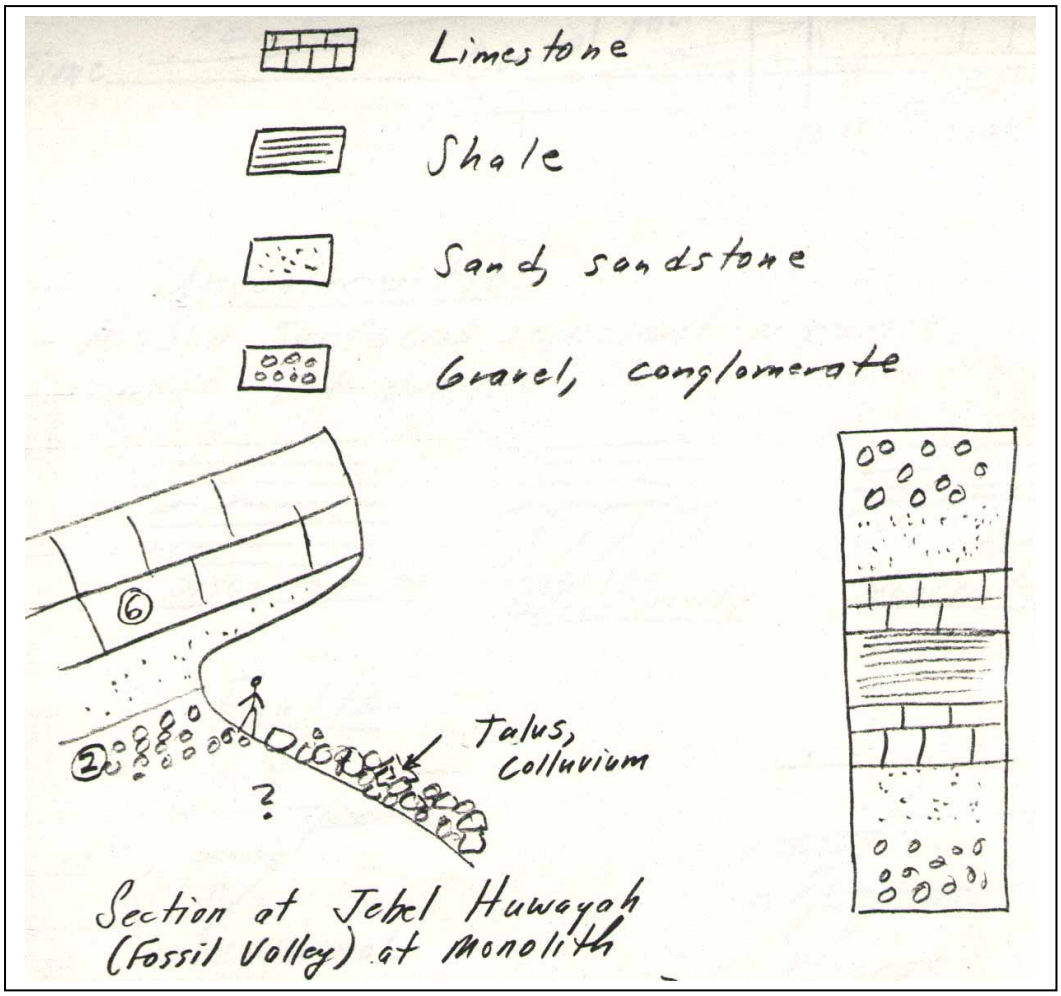
Hardness	Mineral	Hardness of some other items	
1	Talk	2.5	Fingernail
2	Gypsum	2.5–3	Gold, Silver
3	Calcite	3	Copper penny
4	Fluorite	4-4.5	Platinum
5	Apatite	4-5	Iron
6	Orthoclase (Feldspar)	5.5	Knife blade
7	Quartz	6-7	Glass
8	Topaz	6.5	Iron pyrite
9	Corundum (Sapphire/Ruby)	7+	Hardened steel file
10	Diamond		

III – Stratigraphy

Sedimentary Sequences

Transgression	Regression
on-lap	off-lap
sea gets deeper	sea gets shallower
coarser to finer sedimentation	finer to coarser sedimentation

Rock Symbols



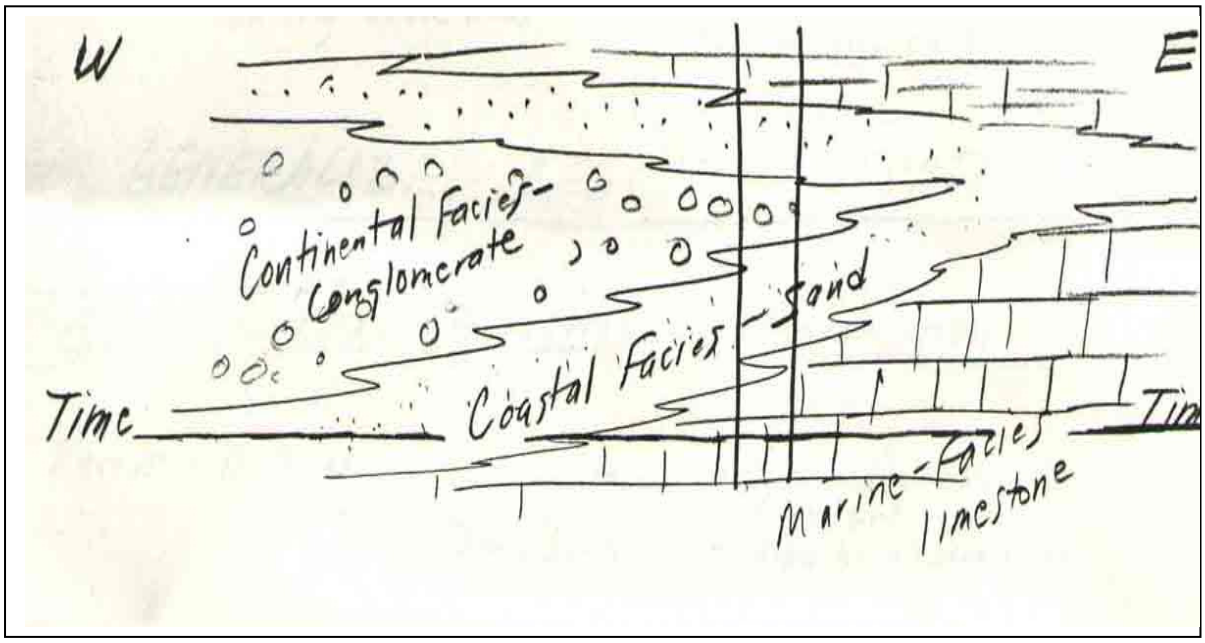
Regression or transgression? *Regression*

Facies

Sediment (later rock) deposited in a particular sedimentary environment, eg. beach facies, shallow marine facies.

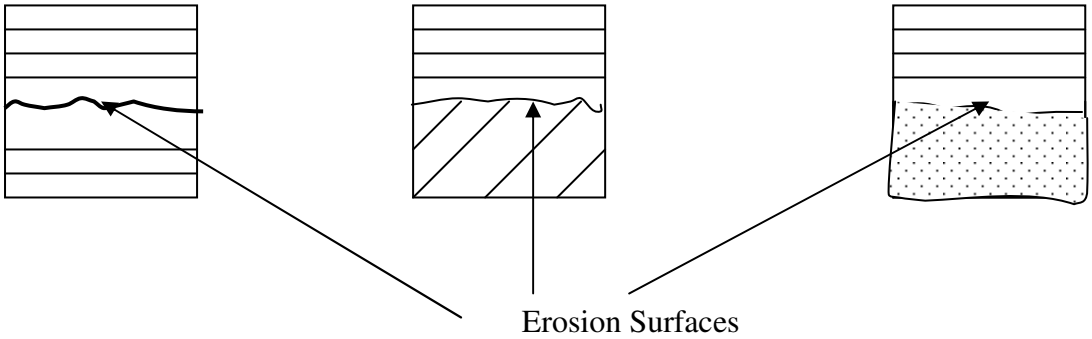
Geological Formations

Generally follow facies boundaries rather than time boundaries.



Unconformities

Erosion surfaces represent a period of uplift and erosion.

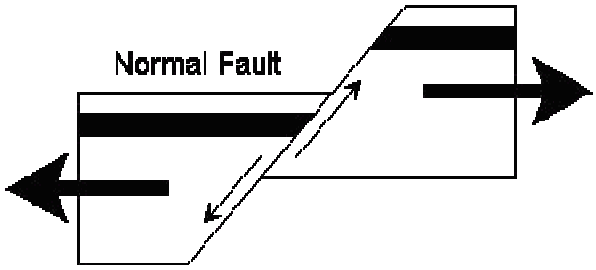


Disconformity Angular unconformity Nonconformity

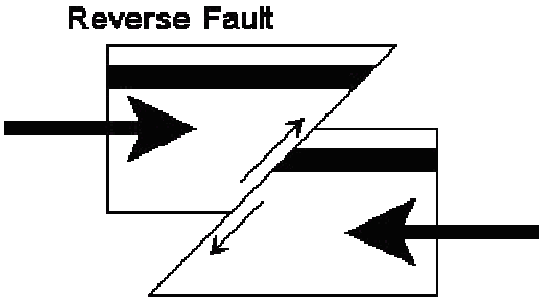
Faults

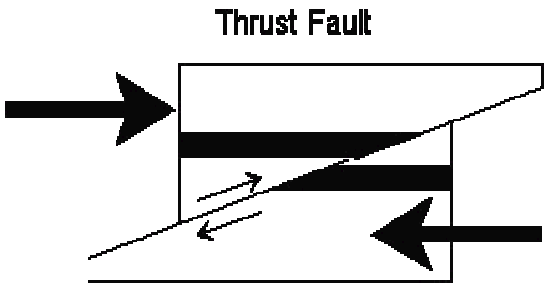
A fault is a fracture or dislocation in the earth's crust along which there has been displacement of the rocks on one side relative to those on the other. The movement of the rocks on a fault may have been in any direction, vertical or horizontal or some combination of these.

Hanging-wall



Foot-wall





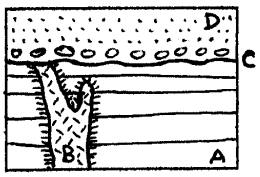
(low angle reverse fault)

Dikes and Sills

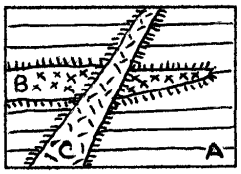
Dikes (or Dykes) are igneous intrusions that occur as sheet-like bodies with near-parallel sides and are normally discordant, cutting across the rock, and are usually vertical or nearly so.

Sills are sheets which have been intruded by overcoming a vertical pressure and are roughly horizontal.

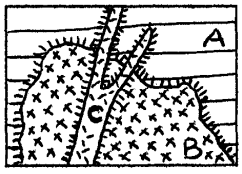
Both are always younger than the rocks they cut.



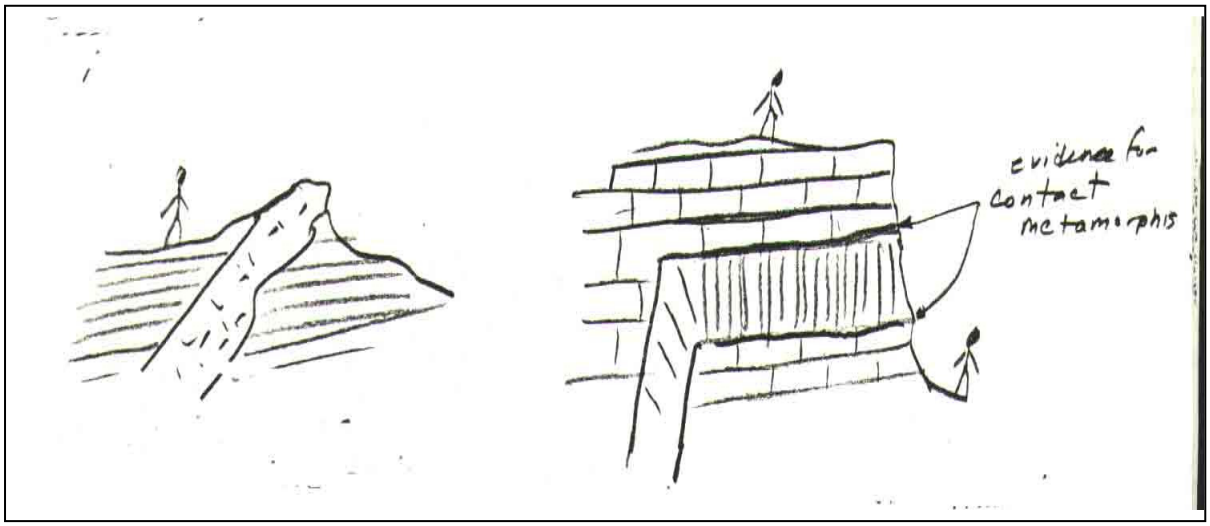
(1) Dike



(2) Dike and sill



(3) Stock and dike



Granite dike cutting shale beds

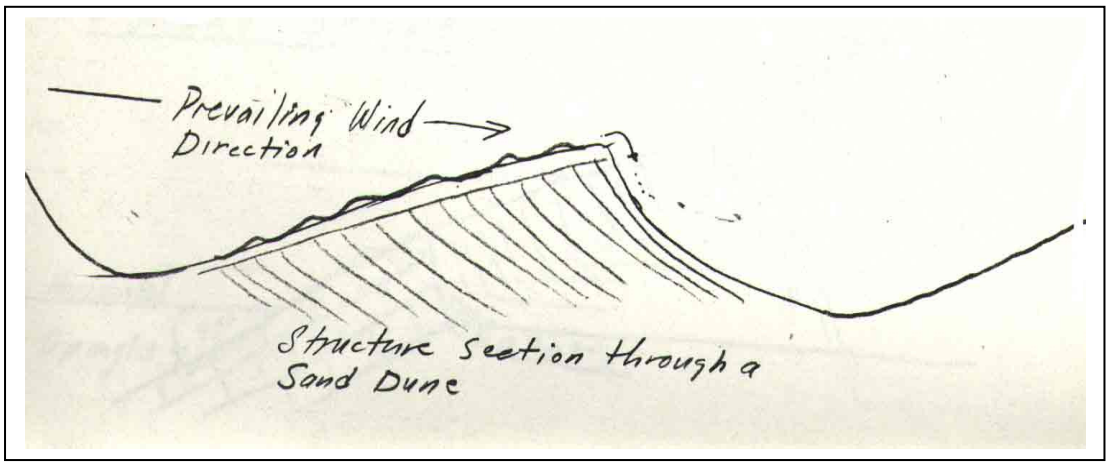
Basalt sill cutting limestone

IV – Generalized Regional Stratigraphy

Age	How old (years B.P.)	Formation	Description	Sample Number
Recent	0-20,000	Alluvium, Dune Sand	Deposited in alluvial fans, channels Deposited as sand dunes	- //
Tertiary	40,000,000	Juweiza Simsima	Deeper marine facies mudstones, siltstones, marls,clays Shallow marine facies limestones, fossiliferous limestones, conglomerates (continental)	/ 3,6,2
Upper Cretaceous	70,000,000	Ophiolites	Peridoties, serpentines, gabbros	8
Mesozoic	260-70,000,000	Hawasina	Limestones, cherts, silicified limestones, silicified shales	4,7
Triassic	250,000,000	Exotic Limestone		5
Mesozoic	260-70,000,000	Sumeini Group	Conglomerates, mudstones, shales, cherts	-

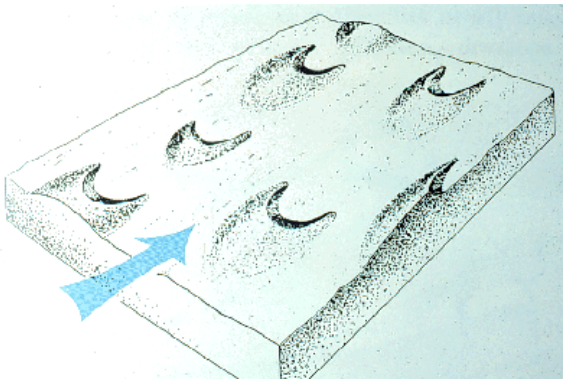
V – Sand Dunes

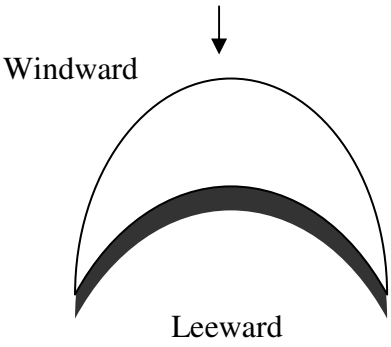
Sand dunes are hills that are formed by wind-blown sand. Once a mound forms, it tends to grow because the friction of the sandy surface slows down the wind, which then cannot carry so much material. The excess is deposited on the dune.



Barchans

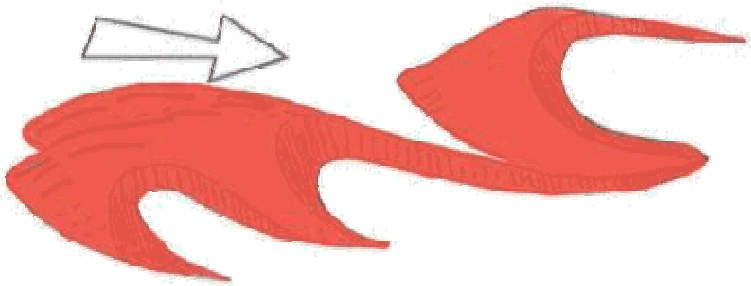
Are asymmetrical crescentic dunes formed in sand deserts over solid sand cover.





Long and gentle windward slope 10-15°,
short and steep leeward slope.
Steepness determined by the max. angle of repose of dry sand 32-33°.

(Plan view)

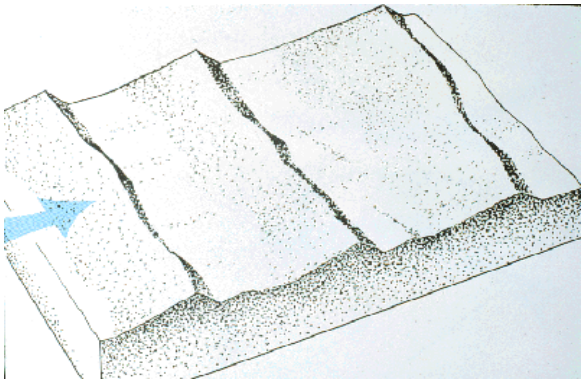


Rows of barchans

Barchans merge forming rows extending perpendicular to the prevailing wind direction.

Transverse dune

Linear dune that moves perpendicular to the wind.



Where did all this sand come from?

The sand comes from the erosion of pre - existing rocks into sand - sized particles. Possibly one major reason why there is so much sand is because during the Ice Ages (which ended about 20,000 years ago) the seabed was about 100 meters lower, exposed high and dry. This may have provided the source for much of the wind - blown sand.

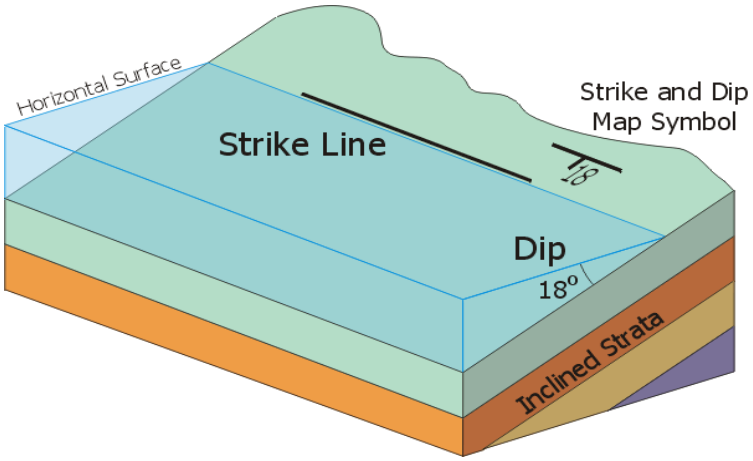
VI – Beach Processes

Erosion: there are many causes of beach erosion. Most of them are natural. These are currents, storms, earthquakes, winds, waves, tides and also the gradual movement of tectonic plates. Some beaches are also destroyed by men when harbours are built. The existence of cliffs on a coastline indicates that erosion is taking its toll on the beach.

Deposition is the geological process whereby material is being added to a landform. It is the process by which wind, water or ice creates a sediment desposit through the laying down of granula material that has been eroded and transported from another geographical location. Deposition occurs when the forces responsible for sediment transportation are no longer sufficient to overcome forces of particle weight and friction that resist motion.

VII – Structural Geology

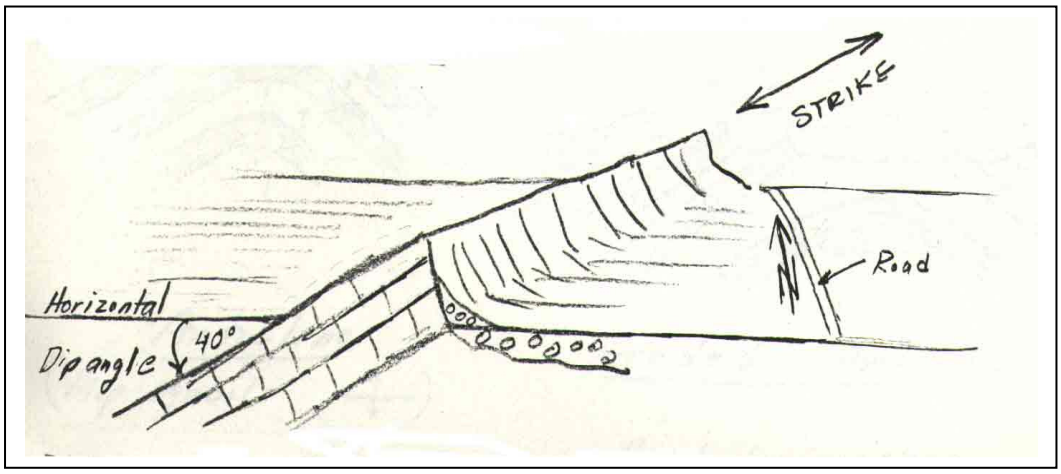
Dip and Strike



Dip is the angle the bed makes with a horizontal plane.

Dip direction is the compass direction the bed is tilted towards (always 90° to the strike).

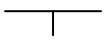
Strike is the compass direction of the trend of the outocrop.



In the above diagram what is the dip, dip direction and strike?

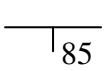
Map symbols

Strike NE
Dip 40° NW



Strike_____
Dip _____

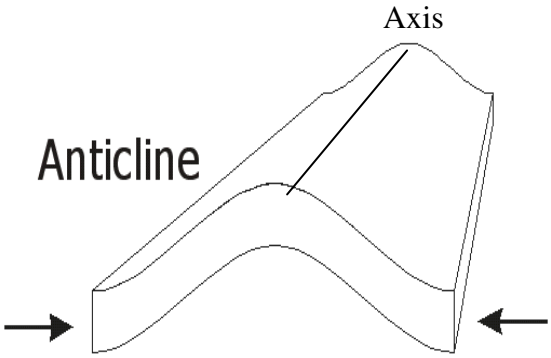
Srike _____
Dip 0°



Strike _____
Dip ____ ____

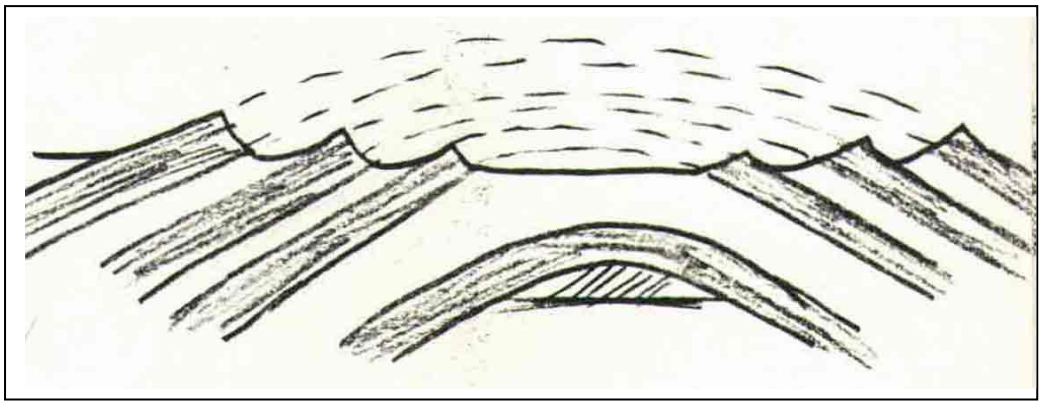
Strike _____
Dip 90°

Anticlines and Synclines

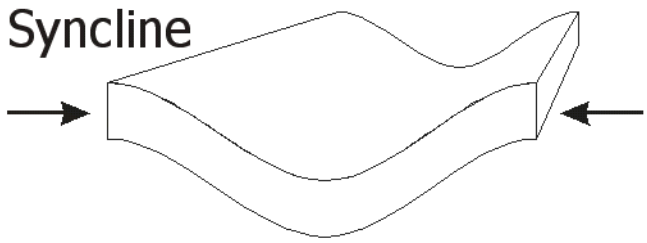


(map symbol: )

Eroded Anticline

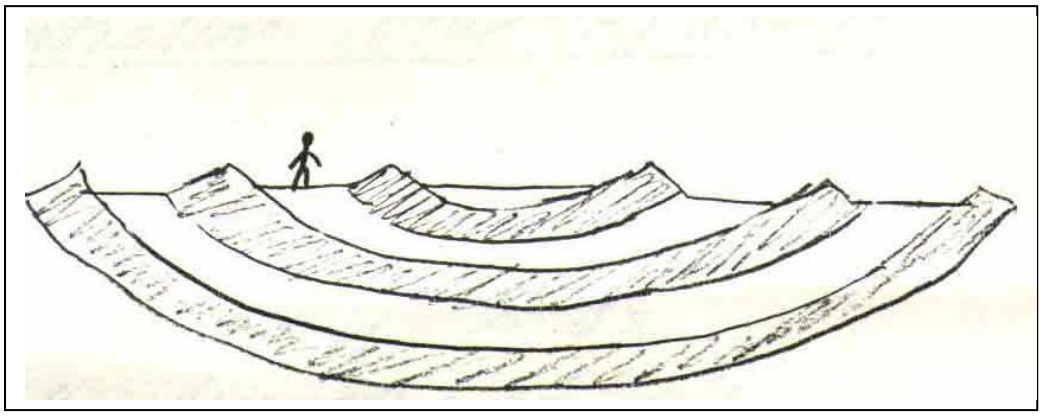


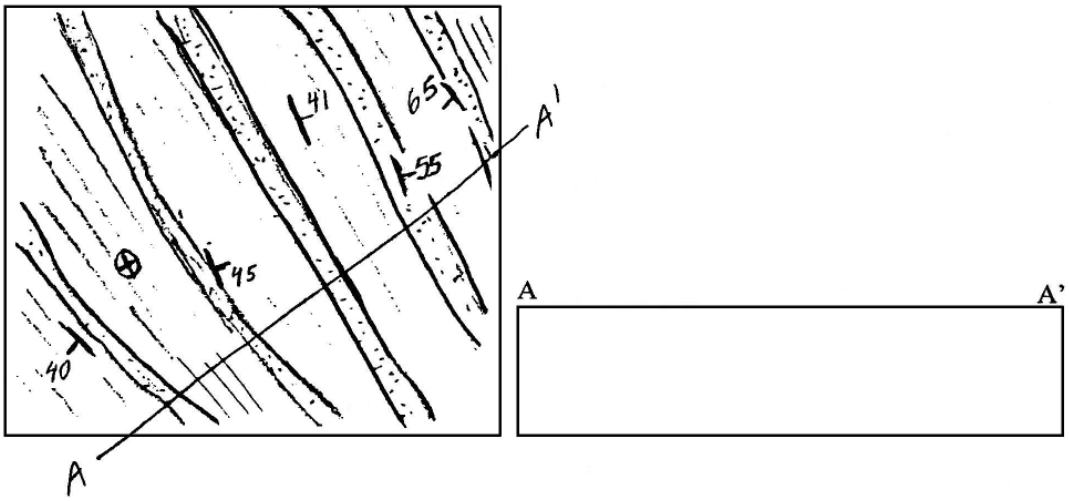
Are beds getting younger or older towards the axis? *Younger*



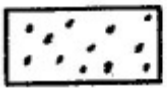
(map symbol: )

Eroded Syncline

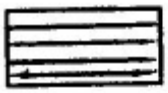




Geological Map Geological Section



Sandstone



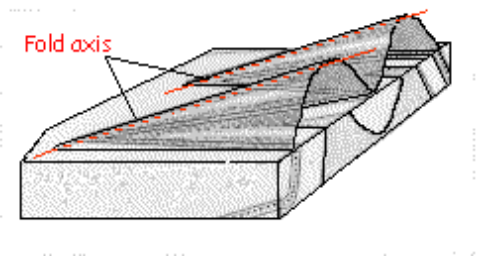
Shale

1 - What is the strike of the beds?

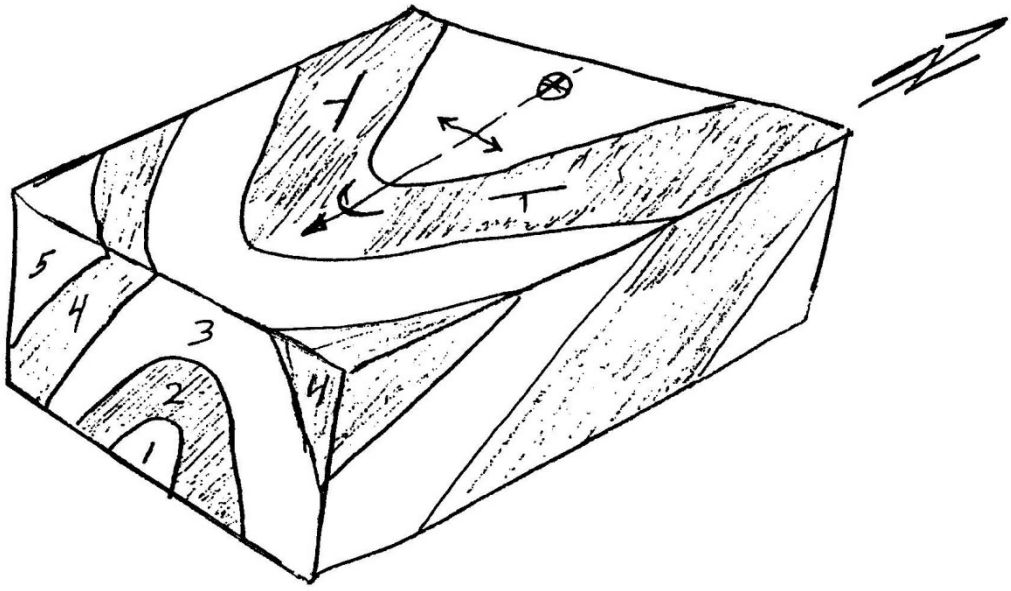
2 - Draw in the axes.

3 - Sketch in structure section along line A

Plunging Folds



Block Diagram of Anticline Plunging South

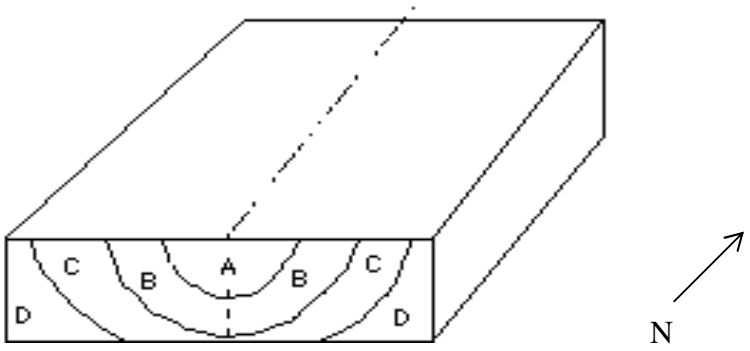


Fill in bed numbers on map and on east face.

Plunging anticlines – on map beds converge in direction of plunge.

Plunging synclines – on map beds converge opposite to direction of plunge.

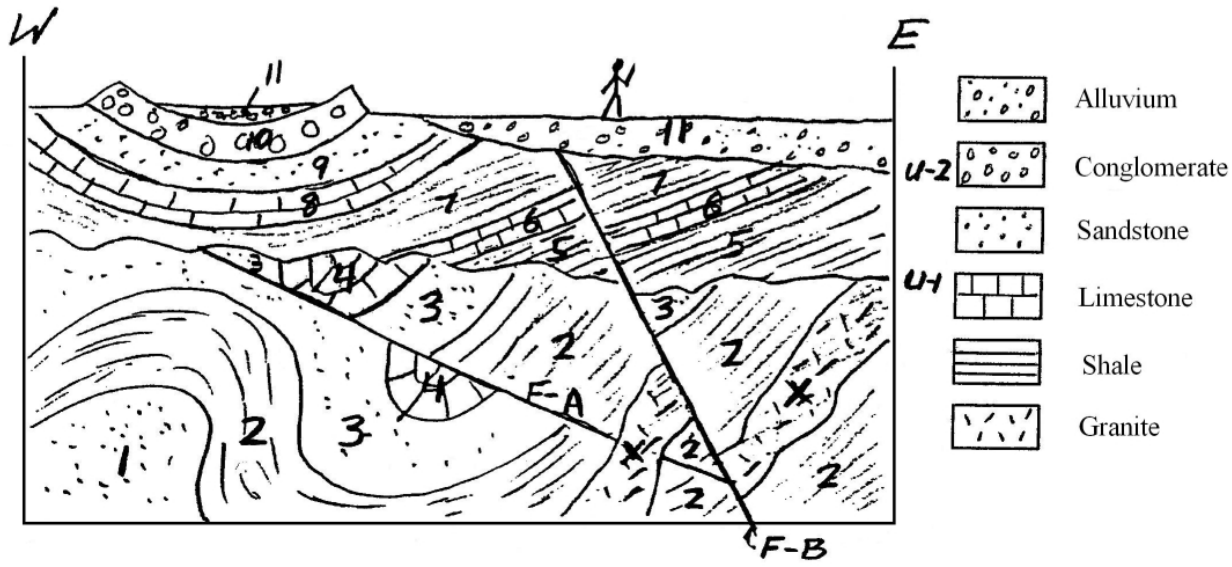
Block diagram of a plunging syncline



Fill in map and east face for syncline plunging north

Put in structural geology map symbols on Jebel Huwayah, Jebel Hafit, Jebel Qatar

VIII – Interpreting Geologic History from a Geologic Section



1 - Which is the oldest bed?

2 - Which is the youngest bed?

3 - What is the age of X?

4 - Is X a dike or a sill?

5 - What kind of fold is 8,9,10?

6 - What kind of fold is 1,2,3?

7 - What kind of fault is F-A?

8 - What kind of fault is F-B?

9 - Which is older F-A or F-B?

10 - What is the age of F-A?

11 - What is the age of F-B?

12 - What kind of unconformity is U-2?

13 - What kind of unconformity is U-1?

14 - How many times was the area uplifted out of the sea?

15 - What happened to the sea between 7 and 10?

16 - Where would be the best place to drill for oil?

17 - Describe the geological history of the area based on the section.

Denise Caporali Lee - 2004