# GEOLOGY 330E PETROLEUM GEOLOGY AND ADVANCED STRATIGRAPHY.

**Two hours**
The only question (regrettably compulsory) can be expressed as follows in seven words.

***OUTLINE A HYDROCARBON EXPLORATION STRATEGY FOR LEBANON***

However let me unpack the question for you. I suggest you divide your work as follows:

**Part 1: Basic Issues to do with Hydrocarbon Plays in Lebanon**

1.1 Source issues

1.2 Reservoir Issues

1.3 etc etc

**Part 2: Most promising potential plays.**

This should identify at least four geographic areas of potential interest.

**Part 3: A suggested initial Research Program**

What weaknesses do you see in the national database with respect to key questions on hydrocarbon potential? How would you fill them bearing in mind issues of cost? You may assume an available budget ceiling of 10 million dollars.

**Available data**

You have access to the following data which you may use or ignore as you see fit.

1. The geologic map at 1:200,000 for south Lebanon; if you need it for the north please ask
2. The idiots guide to Lebanese geology complete with strat column.*
3. A simplified bathymetric map.
4. An E-W cross section across Southern Lebanon modified from Sabbagh 1962.
5. Numerous copies of the sketch map and strat. column to scribble on.
6. A $TTI_{ARR}$ graph suitable for Type 2A kerogens such as those in the Late Cretaceous rocks

- The following useful (!) pieces of information
- The Hermon Oxfordian facies has no volcanics but a dark high TOC shale which can be assumed to extend at least as far as Hasbaya and Rachaya with decreasing potential.
- The Late Cretaceous fish beds have a TOC of 6% in carbonates.
- There are possibly other dark organic rich late Cretaceous beds over much of Lebanon particularly in the Bekaaa and along the coastal margin.

- There are lignites in the Chouf Formation and you can assume a %Ro of 3.5 for these (I am not sure what the true value is).
- Assume a geothermal gradient of around 30° C per km over most of Lebanon for the last 250 My with two exceptions a) A 30 My period of twice this from approximately the Bhannes to end Abeih period, b) very high gradients (70°C per Km) under the late Cenozoic basalt flows.
- The subsurface Triassic in the adjacent countries is evaporitic.
- There are some bitumen seeps in the southwest Bekaa.
- The post Oligocene strata in the Bekaa may be up to 2- 3km thick of sands and clays.
- No wells have penetrated the pre-Jurassic.
- There is the likelihood that a Triassic rift fabric trending NE-SW underlies the southern part of Mount Lebanon and the Bekaa.
- The Jurassic shoreline probably ran NNE-SSW just west of Beirut and Jounieh with facies belts parallel to it and deep water facies to the offshore. Facies thicken up remarkably westwards along the coast so that the Cenomanian alone along the coast is probably a kilometre or more thick.
- Most shallow wells show waterflushing.

Finally:

*There are no right answers.*

*Remember oil is a normal component of sedimentary basins! Be optimistic.*

** Yours to keep as a free souvenir of the course. Who said the fees are too much!*