Petroleum system processes / events

Relative timing

Petroleum system processes

- **Generation** of hydrocarbons
- **Primary migration** – expulsion of the hydrocarbons from the source rock
- Pathway
- **Secondary Migration** of hydrocarbons through migration pathways
  - > Pathways must be formed before the migration starts <-> Tmigration < Tpathways
- **Accumulation** of hydrocarbons inside the trap
  - > Trap must be formed before the migration for hydrocarbons to accumulate <-> Tmigration < T trap_formation
- **Trap formation**

$\Rightarrow$ HC accumulation inside a trap requires: hc generation inside the Source rock, hc migration, primary and secondary, migration pathways and trap, and the formation of the pathways and trap must have happened before the start of secondary migration.

T1<T2 <=> T1 is younger than T2 (T1 happened after T2)

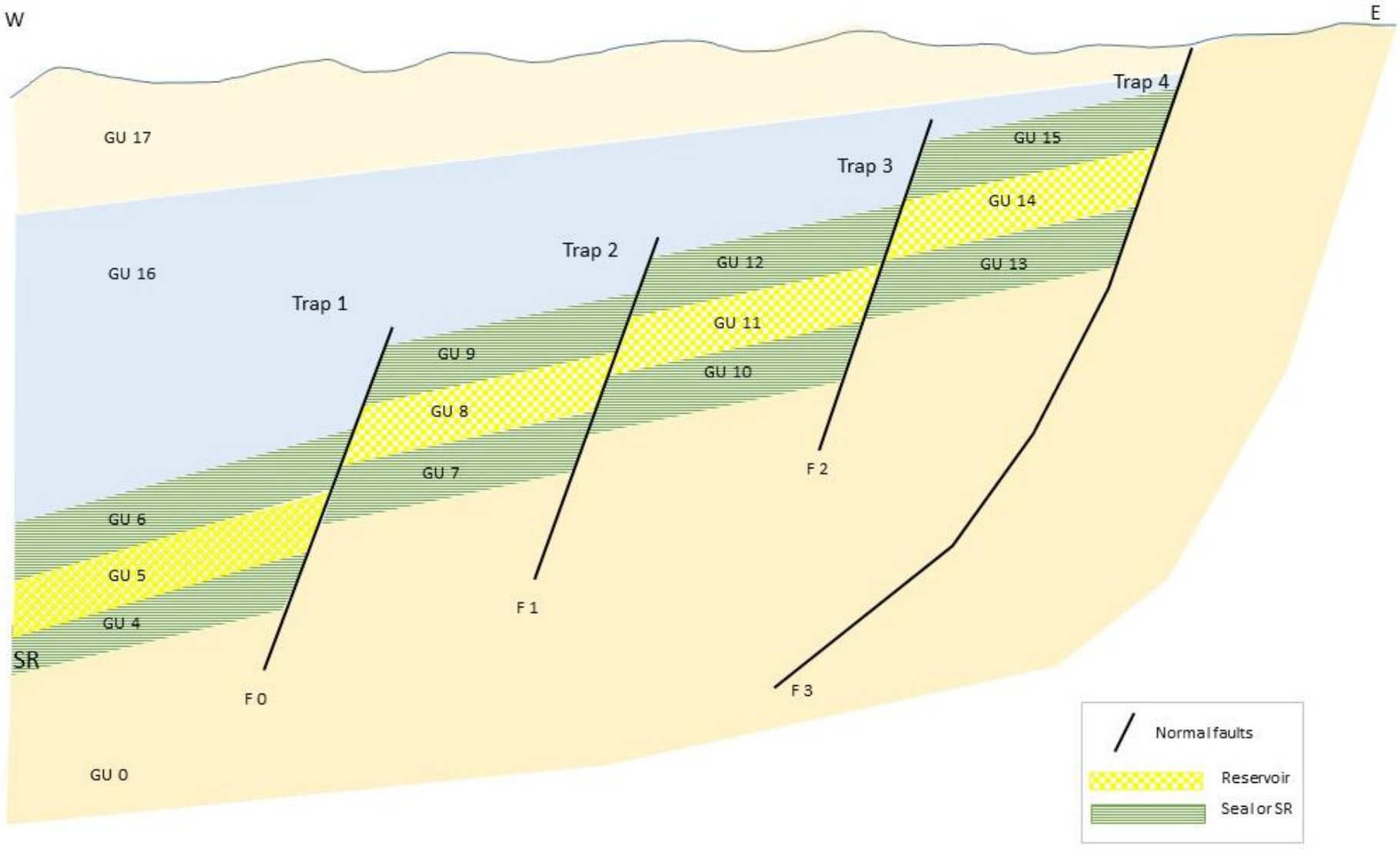
T1>T2 <=> T1 is older than T2 (T1 happened before T2)

The simplest way ☺

- All possible sequences of events (permutations):

1. No HC generation –> no migration -> no accumulation
2. HC generation -> primary migration -> no pathway -> no accumulation
3. HC generation -> primary migration -> pathway formed -> secondary migration -> trap -> no accumulation
4. HC generation -> primary migration -> pathway formed -> secondary migration -> trap formed -> accumulation
5. pathway formed -> trap formed -> HC generation -> primary migration -> secondary migration -> HC accumulation
6. trap formed -> pathway formed -> HC generation -> primary migration -> secondary migration -> HC accumulation
7. pathway formed -> HC generation -> primary migration -> trap formed -> secondary migration -> HC accumulation
8. trap formed -> HC generation -> pathway formation -> primary migration -> secondary migration -> HC accumulation
9. HC generation -> pathway formed -> primary migration -> trap formed -> secondary migration -> HC accumulation

Case study data



The simplest way ☺
(case study rotated fault blocks)

- No HC generation – No primary migration – No secondary accumulation - No accumulation
- HC generation – primary migration
  - Secondary migration happened before the pathways(towards our trap) and trap formation-> No accumulation
    - Tsec_migration > Ttrap_formation -> No Accumulation
    - Tsec_migration > Tpathways_formation -> No Accumulation
  - Secondary migration happened after the pathways (towards our trap) and trap formation -> Accumulation
    - Tsec_migration < Ttrap_formation -> Accumulation
    - Tsec_migration < Tpathways_formation -> Accumulation

  - TF0 = Ttrap1 = T1
  - TF1 = Ttrap2 = T1
  - TF2 = Ttrap3 = T1
  - TF3 = Ttrap4 = T2
  - TF0 = TF1 = TF2 = T1
  - T1 > T2

  - Tmigration = T3

  - Tpathway 1 = T4
  - Tpathway2 = T1
  - Tpathway3 = T1
  - Tpathway4 = T1

T3 < T1 AND T2 ⇔ Accumulation inside the trap1, trap2, trap 3 and trap4
T3 > T1 BUT T3 >T2 ⇔ Accumulation inside trap1, trap2 and trap 3 but No Accumulation inside trap 4
T3 > T1 AND T2 ⇔ No accumulation inside trap1, trap2 , trap3 or trap 4

The more geological way ☺

- Assign a time (an age) to each geological unit (GU) or just define what is the time relationship between them (older / younger).
- Define the ***cross-cutting relationship*** ⇔ Fault F is younger than the GUs that F is cutting and older than the GUs that are above the fault F and not cut by the fault F.
- Timing of the trap formation is the time when the faults stopped moving (stopped being active) ⇔ we can say in this case that Tfault = T trap_formation .

The more geological way ☺ (for case study rotated fault blocks)

- TGU0 > TGU4 > TGU5 >.....>TGU15 > TGU16 > TGU17 (GU0 is older than GU1…GU17)
- Timing of the trap is equivalent with the time when the fault stop being active
  - The age of the fault is equivalent with the age of the youngest GU that the fault is cutting -> infer the timing of the faults (traps formation) using the cross-cutting relationship
    - TF0 < TGU3 (F0 is younger than GU3)
    - TF0 >= TGU16
    - TF1 < TGU3
    - TF1 >= TGU16
    - TF2 < TGU3
    - TF2 >= TGU16
    - TF3 < TGU3
    - TF3 < TGu16
    - TF3 >= TGU17

->F0, F1 and F2 have the same age, F2 is younger than F0, F1 and F2

TF0 = TF1 = TF2 = T1

Ttrap1 = Ttrap2 = Ttrap3 = T1

TF3 = T2

Ttrap4 = T2

Tsec_migration = T4

Tprimary_migration = T5

Tgeneration = T6

The more geological way ☺
(for case study rotated fault blocks)

Tpathway1 = TGU5 = T3
Tpathway2 = TF0 = T1
Tpathway3 = TF1 = T1
Tpathway4 = TF3 = T1

T3 < T4 ⇔ migration into Gu5
T3 < T1 AND T2 ⇔ Accumulation inside the trap1, trap2, trap 3 and trap4
T3 > T1 BUT T3 >T2 ⇔ Accumulation inside trap1, trap2 and trap 3 but No Accumulation inside trap 4
T3 > T1 AND T2 ⇔ No accumulation inside trap1, trap2 , trap3 or trap 4