

Source rock: Nature, type and characteristics

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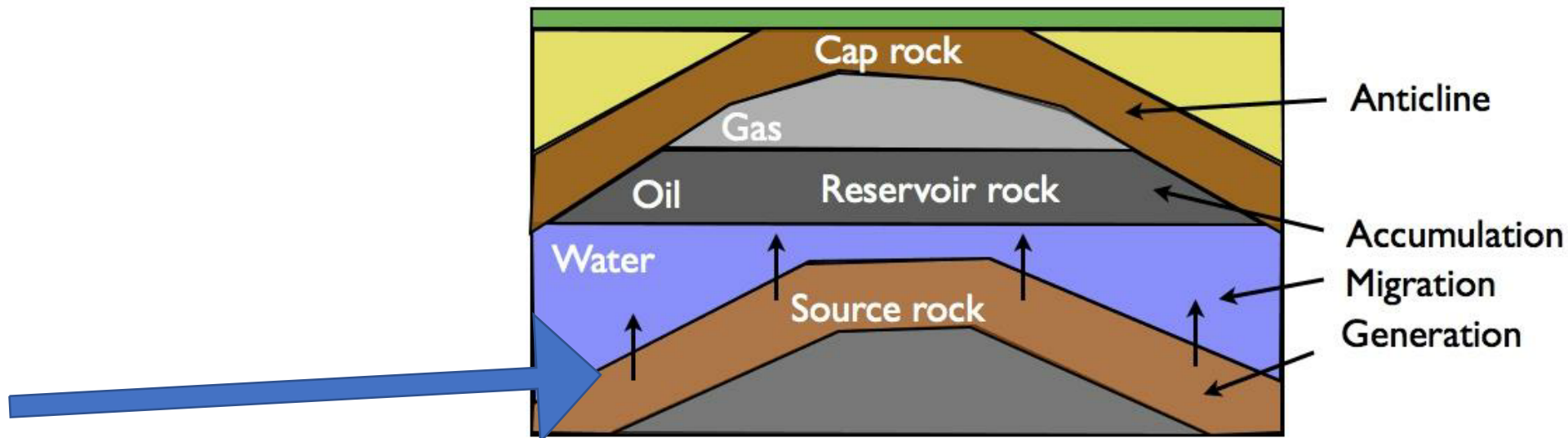
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Outline

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Introduction

- A rock that is capable of generating or that had generated movable quantities of hydrocarbons is called as source rock.
- Example-Shale and limestone. Shale can act as both source rock (for petroleum and natural gas) and reservoir rock (for shale oil and shale gas).



Nature of the Source rock

- Source rocks are organic-rich sediments that may have been deposited in a variety of environments.
- The presence of source rock in the area is the deciding factor for preliminary exploration. A source rock is a crucial part of a petroleum system.
- There are several characteristics related to source rock. These characters govern the economic and technical factors of exploration.
- A source rock should have enough organic matter of good quality that it can expel hydrocarbons in sufficient amount which can migrate to the reservoir rock and may accumulate at suitable trap, it also decide the fate of the exploration.

Nature of the Source Rock- continue

- Typical source rocks, usually shales or limestones, contain about 1% organic matter and at least 0.5% total organic carbon (TOC).
- A rich source rock might have as much as 10% organic matter.
- Rocks of marine origin tend to be oil-prone, whereas terrestrial source rocks (such as coal) tend to be gas-prone.
- Preservation of organic matter without degradation is critical to create a good source rock.
- A source rock generally possesses high porosity but less permeability so that organic matter can cook sufficiently to expel hydrocarbons.

Types of the Source rock

- Source rocks are classified into several types based on the type of kerogen (organic matter) that they contain or based on the capacity to generate hydrocarbons.
- Based on kerogen type
 - Type I source rock
 - Type II source rock
 - Type III source rock
- Based on capacity to generate hydrocarbons
 - Potential
 - Effective
 - Relic effective
 - Spent

Source rock types: Based on kerogen type

- Type I source rocks are formed from algal remains deposited under anoxic conditions in deep lakes : they tend to generate waxy crude oils when submitted to thermal stress during deep burial.
- Type II source rocks are formed from marine planktonic and bacterial remains preserved under anoxic conditions in marine environments: they produce both oil and gas when thermally cracked during deep burial.
- Type III source rocks are formed from terrestrial plant material that has been decomposed bacteria and fungi under oxic or sub-oxic conditions: they tend to generate mostly gas with associated light oils when thermally cracked during deep burial. Most coals and coaly shales are generally Type III source rocks.

Source rock type: Based on generation of HC

- Potential source rock- Rocks which contain organic matter in sufficient quantity to generate and expel hydrocarbons if subjected to increased thermal maturation.
- Effective source rock- Rock which contain organic matter and is presently generating or expelling hydrocarbons to form commercial exploration.
- Relic effective source rock- An effective source rock which has ceased generating and expelling hydrocarbons due to a thermal cooling event such as uplift or erosion before exhausting its organic matter supply
- Spent source rock- An active source rock which had exhausted its ability to generate and expel hydrocarbons either through lack of sufficient organic matter or due to reaching an overmature stage.

Source rock characteristics

- The transformation of organic matter with increasing temperature is called maturation.
- During the course of diagenesis, catagenesis and metagenesis, organic matter converts into kerogen and further expel hydrocarbons.
- The assessment of any rock as a source rock is done based on the determination of the amount of organic matter, type of kerogen (insoluble organic matter) or bitumen and the level of maturity.
- The quantity of organic matter is commonly assessed by a measure of the total organic carbon (TOC) contained in a rock. Quality is measured by determining the types of kerogen. Thermal maturity is most often estimated by using vitrinite reflectance measurements and data from pyrolysis.
- The assessment of the rank or maturity is also done with the help of chemical parameters including volatile matter (daf basis) and carbon (daf basis).

References

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Thank you.
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