The Foreland Basin and Its Application in Hydrocarbon Exploration

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Welcome

This book is adopted from the author pre-thesis, entitled **The Foreland Basin and Its Potential in Hydrocarbon Exploration**. This book will talk about the definition of basin in general, foreland basin in specific, and how it differs compared to other type of basin. A study case from Indonesia's basin will be used as an example of the foreland basin petroleum system.

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This book was made to allow people to understand and visualize the foreland basin forming, evolution, and specific implication on petroleum system. This book was created in the spirit of sharing, as the author realized back then the publications on foreland basin are quite rare, and even today the reference that was used in the pre-thesis, is no longer available.

The author hopeful that this website will be useful, not only

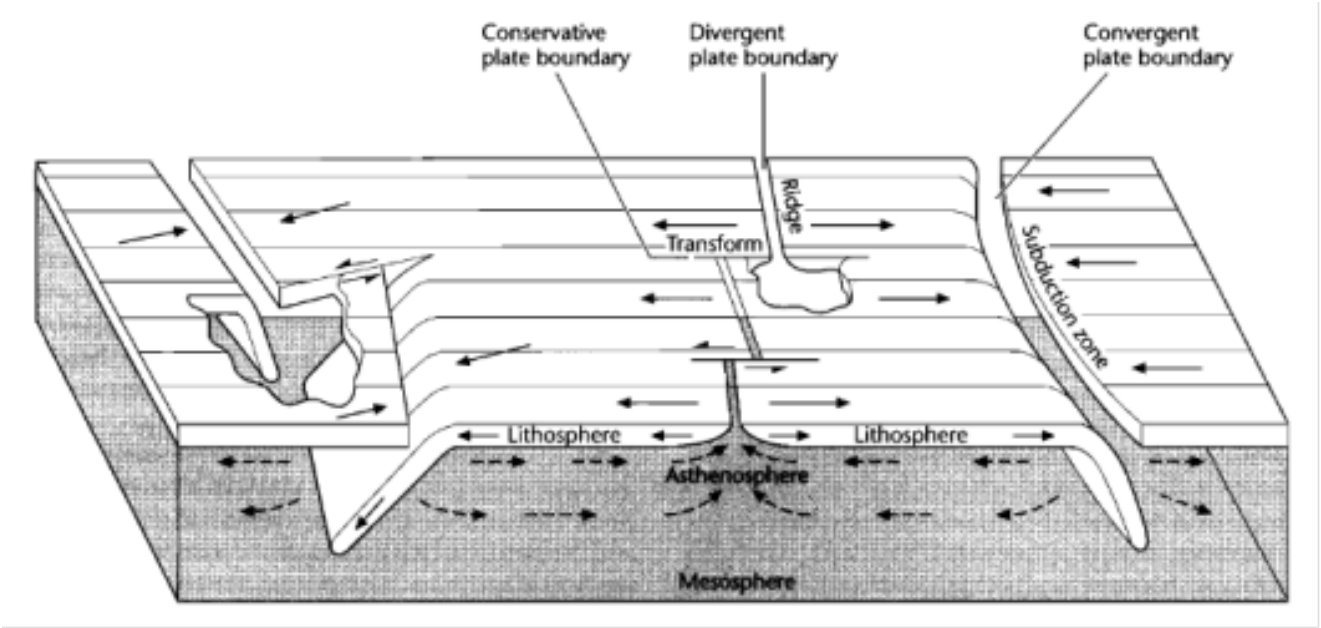
for people learning about petroleum system, but also people interested in learning about foreland basin.

> **Note**
>
> Special thanks to Budianto Toha as my supervisor for this pre-thesis project, who always encourage me to do more and learn more new things about basin analysis and alike. *Semoga sehat selalu pak Bud!*

1 Introduction to Basin

A basin by Einsele (2000) is defined as a place where sediment can be accumulated with enough thickness and preserved in a long duration in geological time-frame. According to "Basin Analysis: Principles and Applications" (2005) by Allen & Allen, a basin is defined as a lower relief structure in comparison to earth surface.

A basin can be classified into several types based on its lithospheric substratum (continental, oceaning, and transitional), position to intracratonic plate margin, and the type of plate movement close to the basin (divergent, convergent, and transform).



The mechanism in which governs the basin forming cannot be separated from processes happening inside the lithosphere,

which consist of multiple plates interacting towards each others. This interaction between plates is shown by the plate margins that moves towards each other (convergent), separated toward each others (divergent), and plates that are moving side-by-side each others (transform), as shown in Figure 1.1.

According to "Basin Analysis: Principles and Applications" (2005), basin-forming mechanism can be grouped into three categories:

1. Isostatic consequences of changes in crustal/lithospheric thickness, caused by the lithospheric stretching or purely caused by thermal, happening simultaneously with the cooling of sea crust which moves away from MOR (Mid-Oceanic Ridge) area.
2. Loading and unloading lithosphere, due to flexural deflection/ deformation which can also be followed by uplifting and subsidence, similar to forefront basin forming.
3. Dynamic topography. Viscous flow from mantle that causes non-permanent uplifting and subsidence.

Based on the three above points, there are two parent groups of basin-forming, which are:

- Basin formed by the lithospheric stretching, can be a rift-drift (divergent movement), and
- Basin formed by the flexing (flexural) of earth crust or sea crust.

1.1 Basin Forming

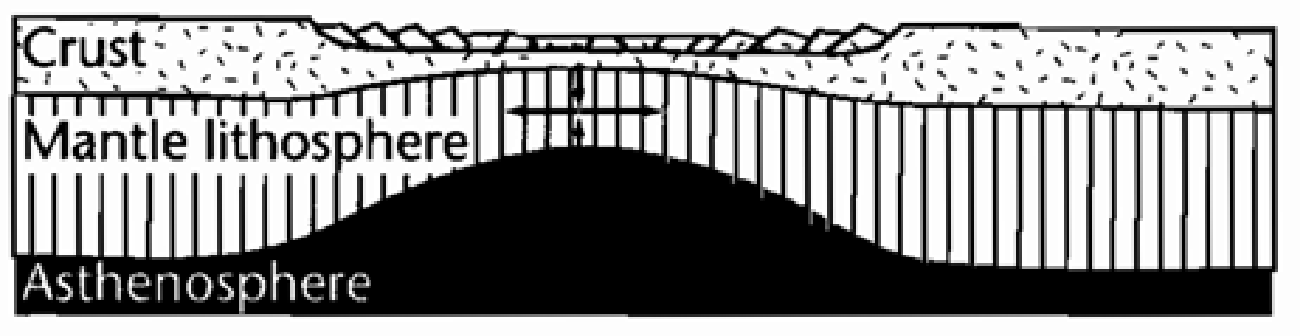
A basin can be formed only when there is a divergent force on the lithosphere. In this sub-chapter, we will be discussing about the mechanism based on litospheric stretching and flexural.

1.1.1 Lithospheric Stretching

Lithospheric stretching is a divergent move on plate that happened because of the pull force of a plate. This force can be caused by pure pull forces like in between plate margins that moves away from each other (divergent), on the adjacent plate margin (transform) due to second order force that creates pull-apart basin, or on plate margin where it moves closer to each other (convergent) as a release-force after compression regime.

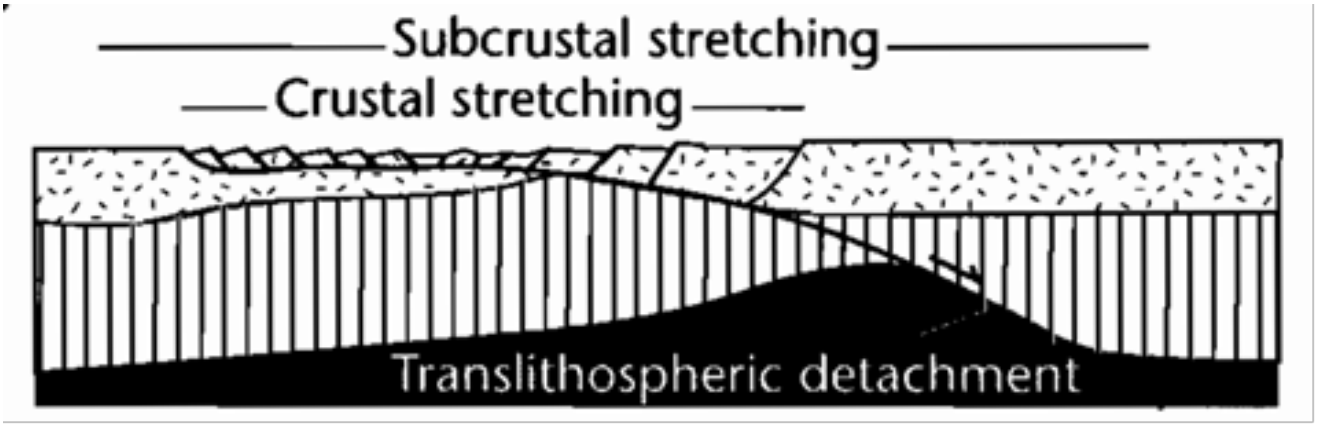
When a lithosphere expoed to lithospheric stretching, astenosphere (bottom part) will flow as more aqueous part, while the crust (upper part) is rigid (brittle) will be exposed to cracking. These two processes happening in the lithosphere will form a crust thinning which will be causing a basin-forming.

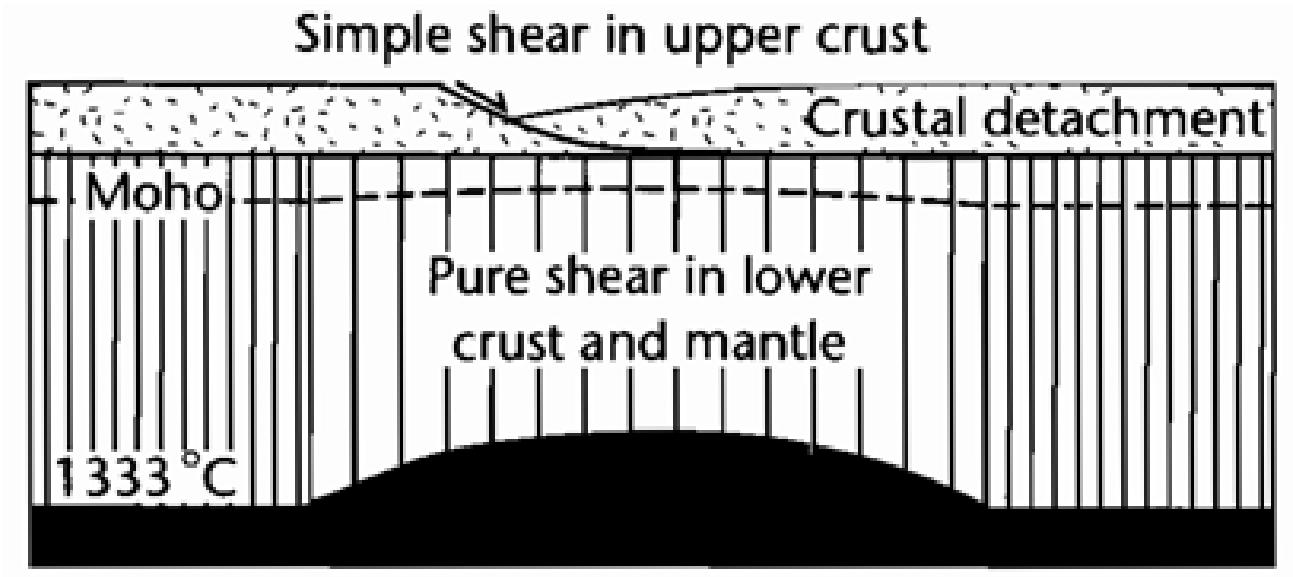
There are three models available to explain these mechanism of crust movement above astenosphere when lithospheric stretching happened: McKenzie, Wernicke, and Cantilever model.

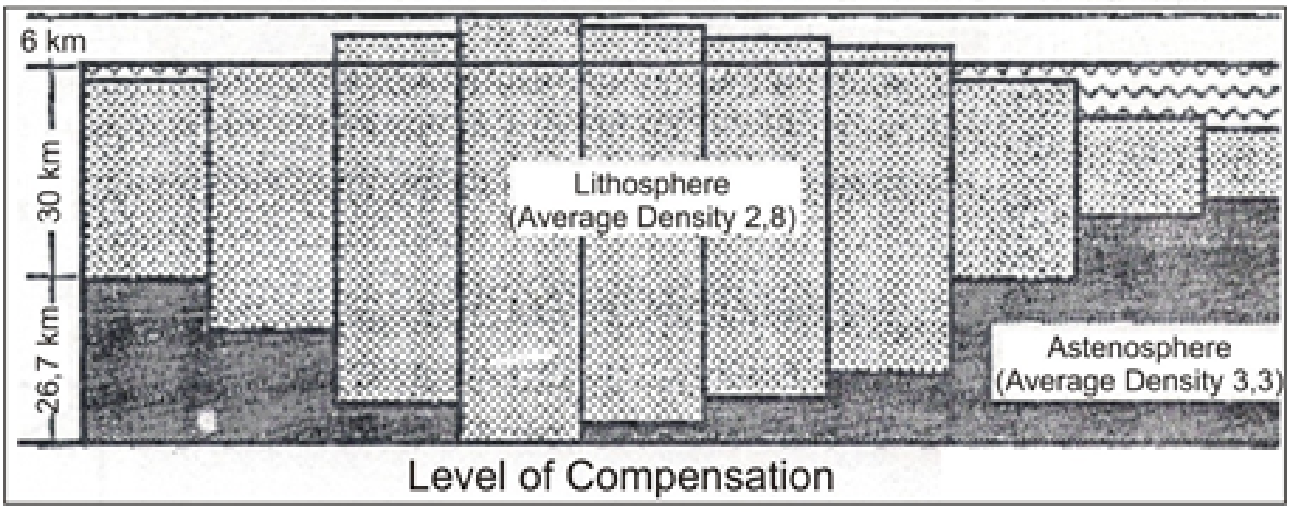


1.1.2 Flexural Isostacy

Isostacy is a theory used to explain about the behavior of lithosphere with astenosphere underneath. According to Airy, crust is distributed according to similar density but different in the root length (column) as depicted in the Figure 1.5 below.


Subcrustal stretching
Crustal stretching
Translithospheric detachment


Simple shear in upper crust
Crustal detachment
Moho
Pure shear in lower
crust and mantle
1333 °C


6 km
30 km
26,7 km
Lithosphere
(Average Density 2,8)
Astenosphere
(Average Density 3,3)
Level of Compensation

2 Summary

In summary, this book has no content whatsoever.

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[1] 2
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References

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Buchanan. 1994. *Extensional Teconics and Basin Inversion.*

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