A Short Note On The Basins In The Light Of The Tectonics In Continental Regime

Zarin Ali[1,1]

[1]Vedanta Hindustan Zin Ltd

November 30, 2022

Abstract

Investigating basins in light of tectonics provides clues to understanding geological happenings serving a great deal to explore base metal deposits & hydrocarbon reservoirs depending on type of basin & sediment accumulations in different margins. This paper focusses on archiving thoughts in wake of tectonics to understand the interplay of divergent,convergent & strike-slip settings leading to association of different basins on continental & oceanic crusts. Association of intracratonic sag basin, rift basin & passive margin basin is proposed in an extensional set up and a trench,forearc, back-arc & foreland basin is proposed for a collisional set up in active margins.

Hosted file

essoar.10511942.2.docx available at https://authorea.com/users/561108/articles/608777-a-short-note-on-the-basins-in-the-light-of-the-tectonics-in-continental-regime

A Short Note On The Basins In The Light Of The Tectonics In Continental Regime

(Miss Zarin Ali, Exploration Geologist, Vedanta Hindustan Zinc Ltd)

Keywords: Basins, tectonics, craton, continental crust, oceanic crust

Abstract

The investigations of the basin in the light of the tectonics provides important clues to understanding the geological happenings and can serve a great deal to explore base metal deposits & hydrocarbon reservoirs depending on the type of the basin and sediment accumulations owing to different margins. This paper therefore, focusses to procure an archive that can help to establish thought processes in the wake of tectonics. The paper uses a simplistic approach to understand the different types of basin dominated by a mix of the divergent, convergent and strike-slip settings. This leads to the association of the different basins on continental and oceanic crusts. A simple association of intracratonic sag basin, rift basin and passive margin basin is proposed in an extensional set up and a trench, forearc, back-arc and foreland basin is proposed for a collisional set up in active margins.

Introduction

The word craton was first proposed by the Austrian geologist Leopold Kober in 1921 as Kratogen. There have been numerous definitions since, but the one we are most familiar with is with reference to the stable continental platforms. A basin is usually viewed as a depression or a repository where sediments start to fill. Numerous schemes have been proposed for basin classifications.

This paper serves to develop a general understanding of the close association of a basin and a craton that has been addressed with continental and oceanic crust. The study differentiates active and passive margins in the different tectonic settings. Basins can be formed in intracratonic(within), pericratonic(margins of continent), intercratonic(in between craton and extending to oceanic crust) and oceanic(independent of craton) settings. The mechanism of basin subsidence is governed by mechanical stretching, thermal subsidence and tectonic loading. Different conditions prevail in different basins.

Discussions

In the purview of continental masses, intracratonic sag basins and intracratonic rift basins are formed within cratons(continental). Intracratonic sag basins are formed possibly as the result of asthenospheric downwelling or isostatic equilibrium following termination of rifting. They are rarely fault-bounded with major fault zones but may contain internal strike-slip faulting (Middleton, 2007). Sag basins are commonly circular to oval in shape and may have multiple histories of basin subsidence. They may be large and thick or small and thin. They may form over older basins and inherit only some of the previously existing structural grain (USGS).

From the Fig.1., for intracratonic sag basins, younger one might be at the centre with a steep dip inwards relative to the older one with a gentle dip inwards depending on the rates of divergence of tectonic plates. They are structurally less disturbed.

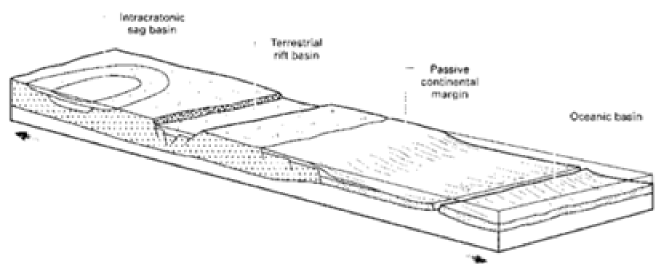

Fig.1. – An illustration of basins in an extensional set up *(Source – google images)*

In the case of intracratonic rift basins, although formed within continental masses in extensional set up, they are normal fault bounded basin. Most normal faults in rift basins are associated with both extensional and strike-slip components. In strike-slip presence, when extensional regime dominates, faulting is called as transtensional basin. So basin bounding fault zone has more offset on one side of the rift than the other zone. They are structurally more disturbed. If rifting continues to operate, there could be possibilities of opening of oceanic basin along margins of continent (pericratonic). There could be development of aulacogens or failed rifts in special conditions like a plume which might lead to a dome like build-up generating three fractures, two of which could be active in terms of rifting and third becomes inactive & might be filled with sediment later.

In the case of passive margin basins, they are usually developed at continent-ocean margins where no subduction is occurring. The more it accentuates to the oceanic areas away from continental crust, the more it has potential to allow biogenic processes to work on it and can lead to formation of carbonate build ups. It is to be noted that if continental drainage occurs, then siliciclastic sediments can allow deltaic accumulations to form. This can also lead to sediment loading due to gravity deformation of basinward transported materials.

While considering the continental margins, in convergent settings (Fig.2.), we usually come across an oceanic crust subducting below a continental crust and a trench which may roll-back beneath landward side of volcanic chain on other side of subduction zone along with development of volcanic arcs due to accretionary prisms. If accretion to continental margins is complete, then there can be accreted back-arc and accreted fore-arc basins.

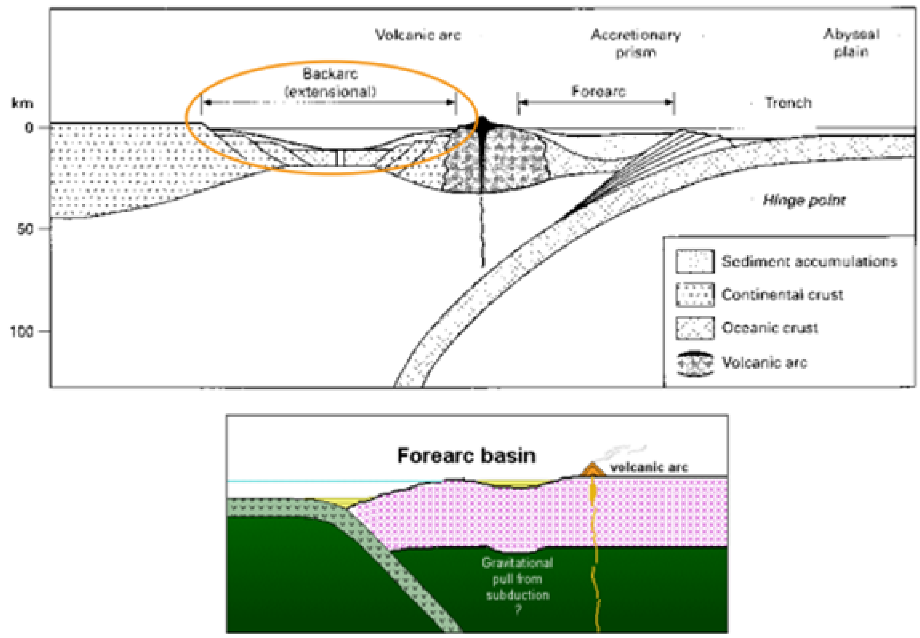

Fig.2. – An illustration of basins in a collisional set up *(Source – google images)*

As suggested by Coleman, J.L., Jr., and Cahan, S.M., 2012 in USGs report, foreland basins are very common and can occur adjacent to decollement fault thrust and fold belts and basement-cored anticlinal uplifts. They can be typically elongated and parallel to almost elliptical in the latter case. They are caused by depressions caused by the weight of a large mountain range pushing the adjacent crust below sea level. Borderland basins are those basins that form along the margins of a continent as a result of transtensional and transpressional faulting associated with the oblique collision of tectonic plates. They form at major bends along the collisional boundary. The combination of basin forming (transtensional faulting) and mountain forming (transpressional faulting) produces relatively small basins and uplifts along the plate boundary. Transtensional/transpressional basins are those basins that form at the margins of continents, typically along plate tectonic boundaries. These plate boundaries appear to have substantially fewer bends than those boundaries that produce borderland basins and associated uplifts. Transtensional/transpressional basins form along both restraining and releasing bends and may be completely surrounded by faults (Coleman, J.L., Jr., and Cahan, S.M., 2012). Pure strike-slip components can lead to strike-slip basins in other scenarios.

Results

The understanding of the basin classification thus, provides a geological framework, owing to which, future investigations can be carried out for exploration activities and basin analysis. In the present realm of the study, the necessity of building a general framework for extensional and collisional set ups are important. Stretching in passive margin might not be associated with plume activities as compared to that of in cases of active margins. The sediment accumulations and their thicknesses will be different.

Conclusions

The continental masses of the craton are affected by different structural disturbances due to extensional and collisional setups. It is with reference to the occurrence of normal and thrust faults. The amount of strike-slip components can vary. In the realm of the present study, therefore, I have addressed the continental setups in a short and descriptive way with the help of existing literatures. A simple association of intracratonic sag basin, rift basin and passive margin basin is proposed in an extensional set up and a trench, forearc, backarc and foreland basin is proposed for a collisional set up in active margins. As Nature is not uniform, these models can just serve as a generalized idea but hypotheses keep coming.

However, the role of tectonics never really ends here and plays an important part in a marine setup where sea levels, sediment supply and their rates differ causing events of transgression and regression and sediment accumulation leading to different depositional tracts. Accomodation discussed in sequence stratigraphy in sedimentary basins refers to the vertical space available for sediments to fill in. Tectonic activity, sea level & sediment supply are some important parameters that will govern the events of transgression & regression, in marine setups.

Acknowledgement

I am grateful to the Vedanta Hindustan Zinc Ltd for its continued support in my learning and development. This paper is a short note on basins in the light of continental regime.

References

Coleman, J.L., Jr., and Cahan, S.M., 2012, Preliminary catalog of the sedimentary basins of the United States: U.S. Geological Survey Open-File Report 2012–1111, 27 p.

Miall, A.D., ed., 2008, The sedimentary basins of the United States and Canada: Elsevier, Amsterdam, 610 p.

Miall, A.D., and Blakey, R.C., 2008, The Phanerozoic tectonic and sedimentary evolution of North America, in Miall, A.D., ed., The sedimentary basins of the United States and Canada: Elsevier, Amsterdam, p. 1–29.

Middleton, M.F., 2007, A model for the formation of intracratonic sag basins: Geophysical Journal International, v. 99, p. 665–676.