

Main tectonic regularity in the structure of continental margins

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The lithosphere plate tectonics theory describes the process of oceanic crust opening and closure in geological history of the Earth using the Wilson cycle [Keary, Vine, 1991]. Upon the end of the cycle the oceanic crust being formed at its early sta-

ges is almost completely destructed in the process of subduction. As for the continental margin it is modified during the cycle with formation of volcanic and non-volcanic islands arcs, back- and fore-arc sedimentary basins, and orogens. During the next

Comparison of models evolution of the ocean and continental margins during the complete Wilson cycle

Model of the ocean evolution (Khain, 2004)		Model of the continental margin evolution			
Geosyncline	Plate tectonic «Wilson cycle»	Stages of Wilson cycle	Substage, time (million years)	The course of crust-mantle substances under the continental margin	Contents of stages
Inland rise (A continental rift)	Continent into pieces; new ocean basin opening	Divergency	0		Rifting when continent breaks up
			200		
Geosyncline stage	Evolution of new ocean depression, forming deep (15-20km) basin, which is filled in sediments (continental slope and new ocean floor)	Convergency	400		Ocean widens. Ocean crust is forming. New quasi-oceanic suboceanic crust is forming on the place of future continental margin
			600		
Partial inversion	The ocean basin closes in some part of the ocean depression, two continents collide and began the stage of overthrusting begins	Collision	800		Closing of the ocean basin. Creating a volcanic chain at active margin and suboceanic crust
			1000		
Closing of the ocean basin	The ocean basin closes in some part of the ocean depression, two continents collide and began the stage of overthrusting begins	Collision	1200		Cooling and subsidence of the mantle diapir when the ocean is closed. Formation of thermal sedimentary basins.
			1000		
The continent erodes and became a platform		The continent erodes and became a platform			Overthrusting of the inverted part of the crust on the passive continental margins and formation of new continental crust
The continent erodes and became a platform		The continent erodes and became a platform			The continent erodes and became a platform

stage of cycle the previously formed continental margin is subjected to deep transformation again leaving in the structure of newborn margin only some relics of the previous ocean crust known as ophiolites. However, as the study proves, complete destruction of the previous continental margin is not reached. Always or quite often it is preserved a significant part of newborn continental crust accreting laterally an existing continental plate and modified during further transformations passing through consecutive stages of states that could be called a vertical line of the tectonostages for particular continental margin. Evidence for that conclusion is an age rejuvenation of the continental crystalline crust while moving from the central parts (shield) towards their outskirts (continental margin). It is proposed the geological timescale of tectonostages derived from the Wilson cycle and established their time boundaries for the last 2500 million years. Along with the developed model for continental margins evolution it allows application of the concept of horizontal sequence of tectonostages transition into vertical and vice versa to study structure of continental margins [Karpenko, Prykhodchenko, 2009]. It is supposed that for the Wilson cycle of 1200 million years every continental margin is subjected to the tectonic process as follows. During the first stage of a divergent epoch (0—200 Ma) a new oceanic basin is forming due to a continental rift. Present-day example of such a rift one can consider the Red Sea Rift and latitude-oriented rift system between North and South America stretched into the Pacific and Atlantic Oceans. Predecessor of the fu-

ture Red Sea ocean was Tethys and Prototethys paleo-oceans originated during the stages of 590,75—385,75 Ma and 992,5—793,0 Ma ago. The Tethys is corresponding to present-day Alpine-Himalayan orogenic zone and related sedimentary basins, and the Prototethys ones to the Donbass Foldbelt and its eastern prolongation into Karpinskiy Ridge. Rejuvenation of continental margins age towards the periphery of the continents set the problem of studying evolution of those margins applying concept of vertical and horizontal sequences of tectonostages. For this purpose the model of evolution (tectonic stratification) of continental margins is developed. It includes six stages of tectonic evolution: origination of a new ocean and its opening (divergent epoch of the Wilson cycle), stage of the oceanic basin shortening and thermal subsidence (convergent stage), the stage of partial inversion, and the next stage of the complete inversion along with the compression thrusting (collision stage) (Table). Corresponding to the stages is the types of crust being formed (ocean, quasi-ocean, quasi-continental, continental). The stages are divided into geosynclinal and orogenic sub-stages (the Bertran cycle). It is demonstrated that tectonostages and orogenies are matching (Alpine, Hercynian, Caledonian, Baikal and others) for the last 1500 million years. Actually, the features and direction of changes in vertical and horizontal sequences of continental margin tectonostages is a basic tectonic regularity to be studied because it determines existing types of sedimentary petroleum-prone basins, sedimentary complexes and separate prospects considered as hydrocarbon traps.

References

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