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THE EVOLUTION OF RIFTING PROCESS IN THE TECTONIC HISTORY OF THE EARTH.

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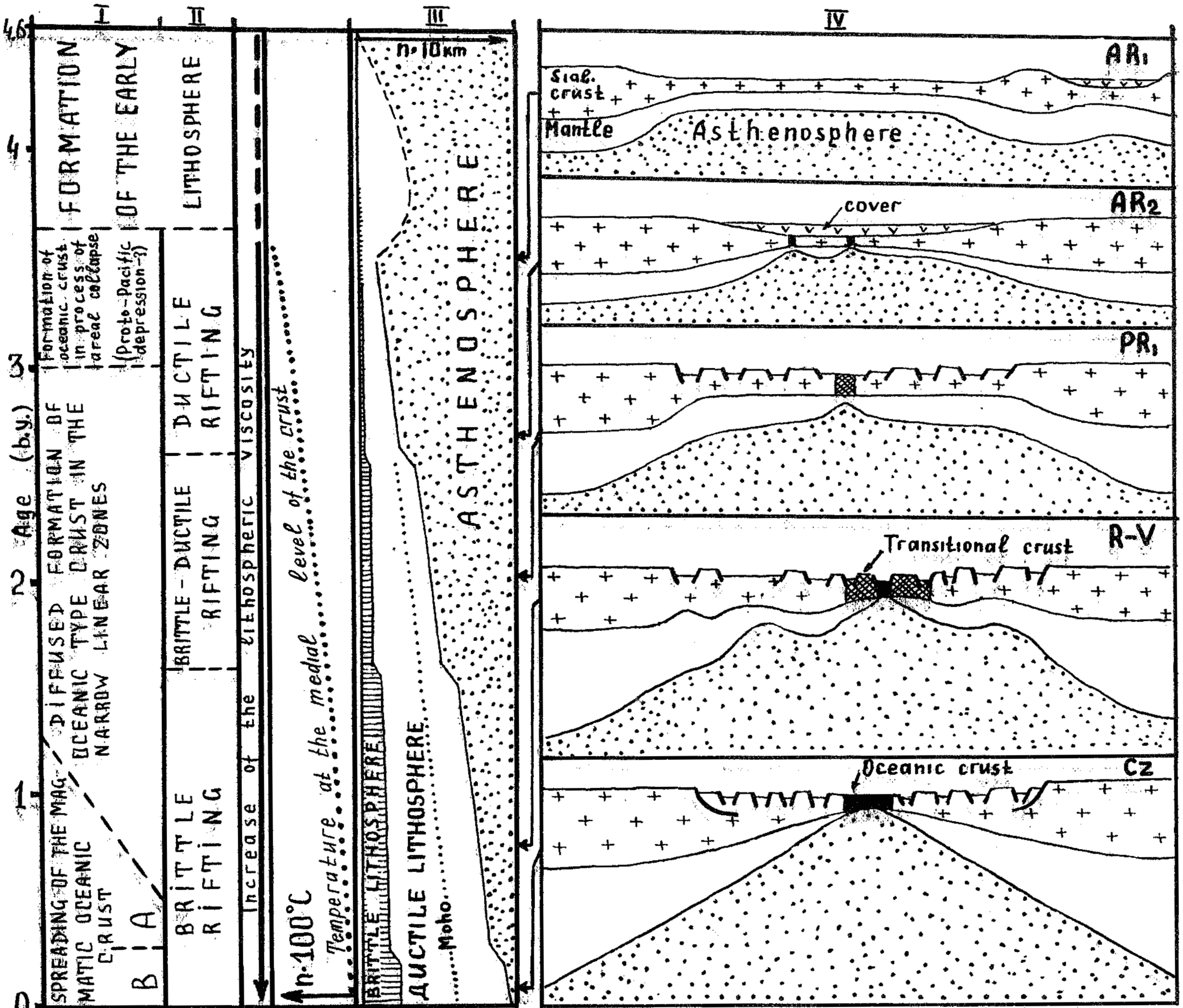
The continental rifting is the response of the lithosphere to the oriented tension (I,4). The distribution of viscosity in the lithosphere plays an essential role during all stages of the rifting. The viscosity is a function of the temperature,the lithostatic pressure,the rock composition,the deformation rate and other factors;the temperature being the most important one. The vertical section of continental lithosphere of the rift zone may be devided into the following layers: the upper crust,in which brittle deformation prevails;the medial crust,in which the role of plastic deformation increases;the lower crust,in which plastic deformation prevails;and the uppermost plastic part of the mantle overlapping asthenosphere. The depth of the boundaries in the crust layers are mainly controlled by the temperature.

Since the Early Archean to present days an average thickness of the continental lithosphere had increased from about 50 km,to approximately I50 km,and the temperature at the medial level of the crust and in the asthenosphere had decreased by 200-400°C (2,5). Consequently,the younger the Earth had been, it's lithosphere was thinner,the thickness of the brittle crust reduced,the heat flow and the temperature of the asthenosphere were higher. A thin heated continental lithosphere overlapping a gently sloping surface of the asthenosphere is able to sustain considerable plastic tension without its disruption (e.g., contemporary Basins and Ridges province). On the contrary,a thick lithosphere,with asthenospheric diapir wedged-in,is capable of quick splitting under horisontal tension,since the stress focusses within a narrow heated zone of relatively low viscosity (e.g.,the Red Sea rift). The figure I displays models of the rifting at the different stages of the Earth's development, which illustrates the evolution of this process through the geological history. The splitting of the continental lithosphere and a notable spreading of the new build oceanic crust may occur under the two conditions only: the lithosphere subjected to tension and to wedging-in of the asthenospheric diapir should be thick; steady flows should exist in the upper mantle under rifts with the splitted crust.

All contemporary mid-oceanic rifts are linked into a global system of belts with ascending mantle flows. There was no such global belts 3,5-I,5 b.y.ago. The global systems of large mobile belts appered first in the Earth's history in the Late Precambrian (the Urals-Mongolian belt,the North-Atlantic belt, ets.). Only at that period the lithosphere aquired the fragility similar to that of the present lithosphere. The continental rifting is likely to have transformed into oceanic type rifting first at the end of the Precambrian and the magmatic oceanic crust had formed then for the first time.



A - in the narrow zones; B - in the large scale.

Fig.I. The model of the rifting evolution during the Earth's history. I - oceanogenesis, II - continental rifting, III - generalized section of the continental lithosphere, IY - the model of the rifting pattern. The values of the horizontal crust tension are believed to be nearly equal and less those for the model of the Late Archean "greenstone" basins. For the Early Archean the contemporary granulite (highly metamorphic) and the greenstone belts are shown; for the Late Archean - the zones of contiguous greenstone belts of the Eastern-Goldfield type; for the Cenozoic - the structure of the Red Sea type. A cover is shown for the Archean "greenstone" basins only. The models are based on the data of (2,3,4,5).

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