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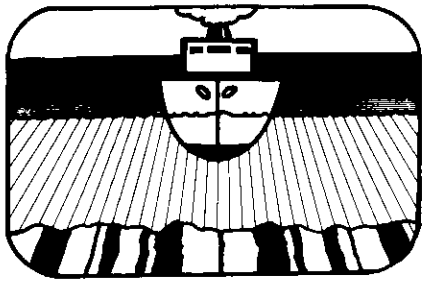

Oceanic Expeditions and Earth Tectonics

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Editor's Note: *Releases dealing with technical developments in the USSR are occasionally received from the Press Office of the USSR Embassy in Canada. This article is presented here as an interesting summary of the state of knowledge of global tectonics in the Soviet Union. (Received May 1987)*

The concept of platform tectonics promoted a turn in theoretical geology toward mobilism, an admission of the fact of horizontal displacements of major masses of land over great distances. Herein lies its great service to modern natural history.

The rates of development of the concept of platform tectonics were amazing. Less than 20 years have passed since its introduction, and it is already used to explain earth tectogenesis, magmatic processes, oil and ore formation and the structural evolution of the earth crust — in short, all the key aspects of geology. Thereby, platform tectonics is gradually developing into a general geological concept, one can even say superconcept, encompassing all aspects of geological knowledge. Such a concept should be appreciated, but aren't we overestimating its value? Can platform tectonics actually provide answers to all or nearly all the principal geological problems? An answer to that question must be sought for in factual data which, unfortunately, are in short supply in platform tectonics. Data procured by scientific expeditions do not always match the concept and require different interpretation.

Empirics and Tectonics

Large platforms horizontally displaced over great distances are known in the Alps, the Carpathian Mountains and the Tatras. In an imaginary vertical cut they form complex tectonic structures with an abnormal arrangement of strata when older strata lie above younger ones.

For a long time, similar anomalies escaped detection in other regions of the planet due to a shortage of information. Later, they were discovered in many mountains both in the USSR and other countries.

Overthrusts in the crust owe their discovery to the recently proven identity of the structure of the crust under the oceans to the so-called ophiolite series in the mountainous zone of dry land. In other words, the mountain structures preserve the traces of long-vanished oceanic basins.

This knowledge proved to be of great theoretical value. On its basis, scientists assumed that the crust under mountains is tectonically laminated rather homogeneously monolithic. The Kola mine (more than 12 kilometres deep) drilled through the crystalline systems of the Baltic shield supplied new data about the tectonic lamination of the foundation. This led to a new concept of tectonic stratification of the crust and the lithosphere. According to this concept scaled lithoplates displace in the crust and the lithosphere in a horizontal direction. Due to difference in the speed of displacement they pile up in some places and stretch in others. This mechanism, properly used, can explain many geological phenomena, including the mode and the origin of mineral occurence.

The new concept, put forth at the Geological Institute of the USSR Academy of Sciences, has been accepted by geologists and applied to survey and prospecting.

What is the reason for the differentiated speed of plate displacement?

What Have Oceanic Expeditions Established?

Let us analyze now the latest data about tectonic displacements in the oceans. Giant fractures in which land masses migrated hundreds and even a thousand-plus kilometres from their original sites were discovered on the bed of the Eastern Pacific. At first they were few, but then, their number grew.

It was recently established that not only is the bed of world's oceans strewn with numerous fractures of differing directions and orders, but that the fractures group in major systems differing in their tectonic nature.

In many a case shallow-water sedimentations overlapped by deep-water sedimentation rocks were found at a depth of four, five and more kilometres. The exploration of underwater mountains revealed a similar picture; many of the deep-water mountain ranges were in the past much closer to the surface. Nobody seem to argue the fact that major sea bed plunges occurred during the past 100 to 150 million years. But what is the mechanism of such plunges? It can be assumed that fractures had an active part to play in these processes. Information obtained by expeditions to the peripheral zones of the Atlantic Ocean leaves no doubt that in the process of the ocean's expansion resulting from the continents drifting apart, coastal zones crumbled causing stepwise plunging of the blocks.

The crust under the oceans features deformations of yet another category, caused by overthrust. They were found by Soviet expeditions not so long ago.

Surveying the Clarion fracture in the central part of the Pacific they found that basic rocks lie atop tholeitic basalts which normally make up the upper part of the crust. An amazing phenomenon was found in the Islandic trough Tonga. It was established that the cut of the oceanic crust repeats itself three times up the slope at an interval of depth of about 5 kilometres.

It was established also that the deepest stratum of the earth crust features inclined platforms which can be regarded as the surfaces of sub-horizontal strippings. As they do not penetrate above basalts and overlapping sedimentation rocks, it is safe to speak of disharmony of tectonic forms in the upper and bottom strata of the crust.

In some regions of the Pacific long-distance migrations of major land masses of the oceanic crust are registered. In favour of this concept it can be said that individual mountains overgrown with corals that are endemic to warm seas can be found in northern latitudes where no corals can form. This reminds of a drift of continental fragments. Science has yet to resolve this mystery.

The above examples are manifestations of tectonic displacements in the crust and, at least, in the upper sector of the mantle in oceanic regions.

How can one explain the geological nature of non-uniformity.

In a general sense, it is linked to the displacement of abysssal materials under the effect of tectonic processes, on the one hand, and to the physical-chemical processes in the mantle, on the other. The motive force of the latter, as many scientists acknowledge, could be the convection of abyssal masses, but the different scale of manifestations and different levels of the location of non-uniformities forbid the simplification of matter displacement processes inside the planet. The system of convectional cells is complex, and they function discretely. Convectional and other flows of abyssal rock masses are linked to versatile tectonic displacements that transform in more viscous layers into horizontal strippings and vertical displacements. The study of material non-uniformities in the abyssal layers of the planet gives an idea about the origin and cause of earth tectogenesis.

All the above issues are broadly discussed in geological literature and will be discussed long time from now. We are just at the beginning of our quest into abyssal mysteries. We need much more information to pass a qualified judgment on tectogenesis and to improve models. Exploration efforts should be focussed on the study of the oceanic crust. This does not mean that the origin of tectonic displacements should be sought exclusively in the abyssal evolution of the globe. The crust and the mantle are deformed under the effect of planetary and extraterrestrial forces which we are unable to identify yet. This double influence is the reason for a disorganized structural layout on Earth.