Geophysical Research Abstracts, Vol. 8, 00450, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00450


# Unique potentialities of hydrocarbon deposits formation in subduction zones

E. Areshev (1), **I. Balanyuk** (2)

(1) Central Geophysical Expedition, Moscow, Russia, (2) P.P.Shirshov Institute of Oceanology RAS, Moscow, Russia

(akivis@geo.sio.rssi.ru / Fax: +7-095-1245983)

The plate tectonics theory presents detailed evidence for the process of plate subduction, in which the ocean floor is underthrust or subducted beneath island arcs and active continental margins. This theory explains the mechanism of generation of piedmont downwarps, regional overthrusts (subduction zones), and geosynclinal folding. All of these interrelated processes have the same reason, namely the overthrusting of island arcs on passive continental margins. The large masses of sediment can be and are being subducted under the island arcs.

The above conclusions are supported by a great many of direct and indirect geologic and geophysic evidences so that they must be regarded as indisputable. Still another new theoretical conclusion, namely of hydrocarbons generation in the zones of subduction of lithospheric plates beneath island arcs and active continental margins is drawn here. This process is described in greater detail in several other publications, so only principal features will be mentioned here.

Hydrocarbons are formed under the outer (nonvolcanic) ridges and slopes of island arcs and the active margins of continents through the hydrolysis and thermolysis of organic matter that is drawn into subduction zones together with the oceanic sediments. As the island arcs are thrust on the continental margins, enormous volumes of clastic and clastic carbonate sediments of continental slopes and shelves enter the subduction zone. The thickness of these sedimentary bodies reaches several (up to 10 – 12 kilometers. Gradually wedging out, the sedimentary prisms cover the ocean floor, sometimes over distances of 200 to 300 km. Moreover, in overthrusting of island arcs on the continental margins, the frontal parts of such arcs often override sediments accumulated on the edges of the continents themselves. This coastal sediment usually is the richest in organic matter, so that the largest hydrocarbon deposits are to be expected precisely where the coastal sedimentary bodies enter the zones of plate subduction.

The excess pressure, generated by the weight of the island arcs and by the thermal waters liberated in the subduction zones by dehydration of oceanic crustal rocks and sediments, drives the hydrocarbons produced from organic matter from zones of their generation to zones of lesser pressure. Even though a large fraction of the hydrocarbons is discharged (and thus lost) within the island arc itself, considerable quantities can migrate from beneath the arc toward the marginal parts of the continental craton upon which the arc is being overthrust, or even to the rear of that craton, behind the arc's volcanic front, seeping through the wide gaps between the relatively narrow volcanic feed channels.

This process of hydrocarbon generation and mobilization has an extremely large scale. Our estimates indicate that during the Phanerozoe alone this process may have generated 1000 times more hydrocarbons than are now present in the known reserves of oil and gas. I.e., the quantity generated in the Phanerozoe is commensurate with the mass of organic matter within the Earth's crust. This disproportion between generation and reserves is indicative of the low efficiency of the mechanism of hydrocarbon migration from sites of their generation to oil and gas basins, but it also underscores the enormous productivity of the process. The amounts of oil and gas lost in the generation of oil and gas fields are indeed enormous. Thus, according to Neruchev's calculations, only 10 to 15% of generated oil and 1 to 2% of gas are trapped in deposits. The remaining hydrocarbons are scattered by diffusion, lost with groundwater discharge, or in subsequent tectonic deformations and destruction of petroliferous strata. Only an enormously productive process of generation and migration of hydrocarbons could have compensated for these losses and created the vast oil and gas deposits with oil and gas concentrations much greater than expected from the hydrocarbon producing potential of surrounding rocks. Examples of such vast deposits are the gigantic accumulations of oil and gas in the Persian Gulf and Venezuela. The described above mechanism of hydrocarbon generation and migration in subduction zones is capable of forming more than enough oil and gas to fill such deposits.

The discovery of this new mechanism of hydrocarbon generation in the zones of subduction of lithospheric plate in no way means that many of the known oil and gas deposits could not have formed via other known processes. In particular, within sedimentary prisms of the old continental margins hydrocarbons must have been generated even before the island arcs were overthrust, with this generating process obeying the rule of the main phase of oil formation. However, oil and gas so produced remained scattered in sediments, without forming large accumulations. Examples of such basins with dispersed hydrocarbons are the eastern shelves of North and South America, the West African shelf, and some other basins located on passive continental margins. There are no giant oil and gas fields even here though the thickness of sedimentary rocks reaches 8 to 10 km. The mobilization of hydrocarbons dispersed in such rocks would require intensive tectonic action, such as that exerted by thrusting of island arcs on the passive continental margins.