MECHANICS OF BASIN EVOLUTION AND ITS RELATION TO THE HABITAT OF OIL IN THE BASIN

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The earth is a speroidal body with finite dimensions. Its size and shape, together with the strength of the crust upon which the sediments rest, determine the size and shape of the tectonic units formed by diastrophism.

The outline and size of the sedimentary basins are controlled entirely by the pre-existing topography, but actively forming structural basins have definite maximum dimensions and geometrical shapes, depending on their mode of origin.

Primary dynamic basins are formed by the subsidence of a portion of the earth's crust as a unit. The individual unit is always round or elliptical, and the maximum diameter of the area, which approaches a plane surface, is of the order of 400 kilometers. The central area, within the points of inflection shown on the profiles where the subsiding floor becomes less convex than the curvature of the earth, is necessarily put into compression. This tangential pressure is transmitted to the sediments as they are deposited. The area outside of the points of inflection on the profiles where the curve becomes more convex than the curvature of the earth constitutes the dynamic rim of the basin and is continuously in tension as long as the basin subsides.

Secondary dynamic basins are grabens and half-grabens formed by normal faulting on top of actively rising large regional uplifts. During their growth such features are in tension normal to their long axis, and in compression parallel to the long axis. The transverse diameter is controlled by the size of the uplift upon which the secondary basins occur and the maximum longitudinal diameter of the individual depression is also of the order of 400 kilometers.

The compaction of clastic sediments is a function of both load and time. Because of the pressure differential between the compressional central area of a dynamic basin and the tensional dynamic rim there is a continuous and diminishing expulsion of fluids from the sediments in the central area towards the rim until compaction ceases or until the rocks reach grain density. As long as the basin is sinking the expulsion of fluids takes place in an updip direction preferentially along permeability channels parallel to the bedding. Although the exact mechanism of oil migration is not known, it is an observed fact that more than 90 per cent of all the oil in a dynamic basin filled with clastic sediments occurs in traps of all kinds within or related to the dynamic rim of that basin.

The same pressure differential exists in dynamic basins which become filled with non-clastic sediments, but because of the lack of more or less continuous permeability channels in an updip direction, the oil accumulations occur at random throughout the basin. The size of such oil accumulations depends on the area of the gathering ground toward the center of the basin and their location in this case is controlled more by permeability pinchouts than by structure.

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