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HUNTER YARBOROUGH—Biographical Sketch

Hunter Yarborough, a geologist and geophysicist of Hunter Yarborough & Associates, Inc., attended the University of Texas, receiving a degree in geology with highest honors and minors in physics and petroleum engineering. Two years were spent in graduate studies. During World War II, he served as an officer and aviator of the U.S. Navy, in both the Atlantic and Pacific theaters. Following the war, Mr. Yarborough worked for Exxon conducting geological, geophysical, and geochemical programs in the exploration for oil and gas. He has been active in all phases of geological, geophysical, and geochemical research, and has traveled over much of the earth working and consulting with active exploration groups.

Mr. Yarborough is a Certified Petroleum Geologist, a member of The American Association of Petroleum Geologists, a Fellow of The Geological Society of America, a member of The American Geophysical Union, a Registered Professional Engineer, and a member of Sigma Gamma Epsilon and Rho Kappa. He has served as Distinguished Lecturer for AAPG and has given technical addresses on oil finding and energy and mineral problems to many universities and geological and geophysical societies in the United States. In addition to many professional awards and recognitions, he is a two-time recipient of AAPG's A. I. Levorsen Memorial Award. Mr. Yarborough is a member of the Governor's Energy Advisory Council for the State of Texas and Executive Vice-President of Global Exploration, Inc.

OROGENIC BELTS, COLLISION TECTONICS, AND MAJOR HYDROCARBON ACCUMULATIONS (Abstract)

Classic concepts of the origin of orogenic belts are being challenged, primarily as a result of the recent development of new geophysical and geological data.

The geosynclinal concept, in which a thick prism of sediments is predicated to have been uplifted vertically without crustal shortening and the sedimentary mass to have been deformed in patterns of symmetrical and asymmetrical gravity-sliding away from the uplifted welt, appears invalid except in very unusual circumstances.

Excluding Andean-type volcanic belts and volcanic island arcs, orogenic belts are formed by: (A) continent-continent collision, resulting from convergence of two or more lithospheric plates; (B) island arc-continent collision, resulting from the collision of offshore volcanic arcs and the sediments and crust of associated back-arc basins with the parent continent; (C) "flat plate" subduction, resulting in crustal shortening with faulting, folding, and shortening of continental crust and/or sediments commonly located hundreds of kilometers within the continent from the subduction zone; and (D) strike-slip (transform, shear, wrench) deformation.

Structural styles A and C usually exhibit crustal shortening and tectonically telescoped crust and sediments. Style B does not necessarily shorten continental crust; however, oceanic crust of the back-arc basin is usually shortened and commonly obducted on the adjoining continent.

Both style and intensity of deformation are in part controlled by the type of crust and sediment being deformed; the rigidity and ductility of the crust are primarily functions of competency, fabric, fluid (pore) pressures, and temperature of the crust.

Orogency involving compression and crustal shortening is not a simple suturing process in which soft rocks are squeezed between rigid plates. Much ductile deformation is involved. Large sialic blocks in fold belts may occur as "orogenic float" rigid crustal blocks supported by masses of low-velocity material. Such "rootless," structurally detached masses remain "afloat" while the underlying lithosphere is being subducted. Compressional forces may dominate in the "float" while the underlying, downgoing lithosphere is bent, resulting in extensional deformation.

The thrust sheets of tectonically telescoped cores and margins of orogenic belts are usually the most visible and obvious scars of collision (and compression). However, the most significant hydrocarbon accumulations may be trapped by structures created by zones of strike-slip deformation formed by the compression and occurring contemporaneously with the main compressive orogeny. Pre-orogeny basins commonly are deformed complexly by large zones of synthetic and antithetic strike-slip faults. Not only are large en-echelon anticlines and synclines, "chopped" folds, half domes, and fault splays formed, but also, where major strike-slip faults and fault zones "lock" and "unlock," huge horst blocks and deep rift-valley basins develop.

The ancestral early and middle Paleozoic "Oklahoma" and "Texas" basins of pre-collision times were simple cratonic sags, probably "rooted" with Precambrian and/or early Cambrian rift basins (aulacogens?).

The Quachita-Marathon Carboniferous "collision" orogeny created the remarkable structural "overlays" that are responsible for trapping most of the oil and gas in these basins. The "Arbuckle-Ardmore" and the "Amarillo-Wichita-Anadarko" systems were superimposed over the Oklahoma basin, and the "Central Basin Platform Delaware" system was superimposed over the Texas basin. In a similar genesis, the "Moorman La Salle" system was superimposed over the ancestral Illinois basin.

Equally striking is the magnitude of the area and the volume of crust (and sediments) that may be deformed by collision orogenies. The "Pennsylvanian" (ancestral) Rocky Mountains are classic products of crustal compression and shearing resulting from collision. Deep rift-valley basins and large fault-block uplifts characterize the "Pennsylvanian" Rockies. Deformation extended northward from the Quachita-Marathon collision margin over 600 miles into the North American continent. The "Uncompahgre-Paradox" structural complex is typical of these "fault-block uplift/rift-valley basin systems."

The hydrocarbon potential of orogenic belts is controlled by the fundamental geological and geochemical factors that control all oil and gas accumulations: (1) structural and/or stratigraphic traps, (2) source rocks of adequate richness and maturation, (3) favorable reservoir rocks, (4) effective sealing rocks, and (5) time of migration of hydrocarbons.