PASSIVE ROOF DUPLEX MODEL AND FUTURE FOLDBELT EXPLORATION IN PAKISTAN

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The objective of this paper is to provide an update on the geo logical processes that occur at mountain fronts in Pakistan. In the early eighties observations from the Kirthar and Sulaiman foldbelts led to development of the Passive Roof Duplex Model (Banks and Warburton, 1986). This model explained many of the observations and became widely adopted and applied to other mountain belts throughout the World.

The Passive Roof Duplex model involves thinskinned displacement of thrust sheets upon a gently dipping common sole thrust. The duplex under-thrusts and elevates the mountain belt adjacent to the undeformed stratigraphy in the Siwalik foreland. Seismic data clearly demonstrate that the cumulative displacement is restricted to the duplex and that deformation is not transferred out into the foreland basin. Instead the Roof Sequence remains stationary, though uplifted, while the Passive Roof Duplex bulldozes beneath.

Over the past 15 years since the original observations in Pakistan many new observations have demanded modifications to the original model given additional constraints provided by the vast quantity of more recent surface and subsurface petroleum industry data.

The principal conclusions presented here are that the Kirthar and Sulaiman fold and thrust belts record only a modest degree of orogenic contraction. Passive Backthrusts appear to have small displacement, and folding rather than thrust faulting, appears to be the dominant shortening process. Orogenic contraction within many mountain belts appears to be accommodated by inversion on steep preexisting extensional faults rather than on low angle thin-skinned thrusts. Such faults are considered to have developed during rifting on the original plate margin. Consequently it is likely they influenced depositional environments and the litho-facies characteristics of potential reservoir, source and seal intervals.

It is of particular importance that the geology of mountain fronts is better constrained since the Kirthar and Sulaiman foldbelts are themse lves emerging as world class petroleum provinces where important gas fields such as Bhit, Zamzama, Pirkoh and Loti, have been discovered.

Future breakthroughs in foldbelt petroleum exploration in Pakistan will be achieved through understanding the often subtle stratigraphic variations caused by extensional fau Its that existed prior to the compressional deformations that generated the mountains. A useful analogue is provided in the Papuan foldbelt of Papua New Guinea.

This paper summarises the implications of the revised Passive Roof Duplex model and of thick-skinned geo logical models for petroleum exploration risk assessment in the foldbelts of Pakistan.