Slumping At The Late Miocene Shelf-Edge, Offshore West Sabah: A View of A Turbidite Basin Margin

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A coalescing series of elongate spoon or scoop-shaped unconformities can be mapped along almost the entire 300 km length of the Late Miocene shelf-edge offshore West Sabah.

The unconformities have an erosional relief of up to 500 m and typical widths of 1-3 kms. Maximum slope angles (without allowing for decompaction) are up to 25 deg. In many cases, the unconformities both truncate and are overlain by marine sediments and are interpreted as due to retrogressive submarine slumping. They may subsequently have been deepened by erosional turbidity currents but retain a smooth slump scar morphology.

The slump scars or channels occur in two geological settings:

(1) On the flanks of growing structures at tectonic shelf margins where parallel bedded shelf seismic facies pass abruptly into a chaotic slope facies composed of alternating offlap and onlap packages: a destructive slope setting.

(2) Within units of seismic foresets representing progradation of a muddy slope system into water depths of up to 750 m: a constructive slope setting.

In both settings the slump scars and channels occur along major fault lines and it is likely that faults caused the slumps due to both seismic triggering and slope oversteepening. Typical sediment volumes of 1-5 km^3 were removed during slumping and subsequent erosion.

Although slump scars are known in the area from the Early and Middle Miocene as well as the Late Miocene, approximately 90% of all the known slump scars and submarine channels occur within the Late Miocene. This was a period of rapid outbuilding of a clastic wedge offshore West Sabah. It is probable that both the outbuilding and slump activity are in part due to a Late Miocene global sea level fall. In one exploration well, shallow marine deposits onlap a slump scar unconformity. A rare example of 'downward-shift in coastal onlap', but this was probably caused by exceptionally rapid uplift of a particular tectonic block rather than sea level fall alone.

Four exploration wells have penetrated the slump scar unconformities and their fills. In all cases except the abovementioned, the fill consists of a monotonous claystone succession deposited in deep water. On seismic sections the fill is normally poorly reflective and shows weak seismic foresetting indicative of subsequent slope progradation.

The slump scars/channels have a two-fold significance for hydrocarbon exploration.

Firstly, the relief created between neighbouring slump scars, overlain by slope clays provided potential for stratigraphic trapping.

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Secondly, the unconformities allow identification of the stratigraphic units which have been eroded and re-deposited basinward. Hence, the sand-proneness of a turbidite basin can be indirectly assesed. In the case of offshore West Sabah, there is a clear relationship between the destructive slope setting discussed above and a major sand-bearing turbidite basin in the northern part of the area.

The widespread occurrence of slump scars in offshore West Sabah is though to be due to a combination of factors, namely active linear basement fault zones acting as basin-margins, rapid sedimentation of clastic sediments without sufficient time for dewatering, and probably, sea level fall.

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