Stratigraphic and Structural Characteristics of a Megaflap Flanking Witchelina Diapir, Willouran Ranges, South Australia

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Megaflaps are panels of near-vertical to overturned deep minibasin strata that extend far up the flanks of primary and secondary diapirs. Vertical relief on megaflaps is on the order of a few kilometers and internally the strata are typically slightly convergent to subparallel. Megaflaps are increasingly being identified post-drill in salt basins worldwide (e.g. Gulf of Mexico, Brazil, Angola), but usually to the detriment of prospectivity when wells encounter unexpectedly old and steep strata due to poor seismic imaging at the salt-sediment interface. In order to increase pre-drill predictability, outcrop-based investigations of megaflap geometric styles, stratal geometries, depositional facies and stratigraphy, and small-scale deformation are imperative for the characterization of salt-flank trap potential. In the Willouran Ranges, South Australia, outcrop exposures provide an oblique cross-sectional view of a megaflap comprising Neoproterozoic Witchelina Quartzite adjacent to the Witchelina diapir. We use stratigraphic and structural relationships of the Witchelina megaflap to test and refine the existing models of megaflap formation.

The Witchelina megaflap has vertical relief of ~2.5km. The lower boundary is a low-angle erosional onlap surface on to a broad salt pillow, while the upper boundary is a diffuse zone with progressive stratal rotation and thinning. Internally, strata are highly convergent and thinned. The near-vertical diapir-flanking strata thin upward from 1450 m at the base to 60 m at the upper reaches. The Witchelina Quartzite was deposited in a high-energy shoreface environment during continental rifting. Depositional thinning over an initially broad salt pillow was punctuated by transgressive erosional events that stripped the crestal cover over the salt pillow. Five stratigraphic intervals are informally defined for the Witchelina Quartzite (Now). Progressively younger stratigraphic intervals (Now 1-4) thin and onlap higher up the inflating diapir flank as it transitioned from a pillow to a steeper-sided diapir. The youngest interval (Now 5), which records minibasin fill adjacent to true diapiric rise, is not included in the megaflap panel. Small-scale deformation reflects minor bed lengthening, as only 2-3% structural thinning was documented near the top of the megaflap. Subsequent shortening during the Delamerian Orogeny enhanced the upturn of the Witchelina megaflap.