Stratigraphic and Structural Characteristics of a Megaflap Flanking the Witcheline Diapir, Willouran Ranges, Australia

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ABSTRACT

Megaflaps are panels of near-vertical to overturned deep minibasin strata that extend far up the flanks of steep primary and secondary diapirs or equivalent welds. Vertical structural relief on megaflaps is on the order of a few kilometers and internally the strata are typically subparallel to slightly convergent. Megaflaps commonly represent the relatively thin roof strata deposited over inflated salt and subsequently modified by simple drape folding, shortening-related squeezing, or a combination of these processes. Megaflaps are increasingly being identified post-drill in salt basins worldwide (e.g., Gulf of Mexico, Brazil, and 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 crosssectional view of a megaflap comprising Neoproterozoic Witchelina Quartzite in the Burra Minibasin adjacent to Witchelina Diapir. We use stratigraphic and structural relationships of the Witchelina megaflap to test and refine the existing models of megaflap formation, as well as distinguish key similarities and differences between megaflaps developed in shallow vs. deep water settings. Comparisons are also made to coeval stratigraphy in the adjacent Delusion Minibasin, where a salt shoulder and halokinetic sequences developed rather than a megaflap, to aid in our understanding and predictability of megaflap formation. The Witchelina megaflap has vertical relief of ~2.5 km. 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 1750 m at the base to 90 m at the upper reaches. In the Burra Minibasin, the Witchelina Quartzite was deposited in a regional high-

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energy shoreface environment during continental rifting. However, in the Delusion Minibasin, the Witchelina Quartzite experienced significant tidal influence associated with topographic restriction caused by the diapir high that acted as a barrier to wave energy. Depositional thinning of megaflap strata over an initially broad salt pillow was punctuated by transgressive erosional events that stripped the crestal cover over the salt pillow. Progressively younger Witchelina stratigraphic intervals in the Burra Minibasin thin and onlap higher up the inflating diapir flank as it transitioned from a pillow to a steeper-sided diapir. Small-scale deformation reflects minor bed lengthening, as only 2-3% structural thinning was documented near the top of the megaflap. Therefore, we interpret the Witchelina megaflap to have formed by simple drape-folding. Subsequent shortening during the Delamerian Orogeny enhanced the stratal upturn to present-day geometries.