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Structural Characterization of the Warraweena Diapir-Weld-Thrust Complex, Flinders Ranges, South Australia

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ABSTRACT

A series of diapirs linked by Delamerian-age contractional structures are exposed in the Warraweena-Mucatoona area of the Northern Flinders Ranges of South Australia. The exposed stratigraphic sequence comprises Neoproterozoic to Cambrian carbonates and siliciclastic rocks that form four structural domains separated by discontinuous bodies of diapiric breccia and linking faults. Domain 1, to the north, forms a large-wavelength, ENE-WSW trending syncline whose southern, near-vertical limb contains composite halokinetic sequences adjacent to diapirs at both ends. It is separated from Domain 2, to the SE, by a syncline-parallel linear structure linking the diapirs. Both diapirs thin toward each other until they become welds (<50 m thick). They are linked by a reverse fault with increased fracture intensity, development of a shear fabric, and no evidence of diapiric material ever having been present. Domain 2 is formed by another tight, large-wavelength syncline whose WNW-ESE trending hinge is truncated by the bounding diapir-weld-fault structure. This structure bifurcates to the west into a southern fault and a northern continuation of the linked diapir-weld-fault trend. In between is Domain 3, comprising a WSW plunging large wavelength syncline truncated to the ENE by the bounding diapir-weld-fault, and Domain 4, composed by small-wavelength, tight, E-W trending anticlines and synclines. The field evidence demonstrates that a series of diapirs and minibasins were well established during the Neoproterozoic and were subsequently squeezed during Delamerian shortening. The fold wavelengths and stratal relationships suggest that Domain 3 is underlain by allochthonous salt, whereas Domains 1 and 2 are primary basins. Although halokinetic sequences were used to constrain the dips of the salt-sediment interfaces in places, the deeper subsurface geometry and origin of the linked diapir-weld-fault structures are uncertain. Based on the evidence, we reject a possible origin as secondary welds representing simple squeezed diapirs; instead, the welds and faults are interpreted as thrust welds and linking thrust faults. They may represent either folded, originally lower-angle structures or out-of-sequence thrusts. Analogous squeezed, welded diapirs and associated thrusts bound three-way truncation traps in basins such as the Gulf of Mexico and offshore Angola, but important details are below seismic resolution. Field relationships demonstrate just how diapirs transition to welds and then thrusts, as well as how small-scale deformation varies along strike.