To view Figure 17's layers in the PDF version of this paper, open the PDF in Adobe Acrobat or Adobe Reader. To view the layers while reading the full-text version of the paper, click http://doi.org/10.1130/GES02089.f17 to download a PDF of the figure.

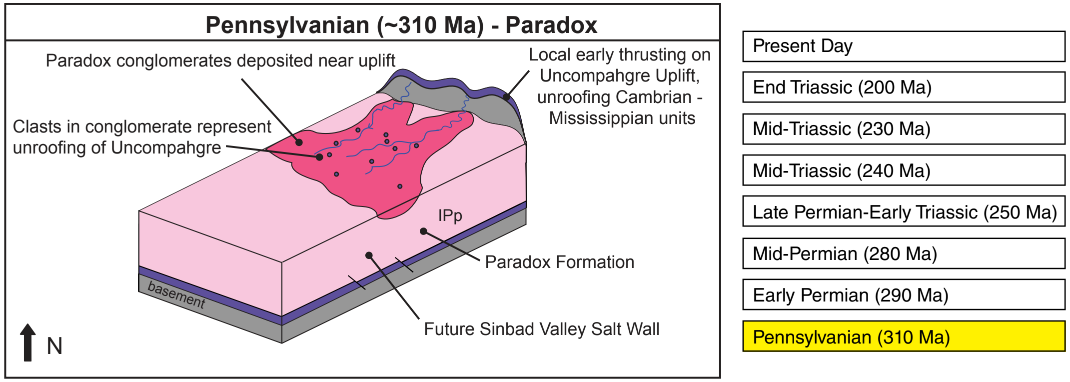

Figure 17. Generalized schematic block diagram illustrating the evolution of the Sinbad Valley salt wall (southwest USA), from deposition of the Pennsylvanian Paradox Formation through present day. Thicknesses are not to scale. Depictions of paleoflow of Cutler, Moenkopi, and Chinle units from paleocurrent data from Venus et al. (2014) and Lawton et al. (2015) and references therein, Banham and Mountney (2013), and Hartley and Evanstar (2017), respectively. To view Figure 17's layers in the PDF version of this paper, open the PDF in Adobe Acrobat or Adobe Reader. To view the layers while reading the full-text version of the paper, click http://doi.org/10.1130/GES02089.f17 to download a PDF of the figure or find the file included with the supplemental file.

Trail Formation overlaps the early thrusts on the margin of the basin. This observation suggests these thrusts were not reactivated but instead were buried when the central Uncompahgre uplifted and provided abundant clastic material that buried the frontal thrusts. The Honaker Trail Formation within the megaflap stratal panel thins across the top of the inflated salt and thickens into the adjacent Roc Creek and Salt Creek minibasins, from seismic and well data. On the northeastern margin, Salt Creek minibasin strata are separated from the roof of the inflated salt by a counterregional fault located over and extending off the ends of a single-flap active diapir (Fig. 17). Eventually, the salt broke through the thin roof, initiating passive salt wall rise and megaflap formation. Although we show this happening during Cutler Group deposition (Fig. 17), it is difficult to determine exactly when it occurred.

The Permian through Triassic stratigraphy around the margins of the Sinbad Valley salt wall record at least three major unconformities, with several minor local, near-diapir unconformities within the Moenkopi Formation. The major unconformities include (1) ca. 290 Ma, in the mid-Cutler Group between the lower Cutler (Rico Formation) and upper Cutler strata, (2) ca. 251 Ma, at the top of the Cutler Group/base Moenkopi Formation, and (3) ca. 200 Ma, at the top Moenkopi Formation/base Chinle Formation. These are consistent with regional unconformities (Orgill, 1971; Hazel, 1994; Condon, 1997; Rasmussen, 2014) identified in subsurface data throughout the Paradox Basin (e.g., Kluth and DuChene, 2009; Rowan et al., 2016; this study), with the first (mid-Cutler) interpreted to mark the time of salt breakthrough. In contrast, the minor, local intra-Moenkopi and Chinle unconformities are observed only in outcrops adjacent to certain salt walls (Shoemaker and Newman, 1959; Hazel, 1994; Lawton and Buck, 2006; Matthews et al., 2007; Trudgill, 2011; Heness, 2016; Hartley and Evenstar, 2017) and probably represent local halokinetic-sequence unconformities generated during passive diapirism (see Giles and Rowan, 2012).

The base-Moenkopi unconformity likely eroded into the growing megaflap on the southern side of the Sinbad Valley salt wall, which was probably an emergent island in an otherwise shallow-marine setting. Moreover, the contact between the Tenderfoot and Ali Baba members of the Moenkopi is an unconformity (Shoemaker and Newman, 1959), suggesting that the diapir was inflating during this time. The gradational contact between the Ali Baba Member and the overlying Sewemup Member is characterized by granules and lumps of gypsum in Sinbad Valley (Shoemaker and Newman, 1959), which represent diapir-derived detritus and an emergent diapir at that time (e.g., Lawton and Buck, 2006; Ribes et al., 2015). Furthermore, the regional unconformity at the base of the Chinle Formation eroded into both the Moenkopi and Cutler strata such that the Moenkopi and uppermost Cutler strata to the southwest of the megaflap are no longer exposed. Chinle strata unconformably overlie lower Cutler strata. Although Kluth and DuChene (2009) suggest that most of the salt growth and related unconformities near Sinbad Valley occurred during the Permian, the beveling of Triassic strata on the diapir flanks indicates that salt growth persisted at least into the early Mesozoic. Thickening toward the diapir of Chinle strata on the proximal side and thinning on the distal side (Fig. 5) also show continuing growth. However, the lack of apparent growth in Jurassic strata suggests that passive diapirism ceased roughly by the end of the Triassic.

Regional field data show slight upwarping and folding of the Cretaceous strata on both flanks of the salt wall over a distance of ~2 km from the diapir (Figs. 4, 5, and 7). This upwarping probably reflects minor diapir rejuvenation during the Laramide and Sevier orogenies in the early Cenozoic (Baars and Stevenson, 1981). Finally, collapse faulting on the margins of the salt wall (Figs. 6C and 11) occurred during the late Cenozoic. This collapse faulting may have occurred as the region experienced uplift, erosion, and salt dissolution (Gutiérrez, 2004; Guerrero et al., 2015). However, the presence of such faults away from the diapir, both off the ends and outside the edges, suggest that minor regional Cenozoic extension may have contributed to diapir collapse as well. In any case, these faults, usually striking parallel to the salt wall, control the present-day geomorphology of the valley and may mask some of the key salt-sediment features. For example, the collapse faults along the southwestern flank overprint the terminations of the megaflap to the northwest and southeast.