Stratigraphic Controls on Fault Zone Complexity and Evolution: The Little Grand Wash Fault, Utah

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Fault zone geometry can be highly variable, ranging from a simple fault plane accommodating all of the displacement to a complex system of fault strands each accommodating part of the displacement. This variability has significant implication for cross-fault transmissibility of fluids in the subsurface. Complex faults can either act as pathways for fluid movement, or can cut connections between sand bodies. Moreover, shale can be incorporated into the fault zone along dip relays reducing cross-fault transmissibility.

The aim of this study was to investigate the impact of mechanical stratigraphy on fault structure complexity at a range of scales. Analysis of fault zones in clastic rocks shows that fault structure and complexity vary as a function of the contrasting mechanical properties of the sandstones and shales. If a link can be established between stratigraphic architecture and fault zone geometry then a prediction of the fault geometry can be inferred. This could be a valuable tool for better understanding the geometry of fault zones and predicting cross-fault transmissibility.

To document the relationship between fault complexity and mechanical stratigraphy we have an ongoing research program on the Little Grand Wash Fault near Green River, Utah. This fault was chosen for study because it is very well exposed and it offers a good example of fault complexity at a range of scales with both strike and dip relays cutting a complex, clastic continental and marine sequence. Field observations show that the geometry of the individual fault zones is highly variable. In some areas there is one simple fault surface, in other areas a very complex fault system is characterized by steep relays, clay gouges and internally undeformed sandstone beds. Moreover, the complexity of the fault system is also observed at different scales and both along and perpendicular to the strike. At a small scale, individual sand and shale beds behave as uniform mechanical units with a competency contrast between them that influences the fault propagation resulting in small-scale dip relay structures. Where the shale beds are significantly thicker than the sand beds small-scale relay structures are still observed. At a larger stratigraphic scale of formations, the large-scale mechanical contrast between formations results in large-scale fault complexity both parallel and perpendicular to strike.