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Fault seal processes in layered sand-mudstone sequences

Using field observations and numerical models, we describe the development of normal faults in layered sand-mudstone sequences. Special focus is put on the processes of clay smear and telescoping along parallel strands.

Detailed field study of excellent outcrops allows a test of the SGR algorithm. Our results show that while point-to-point correlation of SGR to clay in the fault gouge is absent, average SGR values of the total fault show a good correlation with the average clay content of the fault.

A clay smear process by which unexpected amounts of clay can be added to the fault gouge is lateral clay injection. We explored this process using field observations integrated with numerical models. Our model starts with the presence of a releasing bend in a clay layer and the development of a "squeezing block" pushing the clay into the fault zone. The two mechanical constraints on the process of lateral clay injection are that the clay must flow under the overburden load, and must be weaker than the sand layer. Based on this a predictive Clay Injection Potential tool was developed which predicts the possibility of lateral clay injection with help of wire-line log data and cuttings.

Telescoping on (seismically undetected) parallel strands can lead to non-correct interpretation of fault gouge width, and introduces extra complexity and uncertainty in juxtaposition diagrams. Our modeling shows that across fault connectivity can either increase or decrease, and is very sensitive to small variations in the input parameters.